

## *Pediatric Sleep Disorders*

# Sleep Problems of Junior High School Students in Taipei

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**Summary:** The objective of this work was to study the relationship between daily sleep time and characteristics of students, e.g. grade level, gender, and academic program. A sleep habit questionnaire was designed to survey students at two junior high schools, one from northern Taipei and the other from southern Taipei. The impact of shortened duration of sleep on daily function was also evaluated. A total of 965 students and their parents were selected randomly in December 1993 for the questionnaire study. The response rate was 96.4% (930) for students and 88.6% (855) for parents. The self-reported daily sleep time of students declined, and daytime sleepiness and moodiness increased in the higher grades. The girls slept fewer hours than the boys and did not show an increase in daytime sleepiness. Those students not taking the senior high school joint entrance examination slept more hours at night and maintained more alertness in the daytime than those who were taking the examination. The more academic pressures that adolescents faced, the fewer hours they slept. Students not participating in the joint entrance examination seemed to show a healthier sleep pattern. Little sleep at night made the students feel sleepy in the daytime and tired, drowsy, moody and difficult at arising in the morning. The reason why girls slept less than boys needs further investigation. **Key Words:** Daytime sleepiness—Adolescents—Academic pressure—Grade.

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Daytime sleepiness is a common phenomenon among adolescents that often leads them to face risky situations (1,2). Adolescents spend shorter time in sleep than they need (1,3,4), and they go to bed and wake up significantly later than younger children (5). Some of the explanations for this phenomenon include the effects of adolescent development or maturation (3,5,6), decreased parental control at bedtime, school schedule and pressures (7,8), part-time jobs, extracurricular activities (9) and change of circadian rhythm (10,11).

Compulsory education in Taiwan is composed of 6 years of primary school and 3 years of junior high school. Approximately one third of all junior high school students pass the joint entrance examination (JEE) to enter senior high school. About 40% of all senior high school graduates, most of whom come from "star" high schools, pass the JEE to continue their studies in college. Hence, the competition is very keen for junior high school students to pass the senior high

school JEE to enter a star high school. Consequently, this puts a tremendous academic pressure on adolescents in Taiwan and influences their mental health (12). To alleviate the stress on competition, an experimental voluntary school entrance (VSE) program was implemented a few years ago. In the VSE program, students enter senior high school, vocational school or junior college based on their overall achievement in junior high school instead of scores on the JEE. The objective of this paper is to study sleep problems in general and, having the two different academic programs, the VSE and the JEE, compare the sleep patterns and problems of junior high school students in Taipei from two different academic tracks.

## SUBJECTS AND METHODS

A self-administered sleep habit questionnaire (SHQ) was designed to survey sleep habits and sleep problems in junior high school students. Part of the SHQ was modified from questionnaires designed by Carskadon et al. (1) and Strauch and Meier (13), with their permission. The SHQ draft was given to 40 first-year junior high school students and their parents for a pretest.

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The final version for the students included demographic data, self-reported bedtime and rise time on school days and weekends, self-reported total sleep time and required sleep time to maintain normal daily functions, duration of preparing for school, sleep habits (including the situation of going to bed, the way to get up, the main reasons of going to bed later than 11:00 p.m. on school days and weekends and the perceived causes of poor sleep), daytime functions (including frequency of daytime nap, ease of napping, ease in waking, wishing to stay in bed, tiredness, alertness and moodiness in the morning), coping methods for sleep problems, parental controls (Table 1) on daily activities and the Junior Eysenck Personality Inventory test (14). The parental version included demographic data on the parent, the student's parasomnia and sleep habits by parental observation and parental controls on daily activities. Parents were asked to rate each item according to the past month behavior except parasomnia, which is rated for the last 6 months.

To determine the test-retest reliability of both versions of the SHQ, 38 students and their parents were retested 2 weeks after the first test. The kappa values of the categorical variables ranged between 0.54 and 1. The Spearman correlation coefficients of the ordinal and continuous variables ranged between 0.43 and 0.91.

Among 70 junior high schools in Taipei, two medium-sized schools were selected for study. In each school, four classes of each grade level (first, second and third years) were randomly selected as subjects. A total of 965 students, 474 boys (49.1%) and 491 girls (50.9%), and their parents gave consent. The study was conducted in December 1993, 2–3 weeks after their second monthly examination. Each student completed his or her own SHQ at a designated school hour, and the parent completed their version at home. The response rate was 96.4% (930) for students and 88.6% (855) for parents.

The parameters used in the questionnaire, such as self-reported total sleep time, daytime nap and nighttime sleep duration are defined as follows. The "total sleep time", a specific question in the questionnaire and reported by the student, was the sum of subjective total nighttime sleep plus regular nap required by school. The arrangement for at least 30-minute "napping period" after lunch is part of daily schedule for the primary through high schools in Taiwan. The "frequency of daytime nap" did not include the regular nap required by school. The "nighttime sleep duration" was estimated from rise time minus bedtime.

The collected data were analyzed statistically by SPSS/pc+ with two-tailed Student's *t* test, paired *t* test, chi-square test, one-way analysis of variance (ANOVA) with Scheffé test, multiple linear regression and logistic regression.

TABLE 1. Grade level, sex and academic program by parental controls

| Items                   | Grade <sup>a</sup>     | Sex <sup>b</sup>       | Academic program <sup>c</sup> |
|-------------------------|------------------------|------------------------|-------------------------------|
| Kinds of TV programs    | $\chi^2 = 32.63^{***}$ | NS                     | NS                            |
| Duration of watching TV | $\chi^2 = 18.12^{***}$ | NS                     | NS                            |
| Where they go           | NS                     | $\chi^2 = 16.39^{***}$ | NS                            |
| Time to come home       | $\chi^2 = 10.10^{**}$  | NS                     | NS                            |
| Housework               | $\chi^2 = 8.06^*$      | $\chi^2 = 13.00^{***}$ | $\chi^2 = 9.63^{**}$          |
| Beverage consumption    | $\chi^2 = 12.62^{**}$  | NS                     | $\chi^2 = 7.03^{**}$          |
| Food                    | $\chi^2 = 18.93^{***}$ | NS                     | NS                            |
| Friends                 | $\chi^2 = 44.46^{***}$ | NS                     | NS                            |
| Dress                   | $\chi^2 = 15.67^{***}$ | $\chi^2 = 8.20^{**}$   | NS                            |
| Bath times              | $\chi^2 = 14.70^{***}$ | NS                     | NS                            |
| Meal times              | $\chi^2 = 20.34^{***}$ | NS                     | NS                            |
| Bedtimes                | $\chi^2 = 23.43^{***}$ | NS                     | NS                            |
| Rise times              | $\chi^2 = 22.68^{***}$ | $\chi^2 = 10.00^{**}$  | NS                            |

<sup>a</sup> Degrees of freedom = 2.

<sup>b</sup> Degree of freedom = 1.

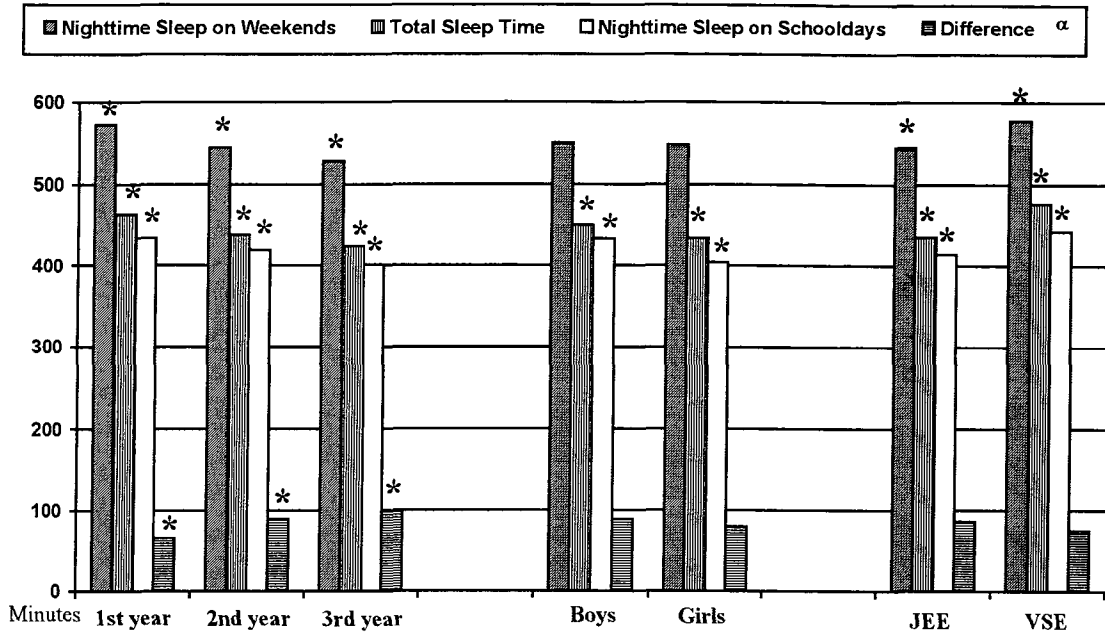
<sup>c</sup> Degree of freedom = 1.

Significance levels of chi-square tests: \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001, NS = not significant.

## RESULTS

### Sleep problems

Of the 447 boys (48.1%) and 483 girls (51.9%) in our sample, 318 were first-year students, 301 were second-year students and 311 were third-year students. Of the 930 total students completing the SHQ, 800 belonged to the JEE track and 130 belonged to the VSE track. The sleep problems and their frequency were as follows: 1) insomnia in the preceding month (more than twice per week) included difficulty in falling asleep (27.2%), midnight awakening (31.9%) and early awakening (22.3%); 2) parasomnia in the preceding 6 months included sleep talking (21.2%), snoring (18.5%), nightmare (17.1%), bruxism (9.0%), sleep terrors (3.2%), enuresis (1.4%) and sleepwalking (0.7%). The main reasons for going to bed later than 11:00 p.m. on school days were as follows: exam preparation for the following day (45.1%), doing homework (27.1%), watching TV or playing electronic games at home (19.4%) and other activities (8.4%). Of the total number of students, 64.6% complained of insufficient sleep, 46.5% complained of feeling tired, 28.3% complained of being moody and 16.3% complained about having a hard time getting up in the mornings. A total of 376 (40.4%) students reported sleeping poorly. The perceived causes of poor sleep were as follows: unknown reason (42.3%), tension and worrying (27.1%), school problems (11.7%), personal or family problems (7.4%), not getting enough exercise (3.7%), noisy environment (3.7%) and physical illness (0.8%). Four hundred and



Note: JEE: students of the Joint Entrance Examination track;

VSE: students of the Voluntary School Entrance track;

α: difference between the self-reported required sleep time and total sleep time.

**FIG. 1.** The above columns show sleep duration by grade level, gender and academic program. \* Indicates statistical significance at  $p < 0.05$  according to grade level by using a one-way ANOVA with Scheffé test, gender by a two-tailed  $t$  test and academic program by using a two-tailed  $t$  test.

one students (43.2%) took a daytime nap occasionally, 138 students (14.9%) took a nap daily and 102 students (11.0%) took two or more naps daily.

### Sleep duration

The mean self-reported total sleep time was 441.68 [standard deviation (SD) = 79.05] minutes. Students went to bed earlier on school days (11:12 p.m.) than on weekends (11:44 p.m.) (paired  $t$  test,  $t = -11.53$ ,  $p = 0.00$ ) and got up earlier on school days (6:11 a.m.) than on weekends (8:53 a.m.) (paired  $t$  test,  $t = -53.35$ ,  $p = 0.00$ ). The mean nighttime sleep duration (rise time minus bedtime) on school days (418.35 minutes, SD = 68.84) was significantly less than that on weekends (548.64 minutes, SD = 101.54) (paired  $t$  test,  $t = -34.62$ ,  $p = 0.00$ ).

### Grade level

The sleep durations for the three grade levels were analyzed using one-way ANOVA with Scheffé test (Fig. 1). The mean total sleep times were 462.71 minutes (SD = 78.80) for first graders, 437.91 minutes (SD = 72.02) for second graders and 423.94 minutes (SD = 81.08) for third graders ( $F = 20.24$ ,  $P = 0.00$ ). The

mean nighttime sleep durations on school days were 434.52 minutes (SD = 69.27), 419.29 minutes (SD = 59.73) and 400.82 minutes (SD = 72.29) for first-year, second-year and third-year students, respectively ( $F = 19.36$ ,  $p = 0.00$ ). The mean nighttime sleep durations on weekends were 573.01 minutes (SD = 107.36), 544.48 minutes (SD = 87.34) and 527.99 minutes (SD = 103.93) for first-year, second-year and third-year students, respectively ( $F = 6.62$ ,  $p = 0.00$ ). The mean differences between the self-reported required sleep time and the total sleep time were 64.96 minutes (SD = 101.49), 89.45 minutes (SD = 120.91) and 98.54 minutes (SD = 130.18) for first-year, second-year and third-year students, respectively ( $F = 6.70$ ,  $p = 0.00$ ). The bedtimes on school days were 10:58 p.m. for first graders, 11:12 p.m. for the second graders and 11:27 p.m. for third graders ( $F = 15.08$ ,  $p = 0.00$ ). The bedtimes on weekends were 11:23 p.m. for first graders, 11:49 p.m. for second graders and 12:02 a.m. for third graders ( $F = 22.13$ ,  $p = 0.00$ ). The six variables that showed significant differences by grade levels in terms of the chi-square test were 1) difficulty in getting up ( $\chi^2 = 16.46$ ,  $df = 6$ ,  $p = 0.01$ ), 2) complaints of insufficient sleep ( $\chi^2 = 6.05$ ,  $df = 2$ ,  $p = 0.0486$ ), 3) feelings of tiredness ( $\chi^2 = 16.85$ ,  $df = 6$ ,  $p = 0.01$ ), 4) feeling moody in the morning ( $\chi^2 = 9.59$ ,  $df = 2$ ,  $p = 0.01$ ),

**TABLE 2.** Academic program by parental control, daytime nap and reasons of going to bed later than 11:00 p.m.

| Variables  | JEE (n = 800) |      | VSE (n = 130) |      | Chi-square test                           |
|--|---------------|------|---------------|------|---|
|  | n             | %    | n             | %    |   |
| Parental controls <sup>a</sup>                             |               |      |               |      |   |
| Beverage no  | 710           | 89.0 | 105           | 80.8 | $\chi^2 = 7.03$ ,<br>df = 1,<br>p = 0.01  |
| yes  | 88            | 11.0 | 25            | 19.2 |   |
| Housework no   | 667           | 83.6 | 94            | 72.3 | $\chi^2 = 9.63$ ,<br>df = 1,<br>p = 0.00  |
| yes  | 131           | 16.4 | 36            | 27.7 |   |
| Daytime nap <sup>b</sup>                                   |               |      |               |      |   |
| None   | 235           | 29.4 | 53            | 40.8 | $\chi^2 = 8.53$ ,<br>df = 3,<br>p = 0.04  |
| Occasional   | 349           | 43.7 | 52            | 40.0 |   |
| Once a day   | 126           | 15.8 | 12            | 9.2  |   |
| Twice a day and more                                       | 89            | 11.1 | 13            | 10.0 |   |
| Reason for going to bed later than 11:00 p.m. <sup>c</sup> |               |      |               |      |   |
| Before 11:00 p.m.  | 184           | 23.1 | 52            | 40.0 | $\chi^2 = 21.00$ ,<br>df = 2,<br>p = 0.00 |
| Homework or studying                                       | 451           | 56.6 | 48            | 36.9 |   |
| TV or other recreational activities                        | 162           | 20.3 | 30            | 23.1 |   |

JEE = students on the joint entrance examination track; VSE = students on the voluntary school entrance track.

<sup>a</sup> Missing two cases.

<sup>b</sup> Missing one case.

<sup>c</sup> Missing three cases.

5) frequency of daytime nap ( $\chi^2 = 34.03$ , df = 6,  $p = 0.00$ ) and 6) being late for class due to waking up late ( $\chi^2 = 6.76$ , df = 2,  $p = 0.03$ ). The occurrences of the six variables increased in frequency as the grade level increased. Parental controls decreased in frequency as the grade level increased (Table 1).

### Gender difference

The continuous variables in terms of gender were analyzed using a two-tailed  $t$  test (Fig. 1). The mean total sleep time of girls (434.23 minutes, SD = 78.77) was less than that of boys (449.77 minutes, SD = 78.63) ( $t = -3.00$ ,  $p = 0.00$ ). The mean nighttime sleep duration on school days for girls (404.30 minutes, SD = 63.81) was less than that of boys (433.37 minutes, SD = 70.64) ( $t = -6.55$ ,  $p = 0.00$ ). The difference between the self-reported required sleep time and total sleep time (boys: 88.69 minutes, SD = 144.47; girls: 80.05 minutes, SD = 88.81) did not differ significantly in either of the two sexes ( $t = 1.10$ ,  $p = 0.27$ ). Analysis of the two-way interaction of grade by sex using ANOVA showed no statistic significance in terms of total sleep time, nighttime sleep on school days and weekends and difference between the self-reported required sleep time and total sleep time. On school days, girls went to bed later (11:22 p.m. vs. 11:01 p.m.,  $t = 4.82$ ,  $p = 0.00$ ) and woke up earlier (6:06 a.m. vs. 6:15 a.m.,  $t = -3.85$ ,  $p = 0.00$ ) than the boys. Girls spent more time in the morning preparing for school (girls: 24.89 minutes, SD = 10.86; boys: 23.29 minutes, SD = 12.37;

$t = 2.09$ ,  $p = 0.04$ ) than the boys. More boys felt tired in the morning ( $\chi^2 = 22.39$ , df = 3,  $p = 0.00$ ) and needed parental supervision to get up in the mornings (Table 1). In our study, girls experienced more parental controls over where they were going, over housework and over dress than did the boys (Table 1).

### Academic program

The mean total sleep time (Fig. 1) of students in the JEE track (435.98 minutes, SD = 76.05) was less than that of the students in the VSE track (476.65 minutes, SD = 87.94) ( $t = -5.50$ ,  $p = 0.00$ ). The mean nighttime sleep duration on school days of students in the JEE track (414.38 minutes, SD = 69.34) was less than those of the VSE track (443.44 minutes, SD = 58.93) ( $t = -4.44$ ,  $p = 0.00$ ). The mean nighttime sleep duration on weekends of JEE-track students (544.64 minutes, SD = 102.69) was less than those of VSE-track students (577.06 minutes, SD = 92.14) ( $t = -2.96$ ,  $p = 0.00$ ). There was no significant difference between the required sleep time and total sleep time based on the types of academic program (JEE track: 85.76 minutes, SD = 121.68; VSE track: 74.51 minutes, SD = 98.86,  $t = 0.99$ ,  $p = 0.25$ ). JEE track students woke up earlier on weekends (8:49 a.m. vs. 9:18 a.m.,  $t = -3.34$ ,  $p = 0.00$ ) than those of VSE-track students. Students on the JEE track (Tables 1 and 2) had more frequent daytime naps and more parental controls over housework and beverage consumption. The reasons for going to

TABLE 3. Odds ratio of sleep patterns on daytime functions and morning situation

| Variables                      | Napping<br>in the<br>daytime | Ease of<br>napping | Tiredness<br>in the<br>morning | Wishing<br>to stay<br>in bed | Moodiness<br>in the<br>morning | Alertness<br>in the<br>morning | Ease in<br>waking |
|--------------------------------|------------------------------|--------------------|--------------------------------|------------------------------|--------------------------------|--------------------------------|-------------------|
| Total sleep time               | 0.9951***                    | 0.9960***          | 0.9970***                      | 0.9973**                     | 0.9982 <sup>NS</sup>           | 1.0017 <sup>NS</sup>           | 1.0019*           |
| Nighttime sleep on school days | 0.9963**                     | 0.9966**           | 0.9961***                      | 0.9973**                     | 0.9970**                       | 1.0023*                        | 1.0033**          |
| Bedtime on school days         | 1.0045***                    | 1.0042***          | 1.0068***                      | 1.0046***                    | 1.0028*                        | 0.9961***                      | 0.9955***         |
| Difference <sup>a</sup>        | 1.0022***                    | 1.0044***          | 1.0032***                      | 1.0027***                    | 1.0009 <sup>NS</sup>           | 0.9973***                      | 0.9984**          |

Significance levels of logistic regression: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . NS = not significant.

<sup>a</sup> Difference between self-reported required sleep time and total sleep time.

bed later than 11 p.m. differed significantly between students in the two tracks (Table 2).

### Impact of sleep time on daytime functions

To understand the variables in correlation with daytime functions and morning state-of-mind, the independent variables, e.g. sleep time, grade, sex, academic program, sleep habits, insomnia, parasomnia, etc., were used in our regression analysis. Only four independent variables, i.e. 1) total sleep time, 2) average nighttime sleep on school days, 3) bedtime on school days and 4) the difference between the self-reported required sleep time and total sleep time, were statistically significant in relation to impact on daytime functions and morning state-of-mind. The odds ratio and level of significance (at  $p < 0.05$ ) are shown in Table 3. Total sleep time was not statistically significant in relation to moodiness ( $p = 0.06$ ) in the mornings and influencing alertness in the mornings ( $p = 0.055$ ). The difference between the self-reported required sleep time and total sleep time in relation to moodiness in the mornings ( $p = 0.11$ ) was not significant.

## DISCUSSION

The rates of self-reported difficulty in falling sleep (27.2%) and having nightmares (17.1%) found in this study were nearly twice of those reported in China (difficulty in falling asleep, 14.9%; and having nightmares, 9.5%) (15). Our subjects had more daytime naps than those in the study of Billiard et al. (one to two daily naps, 3.8%; and more than two daily naps, 1.1%) (16) of young male adults. A total of 23.2% of our subjects considered themselves more sleepy during the day than their classmates. This figure is higher than that reported by Partinen (9.5%) (17). Our subjects reported having more school pressures and problems as the perceived cause of poor sleep than in the study reported by Price et al. (18). Our results on going to bed earlier on school nights, waking up late on weekends and having a shorter nighttime sleep duration on school days than on weekends, are similar to previous

studies (1,13,16,18–21). Our study showed a 2-hour weekend–school day difference in nighttime sleep duration in junior high school students. This 2-hour difference is greater than the results obtained by Anders et al. (19) and Petta et al. (22) that had about a 90-minute difference for ages 13–15 years, and the results reported by Strauch and Meier (13) that had a 30-minute difference for ages 10–14 years. Based on our study, the longer sleep duration during the weekends seems to be a response to insufficient sleep during the weekdays. In short, the sleep patterns of our Taipei students are similar to those of previous studies, but problems seem to be more severe in our study.

In this study, total sleep duration and nocturnal sleep duration, both on school days and on weekends, declined gradually when the grade level increased. As students moved up the grade level, the difference between the self-reported required sleep time and total sleep time became greater, and daytime sleepiness as well as complaints in the morning were more frequent. Compared with the results of Carskadon (1), Anders et al. (19) and Petta et al. (22), our results showed a later bedtime and a shorter nocturnal sleep duration on school days. This result was the same regardless of whether the students were from the JEE track or VSE track. The other studies showed that cumulative sleep deprivation resulted in daytime sleepiness (23–25) and a decline in performance (26–28). In this study, “grade level” was one of the most important factors to affect the daily sleep duration, but not factors such as insomnia, parasomnia or other demographic variables. It was reported that older adolescents become sleepy in the daytime, even when sleeping as much as pre-adolescents, i.e. older adolescents need more sleep than pre-adolescents (1,3). In this study, with a shorter sleep duration and a greater difference between the self-reported required sleep time and total sleep time, the students felt sleepy during the day, tired, drowsy, moody and had a difficult time in getting up in the morning. Carskadon (2) and Carskadon et al. (9) point out that the current economic climate in the United States that encourages teenagers to have part-time work and extracurricular activities, and to spend the money that they earn, results in teenagers getting insufficient sleep.

The consequences of chronic insufficient sleep of teenagers include excessive daytime sleepiness (25), mood changes, increased use of caffeine, stimulants, alcohol and other drugs, all of which make teenagers vulnerable to tragic accidents (2,29–31). However, in Taipei, more than 70% of the students went to bed later than 11 p.m. because of heavy homework and preparation for examinations. Parental involvement both at bedtime and rise time decreased as the adolescents got older. This is different from the report of Carskadon (1), in which parental influence diminishes at bedtime but becomes more important on waking in the morning. Because third-year junior high school students in Taipei always have examinations in early morning, this may account for the early rise time of the students without increased parental control on getting up. Excessive sleepiness related to insufficient sleep can be eliminated by sleeping longer at night. Sleep laboratory studies have shown that an extended nocturnal sleep improves mental alertness and performance (32,33). This finding indicates that we need to educate students, their parents and teachers in order to get teenagers to sleep more at night than they currently do.

The VSE academic program is still at the preliminary experimental stage; hence, students in this program make up only a small minority of the students at the same grade level. In this study, VSE students experienced longer sleep duration, less daytime sleepiness, less homework and fewer examinations in comparison to those on the JEE track. VSE students seemed to have a healthier life than students of the JEE. The findings strongly support the "educational origin" of sleep problems in Taipei.

Although girls slept less than boys, a result that was incompatible with those obtained by Carskadon from the same age group, i.e. 13- to 15-year-olds (1), there was no big gender difference between the required sleep time and total sleep time. It is believed that girls need to wake up earlier to take a shower, fix their hair, put on makeup, dress, put in their contact lenses, etc. (7). Although female students in Taiwan in general pay much less attention to their appearance, in this study we observed that girls did wake up earlier, compatible with the results of Carskadon (1) from the same age group, and spent more time in preparing for school. Girls also did not reveal more daytime dysfunctions than boys in spite of their shorter nocturnal sleep duration. Although girls had more housework chores, the sleep duration of girls who did housework and those who did no housework did not show a significant difference, as analyzed by the *t* test. Some studies (3,5) have reported that no gender differences were found in daytime sleepiness for children at similar Tanner stages. Further investigation is necessary at the biological and psychosocial level to understand why girls

aged 13–15 in Taipei sleep less and do not have an increase in daytime nap and dysfunctions.

In conclusion, adolescents in Taipei complained of more sleep problems than did adolescents from other countries, although some of the problems were not compared at the same age groups. This is particularly true for JEE-track third-year students who are facing tremendous academic competition. The differences in society may be responsible for differing reasons for adolescent sleep problems (2). In Taiwan, academic pressure seems to be the most important factor for concern. We believe that education reform is necessary to meet the developmental needs of adolescents in Taiwan. Through such reform, adolescents will have enough sleep and lead healthier lives.

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