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Sleep patterns in college students Gender and grade differences

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Abstract

Objective: Since gender effect is inconsistent and grade effect has not been addressed in previous studies, we investigated both effects on the daily sleep patterns in a group of young college students. **Methods:** The sample consisted of 237 students aged 18–24 years. Each subject completed a 7-day sleep log. **Results:** Gender differences were found in several sleep variables and those were mostly not dependent on weekday/weekend difference. The female students went to bed and rose earlier and had longer sleep latency, more awakenings, and poorer sleep quality than the male. Gender differences were also shown in the relationship between sleep quality and other sleep variables. The correlation between sleep quality and rise time, time in bed, and sleep efficiency was stronger in men than in women. In contrast, grade differences were mostly dependent on weekday/weekend difference. The freshmen rose earlier and had shorter sleep time than did the other students on weekdays only. Sleep latency was the longest in seniors on weekdays only. **Conclusion:** This study showed that gender differences in sleep patterns and sleep difficulties were remarkable in the group of young college students. Alarmed by the high prevalence of sleep difficulties among general college students, it is recommended that the students should be informed of their sleep problems and the consequences.

Keywords: Gender differences; Sleep disturbances; Undergraduates; University students

Introduction

Previous studies in general adult population have shown that sleep patterns are both quantitatively and qualitatively related to the age and gender [1–4]. The prevalence of insomnia is found to be more common among old people and in women [2,5–11]. A recent study showed that the prevalence of global dissatisfaction with sleep increased with age and was higher in women [12]. Significant age differences are also found in both habitual sleep patterns and sleep disturbances in adolescents. Among both girls and boys, bedtime [3,13–15] is delayed, total sleep time is decreased [3,13–17], and the prevalence of sleep problems increases with age [16]. Compared to older adolescents, young adults go to bed even later and sleep even less [3,13,18]. Disrupted sleep, daytime sleepiness, and dissatisfaction with sleep are more common in young adults than in adolescents [19].

In contrast to age difference, few gender differences in sleep patterns and sleep disturbances have been reported in adolescents [3,14–17]. Although girls go to bed later, wake up earlier, and thus sleep less than boys, they do not have sleep problems more frequently than boys [16]. Compared to adolescents, gender differences in young adults seem to be more frequently reported. Women aged between 18 and 24 years go earlier to bed and wake up earlier than men [3] but have equivalent amounts of total sleep time, number of awakenings, and daytime naps [3,9]. With a wider age range, a study found that women (age 17 to 30 years) were more likely to have nightmares, delayed sleep onset, and frequent night awakenings [20]. Another study using Pittsburgh Sleep Quality Index (PSQI) showed that women aged 20–29 years have poorer sleep quality than men [1]. Reyner and Horne [4], using sleep logs and actimetry, found no significant gender differences in sleep latency, wake up time, total sleep time, or sleep quality in the 20–34 years group, but they found that women had

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more nocturnal awakenings than men. The major cause of awakenings in these young women is children. A home-based electrophysiological sleep recording study in the group of 20–34 years also failed to find significant gender differences in total sleep time, sleep latency, wake after sleep onset, and sleep efficiency. However, it did show that young men had less slow wave sleep than young women [21]. One epidemiological study found that the prevalence of insomnia was higher but that of insufficient sleep was lower in young women aged 20–39 years than in young men [2]. Taken together, although gender differences in sleep patterns and sleep disturbances are global and substantial in general adult population, they are inconsistent and, if any, relatively small effect size in young adults. Furthermore, some sleep parameters, which are more related to sleep disturbances, e.g., sleep latency, number of nocturnal awakenings, and sleep quality, show gender differences starting only in the age of 20s. Some biological maturational processes may contribute to gender differences in the sleep patterns and cause sleep disturbances in young adults. However, factors other than biological ones such as role in family, response to stress, and life style (eating, drinking, smoking, exercise, etc.) can also be involved in gender differences. For example, it has been reported that child caring and disturbances due to the bed partner are the two major causes of nocturnal awakenings in young women [4].

Many college students are single and at their late adolescent and early adult ages. Their sleep patterns and sleep disturbances could be different from those of non-students at their ages [13]. Compared to nonstudent adults in their 20s, college students have later bedtime and rise time and show higher incidence of daytime sleepiness in addition to physical and mental health complaints. Although the student group has the lowest prevalence of global sleep dissatisfaction of all occupations [12], 71% of college students express dissatisfaction with their sleep [22]. Previous studies in college students do not show consistent gender differences in sleep patterns. One study showed that gender differences were not associated with time in bed, number of awakenings, or sleep quality [23]. Another study found no gender difference in sleep latency [24]. In contrast, contradictory findings in gender differences have been reported. Both shorter [25] and longer [26] sleep duration and both poorer [27] and better [26] sleep quality have been reported in men than in women. For sleep disturbances, both significantly lower [24] and higher [27] incidence have been reported in men than in women. These discrepancies cannot be simply attributed to cultural differences of student samples since some studies in the same country also showed inconsistent results, e.g., Refs. [23–25]. Age, however, could be one of the confounding factors since gender difference effect sizes in most sleep parameters are small and even smaller in younger ages. Most studies included a wide age range of college students, e.g., Refs. [23–26].

In this study, we intended to determine gender effect on daily sleep patterns in college students aged 18–24 years. If gender differences occur in such a narrow age range, it would be concluded that gender did play a significant role in sleep patterns in early adulthood. Another purpose of this study is to investigate whether grade (educational level), related to biological as well as academic age, is involved in sleep patterns in college students.

Methods

Subjects

The sample consisted of 237 college students enrolled in the course of "Sleep Management" offered in the spring semester in 1998 and open to all the students in the authors' university. The students were distributed evenly in three classes at three different time slots (8:10–10:00 a.m., 2:10–4:00 p.m., 4:10–6:00 p.m.) on Wednesday. The students who took this course were required to record 7-day sleep logs in the first month of the class as the course assignment. However, they were solicited to give their permission on the incorporation of their sleep log data in this study as courtesy and were informed that no extra credit would be given for their participation. Of the 362 students enrolled in the class, 314 completed the consent forms. Among them, 237 students were aged 18–24. Students from all academic fields of the university, i.e., arts, social sciences, science, engineering, law, and business, were included in the study.

Materials and measures

The daily sleep patterns were recorded in sleep logs. It has been shown that subjective estimates of sleep time and sleep latency in the mornings after the overnight sleep recordings are positively correlated to recorded sleep time and sleep latency, respectively [28,29]. The sleep log form was designed for a 7-day recording period and tended to show the daily sleep pattern of the users. The form included a line space at the top for filling in subject name, major, grade, and recording period. This was followed by the instruction translated as "Please record the daily sleep information in 5 minutes after getting up. Record each nap in 5 minutes after waking up as well." A grid was placed below the instructions. The grid included dates (listed as rows in the first column) and headings for eight self-reported question variables and four self-calculated variables (listed as columns in the first row). The question variables included bedtime, time falling asleep, number of awakenings during the sleep period, time waking up, rise time, sleep quality evaluation (from 1 = *extremely awful* to 10 = *extremely great*), naptime, and significant events on the

Table 1
Demographic characteristics of participating college students

Gender		Freshman	Sophomore	Junior	Senior
Woman	Age, year (range)	18.9 ± 0.8 (18–21)	20.3 ± 1.05 (19–23)	21.1 ± 0.8 (20–24)	22.2 ± 0.6 (21–23)
	Subject number	29	24	31	26
Man	Age, year (range)	19.1 ± 0.8 (18–21)	20.0 ± 0.9 (19–22)	21.6 ± 0.9 (20–24)	22.7 ± 0.6 (22–24)
	Subject number	48	19	48	12

previous day. The self-calculated variables included sleep latency, time asleep, time in bed, and sleep efficiency.

Data analysis

A total of 12 variables were derived from sleep logs. Bedtime, rise time, number of awakenings, sleep quality, and naptime were recorded by subjects. Sleep latency (the time difference between bedtime and time falling asleep), time asleep (the time difference between time falling asleep and time waking up), time in bed (the time difference between bedtime and rise time), sleep efficiency (time asleep × 100/ time in bed), total sleep (the sum of sleep time at night and naptime during the day), bedtime regularity (standard deviation of bedtime over the 7-day recording period), and rise time regularity (standard deviation of rise time over the 7-day recording period) were then calculated. For bedtime, rise time, time asleep, time in bed, and total sleep, we used 2 (genders) × 4 (grades: freshman, sophomore, junior, and senior) × 2 (days: weekday, weekend) analysis of variances (ANOVAs) with repeated measures on day. The data distributions of sleep latency (skewness g1 = 1.123), number of awakenings (g1 = 2.886), sleep efficiency (g1 = − 1.433), sleep quality (g1 = − 0.893), naptime (g1 = 1.045), bedtime standard deviation (g1 = 1.365), and rise time standard deviation (0.797) were significantly skewed. Since significantly skewed sample violates the assumption of normality associated with parametric statistical methods, nonparametric statistical methods were used and medians/semi-interquartile ranges were presented for those skewed data. Gender effect was evaluated by Mann–Whitney test with chi-square approximation, grade effect by Kruskal–Wallis test, and day effect by Wilcoxon signed ranks test with normal (z) approximation.

Based on the cutoff values with significantly increased odds ratios of global sleep dissatisfaction in [12], we define sleep difficulties as time in bed less than 7 h or mean sleep latency longer than 30 min. We also arbitrarily defined sleep difficulties as the number of awakenings more than once, sleep efficiency less than 85%, rating on sleep quality less than 6, or naptime longer than an hour. Pearson chi-square tests were performed for evaluating the dependency of the distribution of each sleep difficulty on gender and on grade, separately.

Pearson correlation was calculated between sleep quality and other sleep variables for each subject. The Fisher's r to z transformation was then performed for each correlation coefficient. One-group t test was used to test whether the means of the z scores were zero and independent t test was used for the gender differences. We performed post hoc comparisons of means by using Tukey's test for ANOVAs and Mann–Whitney test for Kruskal–Wallis test. All statistical analyses were performed using SYSTAT 7.0 for Windows.

Results

The demographic characteristics of the participating college students are depicted in Table 1. No gender differ-

Table 2
Sleep variables for weekdays and weekends by gender

	Woman (n = 110)		Man (n = 127)		
Sleep variable	Weekday	Weekend	Weekday	Weekend	Statistical significance
Bedtime (hh:mm ± min)	1:27 ± 57	1:21 ± 69	1:40 ± 55	1:45 ± 82	G*
Rise time (hh:mm ± min)	8:27 ± 61	9:12 ± 79	8:39 ± 57	9:39 ± 89	G*, D***
Time asleep (min)	381 ± 57	428 ± 65	384 ± 52	438 ± 75	D***
Time in bed (min)	420 ± 57	471 ± 63	418 ± 51	474 ± 69	D***
Total sleep (min)	419 ± 60	466 ± 78	411 ± 60	465 ± 87	D***
Sleep latency (min)	17.5/6.4	15.0/5.7	14.0/5.7	12.0/6.5	G*, D**
Number of awakenings	0.8/0.5	1.0/0.5	0.6/0.4	0.5/0.5	G**
Sleep efficiency (%)	92.1/3.4	93.3/3.8	93.0/2.7	94.4/2.5	D**
Sleep quality	7.2/0.6	7.5/0.7	7.6/0.9	8.0/0.9	G*, D***
Naptime (min)	36.0/22.7	26.4/30.0	22.2/20.7	24.0/23.7	G*

Data are presented as means ± S.D. or medians/semi-interquartile ranges. See the text for a detailed description. Subject numbers (n) are given in parentheses. Gender effect is abbreviated as G and day effect as D.

* Significant difference $P < .05$.

** Significant difference $P < .01$.

*** Significant difference $P < .001$.

Table 3
Correlations between sleep quality and other sleep variables

Sleep variable	Woman ($n=110$)	Man ($n=127$)
Bedtime	.061 ± .562	−.029 ± .545
Rise time*	.042 ± .546	.215 ± .537†††
Time asleep	.241 ± .615†††	.370 ± .571†††
Time in bed*	.064 ± .560	.258 ± .586†††
Sleep latency (min)	−.304 ± .575†††	−.397 ± .644†††
Number of awakenings	−.405 ± .682†††	−.396 ± .925††
Sleep efficiency (%)*	.374 ± .594†††	.532 ± .624†††
Naptime (min)	−.042 ± .498	−.139 ± .917

Data are presented as means ± S.D. The correlation coefficients of each subject were converted to Fisher's z scores, and the means and standard deviations of the z scores were then converted back to correlation coefficients. One-group t test was performed to test whether the means of the z scores were zero and independent t test for gender differences.

* Significance level for gender differences, $P<.05$.

† Significance level for one-group t test, $P<.05$.

†† Significance level for one-group t test, $P<.01$.

††† Significance level for one-group t test, $P<.001$.

ence was found in the mean age. The mean age consistently increased with grade ($F=164.24$, $df=3.233$, $P=.0001$). It was noted that the number of males in sophomore and senior years was less than that of freshmen and juniors. However, we thought this would have, if any, few effect on gender and grade interaction since interaction effect of gender and grade was not significant on any sleep variable.

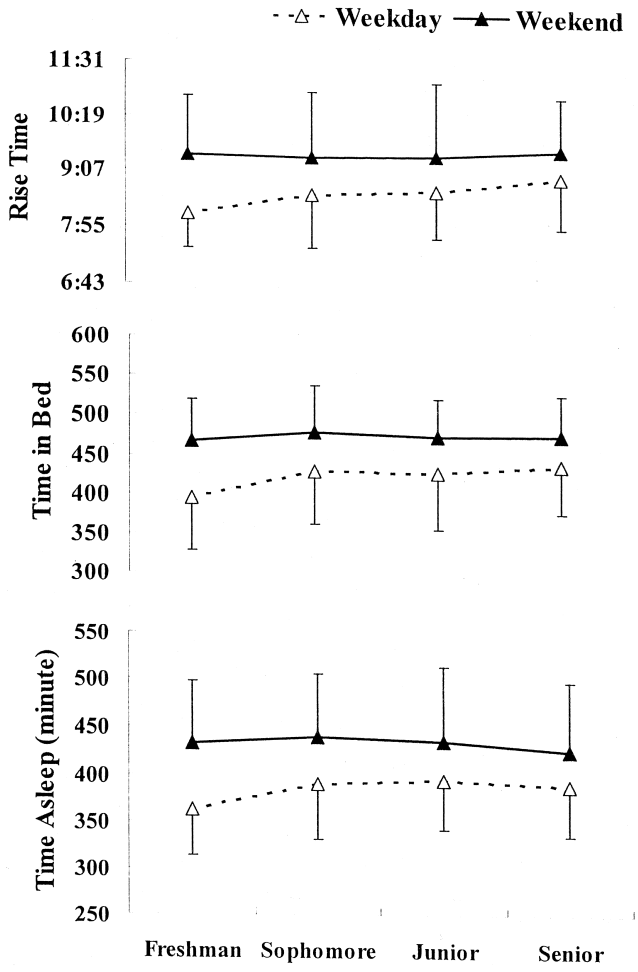

Fig. 1. Mean and standard deviation of rise time (top), time in bed (middle), and time asleep (bottom) across grade on weekdays and weekends.

Weekday/weekend differences

As shown in Table 2, the rise time ($F=84.36$, $df=1.229$, $P<.001$), but not bedtime, was significantly earlier on weekdays than on weekends. The students spent significantly less time in bed ($F=123.45$, $df=1.229$, $P<.001$), slept shorter ($F=102.22$, $df=1.229$, $P<.001$), had less total sleep ($F=74.40$, $df=1.229$, $P<.001$), longer sleep latency ($z=3.274$, $P=.001$) and lower sleep efficiency ($z=3.237$, $P=.001$), and gave significantly lower ratings on sleep quality ($z=4.201$, $P<.001$) on weekdays as compared with those on weekends.

Gender differences

Table 2 also shows that the women had earlier bedtime ($F=5.35$, $df=1.229$, $P=.022$) and rise time ($F=4.14$, $df=1.229$, $P=.043$), longer sleep latency ($\chi^2=6.00$, $df=1$, $N=237$, $P=.014$ on weekdays; $\chi^2=4.84$, $df=1$, $N=237$, $P=.028$ on weekends), more awakenings during night sleep ($\chi^2=7.12$, $df=1$, $N=237$, $P=.008$ on weekdays; $\chi^2=12.54$, $df=1$, $N=237$, $P<.001$ on weekends), lower ratings on sleep quality ($\chi^2=3.52$, $df=1$, $N=237$, $P=.061$ on weekdays; $\chi^2=9.92$, $df=1$, $N=237$, $P=.002$ on weekends), and longer naptime ($\chi^2=7.95$, $df=1$, $N=237$, $P=.005$ on weekdays; $\chi^2=5.48$, $df=1$, $N=237$, $P=.019$ on weekends) than the men. Gender differences were not significant in the bedtime regularity (median/semi-interquartile range: 50/16 min in women vs. 52/18 min in men) or the rise time regularity (66/18 in women vs. 73/22 in men). Bedtime was more regular than rise time (Wilcoxon signed ranks test, z approximation = 6.13, $P<.001$).

We define sleep difficulties as time in bed less than 7 h, mean sleep latency longer than 30 min [12], number of awakenings more than once, sleep efficiency less than 85%, rating on sleep quality less than 6, or naptime longer than an hour. The percentage of difficulties in sleep latency was significantly higher in women (11.82% on weekdays and 15.45% on weekends) than in men (11.81% on weekdays and 6.30% on weekends) on weekends. Sleep difficulties in the number of awakenings were also higher in women (40.91% on weekdays and 37.27% on weekends) than in men (25.20% on weekdays and 18.11% on weekends). Lastly, more women (21.82% on weekdays and 23.64% on weekends) than men (11.02% on weekdays and 21.82% on weekends) took mean naptime longer than an hour on weekdays. In contrast, gender differences were not found in the percentage of sleep difficulties in time in bed (48.94% of all the students on weekdays and 19.83% on weekends), sleep efficiency (12.66% on weekdays and 15.19% on

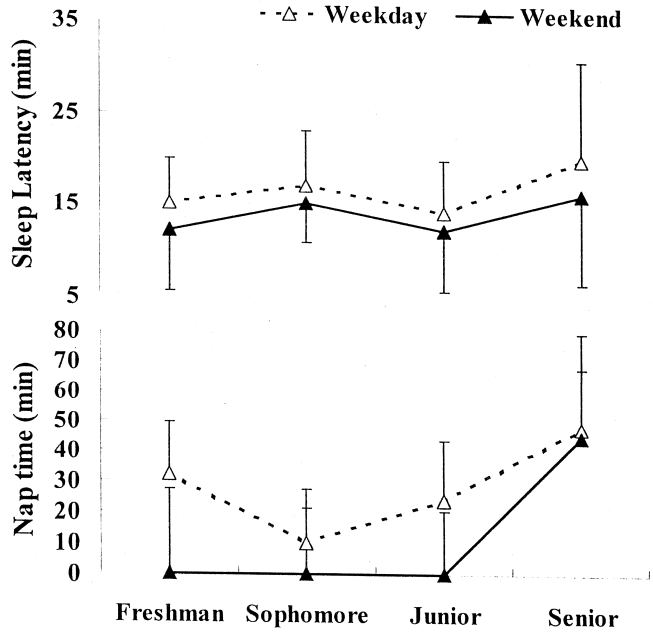

Fig. 2. Medians and semi-interquartile range of sleep latency (top) and naptime (bottom) across grade on weekdays and weekends.

weekends), or sleep quality (14.77% on weekdays and 10.55% on weekends).

The relationship between sleep quality and other sleep variables is presented in Table 3. Sleep quality was positively correlated with time asleep and sleep efficiency but negatively with sleep latency and number of awakenings in both men and women. In contrast, sleep quality was correlated with rise time and time in bed in men but not in women. Furthermore, the relationships between sleep quality and rise time, time in bed, and sleep efficiency were stronger in men than in women.

Grade differences

Interaction effect of grade and day was found on rise time ($F=3.83$, $df=3.229$, $P=.011$), time in bed ($F=4.19$, $df=3.229$, $P=.007$), and time asleep ($F=3.50$, $df=3.229$, $P=.016$). The freshmen had a shorter sleep time at night than other students on weekdays, which was not due to the bedtime difference but an earlier rise time on weekdays (Fig. 1). Of all the students, the seniors had the longest sleep latency ($\chi^2=8.83$, $df=3$, $N=237$, $P=.032$ on weekdays; $\chi^2=5.57$, $df=3$, $N=237$, $P=.134$ on weekends) and naptime ($\chi^2=18.76$, $df=3$, $N=237$, $P<.001$ on weekdays; $\chi^2=9.35$, $df=3$, $N=237$, $P=.025$ on weekends; Fig. 2).

The percentage of sleep difficulties in time in bed was the highest in the freshmen on weekdays ($\chi^2=16.84$, $df=3$, $N=237$, $P<.001$). Difficulties in sleep latency were the highest in the seniors on weekdays ($\chi^2=9.14$, $df=3$, $N=237$, $P=.027$). Grade differences were not found in the percentage of sleep difficulties in awakenings, sleep efficiency, sleep quality, or naptime.

Daytime napping and nighttime sleep

To determine whether longer naptime was related to worse sleep patterns at night [29], we compared the sleep variables of the students whose naptime was longer than an hour with those of the rest of the students. Indeed, students with long naptime had more awakenings at night ($\chi^2=11.13$, $df=1$, $N=237$, $P=.001$ on weekdays; $\chi^2=6.99$, $df=1$, $N=237$, $P=.008$ on weekends) and poorer sleep quality ($\chi^2=6.04$, $df=1$, $N=237$, $P=.014$ on weekdays; $\chi^2=3.10$, $df=1$, $N=237$, $P=.078$ on weekends).

Discussion

This study aimed to determine gender and grade effects on daily sleep patterns in the college students aged 18–24 years. Significant gender and grade differences in several sleep variables were found in this student group. Although the student subjects were recruited exclusively from those enrolled in a single course, the gender and grade effect on sleep might not be specific to this particular group of students. First, the means of all, except for naptime, sleep variables in this study were comparable to those of a group of undergraduates who did not take the course ($n=49$, unpublished data). Second, though the students enrolled in the sleep management course could be somewhat more concerned about their sleep, they probably did not have more sleep problems than other students. The PSQI scores of the students who took the course were not higher but even lower than those of the students who did not took the course (mean global PSQI score, 5.46 ± 1.75, $n=279$ vs.

6.52 ± 2.42, $n = 42$; unpublished data). Nonetheless, we could not definitively exclude the possibility that female students and/or seniors tended to select the course because of sleep difficulties, which might thereby be related to the gender and grade effect shown in this study.

As previous studies have shown, the college students woke up later, had longer time in bed and sleep time, and reported better sleep quality on weekends [17,23,24]. In contrast to the results in [24], this study showed that the bedtime on weekends remained the same as on weekdays. The discrepancy could be explained by much later bedtime on weekdays shown in this study than previously shown. The students went to bed on weekends at the time equivalent to those in [24]. On the other hand, not reported previously, the students had shorter sleep latency and better sleep efficiency on weekends. Stress, especially the emotional responses to it, is related to several sleep aspects, including sleep latency [31]. It is possible that for some students, less stress on weekends is one of the factors related to shorter sleep latency on weekends. Furthermore, based on their relationship to sleep quality (Table 2), shorter sleep latency, longer sleep time, and higher sleep efficiency all directed to better sleep quality on weekends.

In contrast to previous studies, which mostly failed to find gender differences in daily sleep patterns, we did find those in several sleep variables. Given that female college students reported a higher level of stress than male students [32] and, as mentioned above, that stress is related to sleep [31], stress could be involved in the gender difference in sleep. On the other hand, since gender differences were also shown in the relationship between sleep quality and other sleep variables, sleep perception and cognition difference could be another factor. However, future studies are still needed to clarify how biological and psychological maturational processes, stress, sleep perception, and cognition, as well as other factors, relate to gender differences in self-reported sleep patterns in college students.

One special aspect concerning gender differences is that the poorer sleep patterns and the higher prevalence of sleep difficulties in the female college students persist even on weekends. It was further noted that the number of women with sleep latency difficulty even increased on weekends compared to weekdays. In contrast, the number of men with sleep latency difficulty decreased on weekends. It seemed that weekend was of benefit to men but not to women in terms of reduction in sleep latency difficulty. We think this finding is very important and merits further studies. Weekends are thought to be more relaxed and thus more helpful to a good night sleep than weekdays. Why women could not take the advantage of weekends like men needs further studies to answer the question. Another thing to be pointed out is that unexpected gender differences were also found in the number of awakenings at night in these young college students. One previous study in general young adults found that the major causes of more awakenings in young women were children and bed partners [4]. Of the 237 students participating in this study, 235 students answered question 10 (“Do you have a bed partner or roommate?”) in PSQI administered in class as a course activity. Only 4 of the 235 student reported having a partner in same bed. On the other hand, married rate was below 16% and fertility rate was below 7% in women aged 20–24 years in Taiwan (MOI Statistical Information Service http://www.moi.gov.tw/W3/stat/, Department of Statistics, Minister of the Interior, ROC). It is likely that most female students in this study were single and had no children. Even if most of them had no children and had no bed partners, the women still had more night awakenings than the men. The relationship between naptime and awakenings suggests longer naptime could be attributed to more awakenings in the female college students. Future studies are still needed to clarify whether other factors also cause the young female college students to wake up more frequently at night.

To the best of our knowledge, this is the first study to show an interaction effect between grade and weekday/weekend on sleep among college students. Grade differences in sleep patterns were shown mostly on weekdays only. The freshmen got up earlier and slept less compared to other students on weekdays but not on weekends. The seniors having the longest sleep latency were shown only on weekdays. Over twice more seniors (26.31%) than other students (9.03%) had sleep latency difficulty on weekdays but not on weekends. It is likely that grade differences shown only on weekdays were due to different activity schedules and academic demands on weekdays in different grades instead of biological age differences. Although those grade differences subsided on weekends, the much higher number of short sleep time in the freshmen (67.53%) and that of sleep latency difficulty in the seniors on weekdays still warrant a heightened attention to the grade-related sleep problems among college students.

In summary, this study found significant gender and grade differences in several sleep variables among college students. The gender difference in most sleep variables did not depend on weekday/weekend difference, but the grade difference depended on weekday/weekend difference. The poorer sleep patterns of the female students on both weekdays and weekends warrant special attention to the progress of their sleep problems in the long run. The freshmen need to be especially aware of the consequences of insufficient sleep and the seniors need to deal with long sleep latency and naptime. On the other hand, this study found that the percentage of sleep difficulties in general college students was amazingly high, e.g., over 48% of the college students had short sleep time, which suggests a probably equivalent amount of students had insufficient sleep on weekdays. Although taking naps during daytime may be beneficial to make up for some insufficient sleep at night and to reduce sleepiness in class, it was limited because naptime over an hour would be related to more awakenings at night. Since near one fifth of the young college students had short sleep duration on weekends,

sleep debt could be chronically accumulated in those students. In addition to insufficient sleep, other sleep difficulties are also common among the college students. These findings warrant sleep education programs and interventions for the students as previously suggested [24,30]. It is conceivable that sleep education in college students may help them be aware of their own sleep problems and thereby willing to choose activity schedules and sleep habits good for sleep.

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