pii: jc-17-00120 http://dx.doi.org/10.5664/jcsm.6760

JCSM
Journal of Clinical Sleep Medicine

SCIENTIFIC INVESTIGATIONS

Sleep Duration and Sleep Patterns in Chinese University Students: A Comprehensive Meta-Analysis

Lu Li, MSc[1,2*]; Yuan-Yuan Wang, PhD[1,*]; Shi-Bin Wang, PhD[3,*]; Lin Li, MSc[4,5]; Li Lu, MSc[1]; Chee H. Ng, MBBS, MD[6]; Gabor S. Ungvari, MD, PhD[7]; Helen F.K. Chiu, FRCPsych[8]; Cai-Lan Hou, MD, PhD[3]; Fu-Jun Jia, MD[3]; Yu-Tao Xiang, MD, PhD[1]

*[1]Unit of Psychiatry, Faculty of Health Sciences, University of Macau, Macao SAR, China; [2]The Affiliated Brain Hospital of Guangzhou Medical University (Guangzhou Huiai Hospital), Guangzhou, China; [3]Guangdong Mental Health Center, Guangdong General Hospital and Guangdong Academy of Medical Sciences, Guangdong Province, China; [4]Faculty of Life Sciences and Biopharmaceutics, University of Shenyang Pharmaceutical, Shenyang, China; [5]Liaoning Medical Device Test Institute, Shenyang, China; [6]Department of Psychiatry, University of Melbourne, Melbourne, Victoria, Australia; [7]Graylands Hospital, Perth, Australia; [8]Department of Psychiatry, Chinese University of Hong Kong, Hong Kong SAR, China; *contributed equally*

Study Objectives: This meta-analysis aimed to determine duration and patterns of sleep in Chinese university students.

Methods: English (PubMed, PsycINFO, Embase) and Chinese (SinoMed, Wan Fang Database, and Chinese National Knowledge Infrastructure) databases were systematically and independently searched from their inception until August 16, 2016. Data on sleep duration and sleep patterns of tertiary student population in eligible studies were extracted and pooled using random-effects models.

Results: A total of 57 studies with 82,055 university students were included in the meta-analysis. Pooled mean sleep duration was 7.08 h/d (95% confidence interval [CI]: 6.84 to 7.32 h/d). The percentage of students with sleep duration shorter than 6 h/d and 7 h/d (short sleep) was 8.4% (95% CI: 5.7% to 12.3%) and 43.9% (95% CI: 36.9% to 51.1%), respectively. In contrast, the percentage of students with sleep duration longer than 8 hours and 9 hours (long sleep) was 18.3% and 5.7%, respectively. The pooled mean bedtime was at 12:51 AM. The percentage of university students who fall asleep after midnight was 23.8%. The percentage of students with sleep latency more than 30 minutes was 25.5%. The pooled mean wake-up time was at 8:04 AM on weekdays and 9:52 AM on weekends.

Conclusions: Short sleep duration and unhealthy sleep patterns were found to be common among Chinese university students.

Keywords: China, meta-analysis, sleep duration, sleep patterns, university students

Citation: Li L, Wang YY, Wang SB, Li L, Lu L, Ng CH, Ungvari GS, Chiu HF, Hou CL, Jia FJ, Xiang YT. Sleep duration and sleep patterns in chinese university students: a comprehensive meta-analysis. *J Clin Sleep Med.* 2017;13(10):1153–1162.

INTRODUCTION

The use of smartphone and electronic reading devices prior to bedtime is becoming more common, resulting in changing sleep patterns.[1–3] In the past 50 years there was a decline in sleep duration by 1.5 to 2 hours in the United States.[4] Sleep time is shortened and bedtime is typically delayed in adolescence,[5] a finding also noted in university students. Apart from the effect of new media, other factors including the lack of parental supervision, changed living environment on campus, caffeine or energy drinks, and academic stress may contribute to irregular sleep habits in university students.[5–8] Over the past decades, the prevalence of dissatisfaction with sleep quality among university students has increased.[9]

Irregular sleep habits and other sleep problems in university students are a global issue. For instance, 36.2% of Palestinian university students have a sleep latency of more than 30 minutes and 41.7% go to bed after midnight.[10] In the United States, students go to bed at 12:17 AM and wake up at 8:02 AM on weekdays, but mean bedtimes (1:44 AM) and wake-up time (10:08 AM) are delayed on weekends.[7] In China irregular sleep habits, delayed bedtime, early wake-up, and sleep deprivation are also common in university students. According to the report of the Ministry of Education in 2015, there were approximately 37 million university students in China accounting for approximately one-fifth of university students globally. University students have to cope with multiple pressures, including a shrinking job market, that increase the risk of irregular sleep patterns. Socio-demographic and cultural factors play important roles in sleep-related disturbances including irregular sleep habits[11–14]; therefore, findings obtained in a particular sociocultural context, in Western or Middle-Eastern countries, can hardly be generalized to other countries such as China.[15]

BRIEF SUMMARY

Current Knowledge/Study Rationale: Short and long sleep duration and sleep patterns are usually associated with poor health outcomes. The results of patterns of sleep duration in Chinese university students have been inconsistent.

Study Impact: Short sleep duration and unhealthy sleep patterns were common in Chinese university students. Given their negative effect on health, quality of life, and intellectual performance, educational and health professionals should pay more attention to sleep patterns in this population.

Irregular sleep-wake patterns and poor sleep quality are associated not only with increased tiredness but also with significant effects on endocrinology, immunology, and metabolism status.[16,17] Sleep-deprived students usually perform significantly worse than those with normal sleep.[18,19] In addition, short sleep duration is associated with unhealthy risk behaviors, such as alcohol and tobacco use, which could increase the risk for developing hypertension, obesity, diabetes, hypercholesterolemia, and even mortality.[20–25] In contrast, long sleep duration can also be associated with negative outcome, such as increased risk of cardiovascular disease and cognitive impairment.[26–28]

To date there has been no gold standard criteria for short and long sleep duration. Epidemiological studies usually defined self-reported short and long sleep duration as less than 6 or 7 hours per day and more than 8 or 9 hours per day, respectively.[26,29–31] Some researchers suggested 7 to 8 hours per day as appropriate for the university students, whereas fewer than 7 hours is defined as short sleep and more than 8 hours is regarded as long sleep.[32,33] The National Sleep Foundation has recommended 7 to 9 hours per day as the appropriate sleep duration for young adults.[34]

To date a number of studies have examined sleep duration and patterns in university students, but the results have been inconsistent. There has not been any meta-analysis of the pooled data on sleep duration and patterns in this population, which is the rationale for conducting this study.

METHODS

Search Strategies

Both English (PubMed, EMBASE and PsycINFO) and Chinese (SinoMed, WanFang, and Chinese National Knowledge Infrastructure [CNKI]) databases were systematically and independently searched by two reviewers from inception until August 16, 2016. The following search terms were used, including ("China" or "Chinese") and ("insomnia" or "sleep symptoms" or "sleep disorders" or "sleep quality" or "sleep disturbance" or "sleep problem" or "sleep time" or "sleep duration" or "sleep habit" or "sleep pattern") and ("prevalence" or "epidemiology survey" or "cross-sectional study") and ("university students" or "college students" or "undergraduate students" or "adolescents" or "young adults"). We also searched the reference lists of the selected articles to find additional records.

Study Selection

We included original quantitative studies that satisfied the following criteria: (1) cross-sectional epidemiological studies conducted in university students in mainland China, Hong Kong, Macao, and Taiwan; and (2) available data on self-reported nocturnal sleep time (mean and standard deviation, proportion of short and long sleep duration, or sleep pattern (bedtime, wake-up time, afternoon nap, and sleep latency). Exclusion criteria were: (1) case studies, (2) surveys without sampling method, and (3) specific populations (eg, patients in hospitals, or those having physical or psychiatric problems). Two reviewers (LL and YYW) checked the title, abstract, and full text of the initial search results independently, and any discrepancies uncovered during these procedures were checked and resolved by a third reviewer (SBW).

Quality Evaluation

Two reviewers (LL and YYW) assessed the methodological quality of the included studies using the 22-item Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) instrument that assesses the title, abstract, introduction, methods, results, and discussion sections of included studies.[35] Disagreements were resolved by discussion between the two reviewers, and a third reviewer (SBW) was referred if needed. Studies with a score of 11 or less were classified as "poor quality."[36] Otherwise, they were rated as "good quality."

Data Extraction

Data were independently extracted by two reviewers (LL and YYW), and were checked by a third reviewer (SBW). The following information was extracted and tabulated: sampling and recruitment methods, study time, characteristics of the participants, study location, and sleep-relevant information.

Statistical Analyses

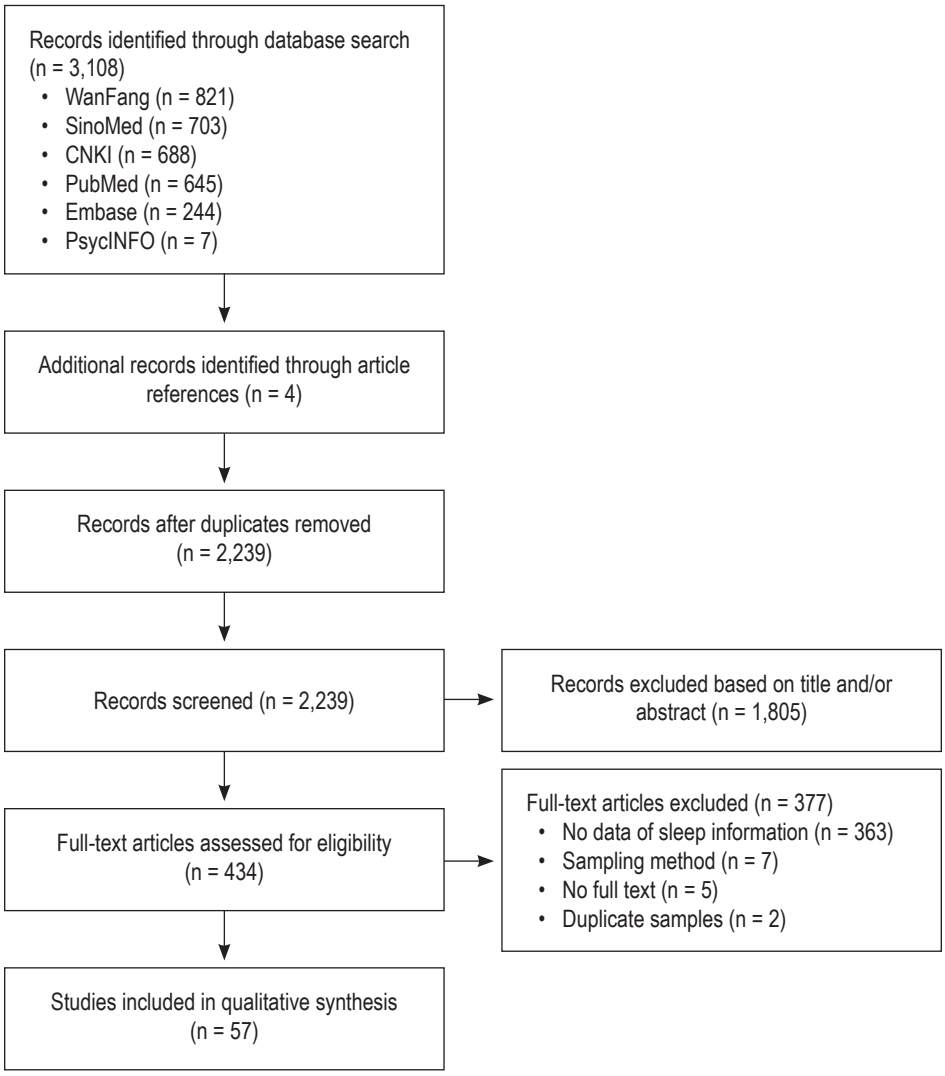
The Stata software version 12.0 (Stata Corporation, College Station, Texas, United States) and the Comprehensive Meta-Analysis software version 2 (Biostat Inc., Englewood, New Jersey, United States) were used to perform the meta-analysis. The outcome measures of the individual studies were combined using a random-effects model, and standardized mean difference with 95% confidence intervals (CI) was used for data synthesis. I^2 statistic was used to evaluate heterogeneity of the studies, with I^2 values greater than 50% indicating heterogeneity.[37] The visual funnel plot, Egger test, and Begg test were used to assess possible publication bias.[38] The "trim and fill" method was used to estimate the number of potential missing studies using a random-effects model. Sensitivity analysis was conducted by excluding each study individually to evaluate the quality and consistency of the results. All analyses were two tailed, with alpha set at .05.

RESULTS

Search Results, Studies Characteristics, and Quality Assessment

Figure 1 presents the flow chart of the search and selection process. A total of 3,112 records were collected during the initial search. After removing the duplicates, 2,239 were screened by title and abstract. After full-text review of the remaining 434 studies, 377 studies were excluded. Finally, 57 studies (10 studies in English and 47 studies in Chinese) with 82,055 university students were included for analyses. **Table 1** shows the basic characteristics of the studies, in which 18 reported the mean sleep duration and 41 reported the prevalence of short and/or long sleep. The mean STROBE score of the included studies was 15, ranging from 11 to 20. Five studies (8.8%) were rated as "poor quality," and the rest were "good quality."

Figure 1—Flowchart for the selection of studies.



CNKI = Chinese National Knowledge Infrastructure.

Sleep Duration

The pooled sleep duration in 18 studies with available data was 7.08 h/d (95% CI: 6.84–7.32 h/d) (**Figure 2**). **Table S1** in the supplemental material shows the proportion of short and long sleep duration in the university students. The proportion of those with sleep duration less than 6 h/d and 7 h/d was 8.4% (95% CI: 5.7% to 12.3%) and 43.9% (95% CI: 36.9% to 51.1%), respectively. The proportion of those with sleep duration more than 8 hours and more than 9 hours was 18.3% (95% CI: 13.2% to 24.8%) and 5.7% (95% CI: 3.2% to 9.9%), respectively.

Sleep Patterns

The sleep patterns of university students are displayed in **Table S2** in the supplemental material. The pooled mean bedtime of 5 studies with 8,695 students and available data was 12:51 AM (95% CI: 11:56 PM to 1:50 AM). The proportions of those having bedtime after 11:00 PM and midnight were 72.7% (95% CI: 59.0% to 83.2%) and 23.8% (95% CI: 12.3% to 40.9%), respectively. The pooled mean wake-up time on weekdays of 4 studies with 7,063 students was at 8:04 AM (95% CI: 5:40 AM to 9:27 AM) and the pooled mean wake-up time on weekends from 2 studies was at 9:52 AM (95% CI: 9:02 AM to 10:43 AM). The proportion of wake-up time before 6:00 AM, 6:00 AM to 7:00 AM, and after 7:00 AM were 9.0% (95% CI: 6.0% to 13.4%), 54.5% (95% CI: 35.7% to 72.1%), and 35.7% (95% CI: 7.1% to 79.5%), respectively. The mean sleep latency was 16.96 minutes (95% CI: 13.46 minutes to 20.47 minutes). The proportion of those with sleep latency more than 30 minutes and more than 60 minutes were 25.5% (95% CI: 20.2% to 31.7%) and 5.0% (95% CI: 3.2% to 7.5%), respectively. The proportion of those having an afternoon nap from 10 studies with 19,000 students was 86.4% (95% CI: 76.3% to 92.6%), and the pooled mean afternoon nap duration was 54.24 minutes (95% CI: 37.12 minutes to 42.30 minutes).

Subgroup Analyses

The pooled mean sleep duration and proportion of short (< 6 h/d) and long sleep (> 9 h/d) by sex, survey time, sample size, major (medical and non-medical students), school days, and region

Table 1—Characteristics of studies included in the meta-analysis.

No.	Author and Publication Year	Sampling Method	Study Year	Sample Size	Age (mean ± SD or range)	Medical Student	Grade	Students From Rural Area (%)	Male (%)	Province	Area	Sleep Information	STROBE Score
1	Xue SP 1998 [57]	R	NR	358	21 ± 2.5	No	NR	50.00	44.41	Neimenggu	Northern	M, SD	13
2	Yang CM 2003 [58]	S	NR	1,922	18.5 ± 0.93	No	1	NR	72.11	Taiwan	Southern	M, SD	17
3	Duan QB 2004 [59]	R	NR	2,797	NR	No	NR	43.12	56.90	Sichuan	Southern	M, SD	12
4	Cheng P 2004 [60]	R	NR	213	NR	No	NR	NR	57.74	Guangdong	Southern	SP, < 6, < 7, > 8, > 9	12
5	Tsai LL 2004 [49]	Con	1998	237	18–24	no	1–4	NR	53.58	Taiwan	Southern	M, SD, SP	18
6	Ma HL 2005 [61]	C	2002	1,128	20.8 ± 1.19	Yes	1–3	NR	47.07	Liaoning	Northern	M, SD, < 7	12
7	Chen W 2005 [62]	C	2003	122	20.8 ± 0.7	Yes	NR	NR	40.98	Zhejiang	Southern	M, SD, SP	11
8	Xiao Q 2005 [63]	C	NR	3,204	21.0 ± 1.0	Yes	1–5	NR	59.14	Guangdong	Southern	< 6, < 7	12
9	Yang K 2006 [64]	C	2006	1,070	19.7 ± 0.99	No	1	NR	56.00	Shanxi	Northern	M, SD, SP, < 6, > 8	16
10	Zhang YX 2006 [65]	C,S,R	NR	1,422	NR	No	NR	NR	NR	Jiangsu	Southern	< 6, > 9	13
11	Yang JW 2007 [66]	C,R	2005	1,284	NR	No	1–3	NR	NR	Jiangsu	Southern	M, SD, < 6, < 7, > 8, > 9	14
12	Zhou JF 2007 [67]	C	NR	549	18.97	Both	1	46.30	47.50	Jiangsu	Southern	< 6, < 7, > 8, > 9	11
13	Shao YS 2007 [68]	R	2005	902	19.8 ± 1.8	No	1–4	NR	54.55	Hubei	Southern	SP, < 6, < 7, > 8, > 9	13
14	Pan JJ 2007 [69]	C,R	NR	264	20.7 ± 1.21	No	NR	NR	46.59	Hubei	Southern	< 6	13
15	Wang FC 2007 [70]	S,R	NR	542	NR	No	NR	NR	NR	Henan	Northern	SP, < 6, < 7, > 8	11
16	Chen YH 2008 [71]	S,R	2008	205	18–23	Yes	1,4	39.02	16.59	Guangdong	Southern	< 6, < 7	16
17	Suen LK 2008 [72]	Con	2006	400	20.7 ± 1.56	Both	1–4	NA	37.50	Hong Kong	Southern	M, SD, SP	18
18	Tsui YY 2009 [73]	C	2005	620	19.9 ± 1.2	No	NR	NR	29.84	Hong Kong	Southern	M, SD, SP	19
19	Ma YH 2009 [74]	R	2008	1,579	NR	No	1–4	NR	48.83	Zhejiang Guangxi	Southern	< 7	15
20	Kang JH 2009 [75]	R	NR	160	20.3 ± 1.9	Yes	1	NR	50.63	Taiwan	Southern	M, SD, SP, < 7, > 8	20
21	Li MJ 2009 [76]	C	NR	4,808	21.0 ± 1.0	Yes	1–5	NR	39.41	Heilongjiang	Northern	< 6	13
22	Gao L 2009 [77]	R	2007	1,901	18.2 ± 1.53	Yes	1–3	NR	NR	Shandong	Northern	< 6, < 7	14
23	Xu XY 2010 [78]	C,R	NR	833	20.6 ± 0.94	Yes	NR	NR	54.62	Guangdong	Southern	SP, < 6	15
24	Sing CY 2010 [79]	S	NR	529	21.0 ± 1.77	No	NR	NR	45.40	Hong Kong	Southern	M, SD, SP, < 6, > 9	18
25	Xue L 2011 [80]	C,S	2010	2,002	19.9 ± 1.38	Yes	1–4	58.29	41.16	Anhui	Southern	SP, < 6, < 7, > 8, > 9	16
26	Jiang DQ 2011 [81]	C	NR	6,176	NR	Both	1–3	64.60	53.19	Anhui	Southern	SP, < 6, > 8	16
27	Zhang SL 2011 [82]	S	NR	341	NR	Yes	1–5	NR	42.23	Guangdong	Southern	SP, < 6, < 7, > 8, > 9	13
28	Mao SF 2011 [83]	R	NR	527	21.0 ± 0.42	No	NR	NR	44.59	Xinjiang	Northern	< 6, < 7, > 8	17
29	Lu J 2012 [84]	R,S	NR	255	NR	No	1–4	72.16	41.18	Xinjiang	Northern	M, SD,	14
30	Jin XM 2012 [85]	C,R	NR	450	20.5 ± 1.9	No	1–4	NR	50.20	Shanxi	Northern	< 6, < 7,	15
31	Zhang R 2012 [86]	C,S,R	NR	228	NR	No	1–3	NR	NR	Jiangsu	Southern	SP, < 6, < 7	13
32	Luo CH 2012 [87]	C,S	NR	1,038	NR	Both	NR	NR	41.40	Guangdong	Southern	SP, < 6, < 7	13
33	Zhang L 2012 [88]	C,S,R	NR	1,903	20.8 ± 1.2	No	1–3	NR	34.31	Chongqing	Southern	> 8	17
34	Zhang XY 2012 [89]	C,R	2008	3,207	21.1 ± 1.57	No	1–5	NR	50.11	Tianjin	Northern	SP, < 6, < 7	19
35	Zhang FL 2012 [90]	R	2010	2,996	NR	No	3	NR	38.25	Hunan	Southern	< 6, < 7, > 8, > 9	13
36	Jie HC 2012 [91]	C,R	2010	685	NR	Yes	NR	NR	37.96	Beijing	Northern	< 7	14
37	Cheng SH 2012 [92]	S	2008	4,318	NR	No	1	NR	65.77	Taiwan	Southern	M, SD	17
38	Yu QC 2013 [93]	M,C,R	2012	5,806	19.2 ± 1.13	No	1,2	NR	50.53	Anhui	Southern	M, SD	18
39	Zhou W 2013 [94]	R	2011	937	19.8 ± 1.69	No	1–3	NR	27.21	Zhejiang	Southern	SP, < 6	15

NR = not reported, SD = standard deviation. **Sampling Method:** Con = convenience sampling, C = cluster sampling, M = multistage sampling, R = random sampling, S = stratified sampling. **Sleep Information:** M = mean of sleep duration, SD = standard deviation, < 6 = the percentage of participants with a sleep duration < 6 h/d, < 7 = the percentage of participants with a sleep duration < 7 h/d, > 8 = the percentage of participants with a sleep duration > 8 h/d, > 9 = the percentage of participants with a sleep duration > 9 h/d, SP = sleep patterns (get up time, bedtime, sleep latency, afternoon nap).

Table 1 continues on the following page

Table 1 (*continued*)—Characteristics of studies included in the meta-analysis.

No.	Author and Publication Year	Sampling Method	Study Year	Sample Size	Age (mean ± SD or range)	Medical Student	Grade	Students From Rural Area (%)	Male (%)	Province	Area	Sleep Information	STROBE Score
40	Shi SS 2013 [95]	C,S	NR	882	NR	No	1,4	NR	NR	Shanxi	Northern	SP	17
41	Li DF 2013 [96]	C	2012	1,037	19.6 ± 1.11	Yes	1,2	79.94	0.00	Shanxi	Northern	SP, < 6, > 8	14
42	Lin HY 2013 [97]	C,S	2012–2013	450	21.0 ± 1.11	Yes	1–3	NR	19.56	Fujian	Southern	< 7, > 8,	18
43	Li J 2013 [98]	C,R	2012	3,130	20.3 ± 1.24	No	1,2	NR	31.30	Anhui	Southern	< 7	17
44	Wong ML 2013 [99]	C	2010–2012	930	21.7 ± 2.22	No	1–4	NR	33.30	Hong Kong/ Macao	Southern	M, SD	18
45	Zuo GW 2014 [100]	C,R,S	NR	2,520	20.6 ± 1.03	No	2	NR	26.86	Guangxi	Southern	M, SD	14
46	Jin Y 2014 [101]	C	2012	1,632	19.7 ± 1.03	Yes	1–3	78.90	21.00	Zhejiang	Southern	M, SD, SP	18
47	Ni J 2014 [102]	R	2012–2013	168	NR	No	3,4	NR	35.70	Hubei	Southern	SP, < 6, < 7, > 8	14
48	Zheng YY 2014 [103]	R	NR	1,873	18–23	No	NR	NR	52.84	Henan	Northern	SP	16
49	Huang XH 2014 [104]	R	NR	277	NR	No	1–3	NR	37.18	Jiangsu	Southern	SP, < 6, > 8	11
50	Cai HY 2014 [105]	C,S	NR	438	20.1 ± 1.23	Yes	1–4	NR	49.09	Guangdong	Southern	< 6, < 7, > 9	13
51	Chen Y 2014 [106]	Con	NR	656	20.0 ± 1.0	No	NR	NR	37.35	Tianjin	Northern	SP	13
52	Chen CJ 2015 [107]	C	NR	246	NR	No	4	NR	63.01	Guangdong	Southern	SP, < 6	11
53	Chen Q 2015 [108]	S,R	2014	493	NR	Yes	1–3	NR	60.85	Guangdong	Southern	< 6, < 7, > 8	14
54	Shen JB 2015 [109]	C,S,R	NR	220	NR	No	1–3	NR	50.00	Shanxi	Northern	SP, < 6, > 9	14
55	Qian YK 2015 [110]	C,S,R	NR	1,566	NR	No	1–4	54.34	33.27	Jiangsu	Southern	< 6, > 9	14
56	Li M 2015 [111]	C	NR	1,534	20.1 ± 1.22	No	2–3	NR	40.09	Zhejiang	Southern	< 6, > 8	15
57	Wang L 2016 [112]	S	2013	6,085	NR	Yes	1–5	NR	28.70	Neimenggu	Northern	< 6, < 7	18

NR = not reported, SD = standard deviation. **Sampling Method:** Con = convenience sampling, C = cluster sampling, M = multistage sampling, R = random sampling, S = stratified sampling. **Sleep Information:** M = mean of sleep duration, SD = standard deviation, < 6 = the percentage of participants with a sleep duration < 6 h/d, < 7 = the percentage of participants with a sleep duration < 7 h/d, > 8 = the percentage of participants with a sleep duration > 8 h/d, > 9 = the percentage of participants with a sleep duration > 9 h/d, SP = sleep patterns (get up time, bedtime, sleep latency, afternoon nap).

are summarized in **Table 2**. There were no significant associations between sleep durations, sex, different survey times, different sample sizes, medical or non-medical students, and southern and northern regions of China. There was significant difference in sleep duration on school days (6.71 hours, 95% CI: 6.50–6.92) and on weekends (8.36 hours, 95% CI: 8.04–8.67). The pooled mean sleep duration in mainland Chinese students from 11 studies with available data was 7.23 hours (95% CI: 6.92–7.61), which was significantly longer than that in students in Hong Kong, Macao, and Taiwan (6.77 hours, 95% CI: 6.67–6.88). Short sleep (< 6 h/d) was significantly higher in medical students (16.9%, 95% CI: 10.0% to 27.1%) than in non-medical students (7.4%, 95% CI: 5.8% to 9.5%). Long sleep (> 9 h/d) was more frequent in non-medical students (9.9%, 95% CI: 5.4% to 17.5%) than in medical students (1.6%, 95% CI: 0.5% to 5.0%).

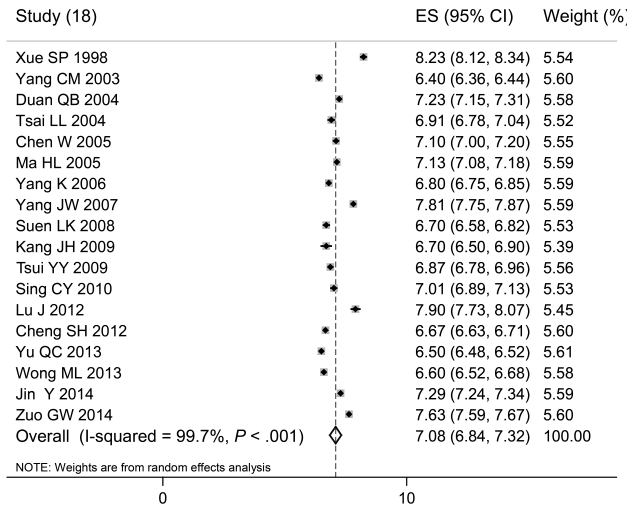
Publication Bias

There is no publication bias in sleep duration (**Figure 3**). Based on the results of visual funnel plot and the Egger test, publication bias was observed in the short sleep group (< 6 h/d); therefore, the "trim and fill" method was performed. Five studies were missing in the short sleep duration group (< 6 hours) (**Figure S1** in the supplemental material). The recalculated prevalence of short sleep (< 6 hours) according to the "trim and fill" method was 10.8% (95% CI: 7.58% to 15.2%).

Sensitivity Analysis

Each study was sequentially excluded in each group and the recalculated combined results did not change significantly, which indicates that none of the individual study significantly influenced the overall meta-analysis result in each group.

Figure 2—Forest plot of the mean sleep duration.



CI = confidence interval, ES = effect size.

DISCUSSION

This was the first meta-analysis that examined sleep duration and sleep patterns in Chinese university students. The

Table 2—Subgroup analyses of sleep patterns.

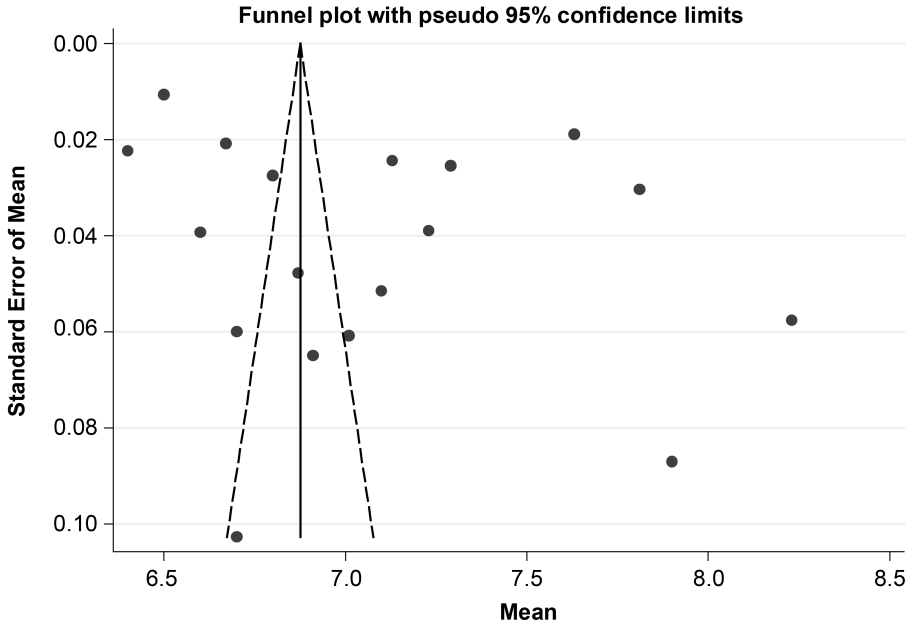
Subgroups	Categories (no. of studies)	Mean	SE	95% CI	Sample Size	I^2 (%)	*P*	Q (*P*)
Subgroup analyses of sleep duration								
Sex	Female (9)	7.21	0.130	6.95–7.46	4,746	98.2	< .001	0.136 (.71)
	Male (9)	7.28	0.125	7.03–7.52	3,880	97.7	< .001	
Study year	1998–2005 (5)	7.17	0.186	6.80–7.53	3,391	99.1	< .001	3.242 (.072)
	2006–2012 (6)	6.76	0.127	6.51–7.00	14,156	99.4	< .001	
Sample size	≤ 1,000 (9)	7.11	0.182	6.75–7.47	3,611	98.8	< .001	0.061 (.80)
	> 1,000 (9)	7.05	0.174	6.70–7.39	22,477	99.8	< .001	
Medical	Yes (4)	7.09	0.075	6.93–7.23	3,042	93.6	< .001	0.034 (.85)
	No (13)	7.11	0.156	6.81–7.42	22,646	99.7	< .001	
School days	Yes (5)	6.71	0.108	6.50–6.92	4,779	97.8	< .001	73.09 (< .001)
	No (5)	8.36	0.160	8.04–8.67	4,779	98.2	< .001	
Region	North (3)	7.75	0.403	6.96–8.54	1,741	99.4	< .001	3.583 (.058)
	South (15)	6.95	0.131	6.69–7.20	24,347	99.7	< .001	
Mainland China	Yes (11)	7.27	0.175	6.92–7.61	18,894	99.8	< .001	7.252 (< .001)
	No (7)	6.67	0.055	6.67–6.88	7,194	89.3	< .001	

Subgroups	Categories (no. of studies)	Proportion (%)	95% CI	Events	Sample Size	I^2 (%)	*P*	Q (*P*)
Subgroup analyses of the rate of short sleep duration (< 6 h/d)								
Sex	Female (5)	4.2	2.7–6.5	104	2,312	72.3	.006	2.971 (.085)
	Male (3)	11.1	4.0–27.4	95	615	93.5	< .001	
Study year	2005–2009 (6)	7.6	2.3–22.7	1,196	8,569	99.6	< .001	0.004 (.95)
	2010–2014 (7)	7.9	5.5–11.3	1,540	13,718	97.2	< .001	
Medical	Yes (11)	16.9	10.0–27.1	6,031	21,347	99.6	< .001	7.542 (.006)
	No (20	7.4	5.8–9.5	1,666	18,582	95.6	< .001	
Sample size	≤ 867 (17)	8.6	5.7–12.9	768	6,523	96.5	< .001	0.081 (.77)
	> 867 (17)	9.5	5.5–15.9	7,243	41,169	99.7	< .001	
Region	North (10)	8.9	5.6–14.0	4,406	19,847	99.6	< .001	0.0001 (.99)
	South (24)	8.9	4.4–17.3	3,606	27,845	99.3	< .001	
Subgroup analyses of the rate of long sleep duration (> 9 h/d)								
Study year	2005 (2)	13.4	8.2–21.3	312	2,186	94.6	< .001	0.95 (.32)
	2010 (2)	7.1	2.1–21.9	463	4,998	99.0	< .001	
Medical	Yes (3)	1.6	0.5–5.0	83	2,781	85.4	< .001	7.68 (.006)
	No (7)	99	5.4–17.5	1,030	8,919	98.7	< .001	
Sample size	≤ 902 (6)	4.7	1.4–14.5	337	2,979	98.5	< .001	0.24 (.62)
	> 902 (5)	6.6	3.4–10.6	791	9,270	98.6	< .001	
Region	North (1)	5.0	2.8–8.8	11	220	–	–	0.12 (.72)
	South (10)	5.8	3.2–10.3	1,118	12,029	98.7	< .001	

CI = confidence interval, SE = standard error.

pooled mean sleep duration was 7.08 h/d, which is within the range (6.4–7.9 h/d) reported in other countries.[39–42] The variation between different studies could be partly attributed to the discrepancy in socioeconomic and cultural factors, sampling methods, and measurements. Although the mean sleep duration was within the standard recommended range of 7 to 9 h/d,[34] the proportion of students with less than 6 hours sleep duration was 8.4%, which is higher than the corresponding

Figure 3—Funnel plot of publication bias for the 18 studies with available data on sleep duration.



Begg test: $Z = -0.45$, $P = .649$; Egger test: $t = 1.76$, 95% confidence interval (−2.7, 6.1), $P = .098$.

figure of 5.9% found in a nationwide study in Chinese adults.[12] The proportion of students with sleep duration less than 7 h/d was 41.3% (95% CI: 35.0% to 47.9%), which is higher than the corresponding figure (33.4%) in a study in Chinese adults.[43] The higher proportion of short sleep suggests a high rate of sleep deprivation among Chinese students. The figure found in China is considerably higher than the figures in other countries (eg, 24% in the United Kingdom[44] and 30% in Korea[41]). Several reasons may account for the common short sleep duration in university students. First, late-night activities and early-morning school demands could dramatically reduce sleep duration.[7,45] Second, external factors, such as high caffeine consumption and late-night use of electronics may delay sleep onset and shorten sleep.[1,41] Third, lack of self-control and regular sleep schedule could contribute to short sleep duration.[46]

In this study the mean sleep duration did not significantly differ between medical and non-medical students (7.09 versus 7.11 h/d), but the rate of short sleep (< 6 h/d) was significant higher in medical students than in non-medical students (16.9% versus 7.4%). Traditionally, medical students in Chinese universities have more academic stress than other students and many have to shorten their sleep duration in order to meet the academic demands.[47] In addition, some studies found that psychological distress, anxiety, depression, and suicidality are relatively common in medical students,[48] which could increase the likelihood of short sleep duration. In contrast, long sleep (> 9 h/d) was more frequent in non-medical students than in medical students (9.9% versus 1.6%). Of note, university students in mainland China had a longer sleep duration than their counterparts in Hong Kong, Macao, and Taiwan (7.23 versus 6.77 hours). We assume that this could be partly explained by the differences in study demands, education, and school schedule.

Although there are substantial differences in living habits, economic level, and seasonal and cultural contexts between south and north parts of China, subgroup analysis did not reveal a significant difference between the two areas. In China, most university students live on campus with similar living environment/schedule and relevant living rules, which could offset any difference in sleep duration and patterns. The association between sex and sleep pattern has been inconsistent across studies (eg, male students reported longer sleep than females in Korea, but no significant sex difference was found in Iran and Taiwan).[41,42,49] However, no sex difference in sleep pattern and sleep duration was found in this study.

The basic sleep schedules (ie, bedtimes and wake-up times) in this study were similar to those in the United States and Korea.[7,41,46,50] The bedtime was 12:51 AM (95 CI%: 11:56 PM to 1:50 AM). More than one-fourth of Chinese students had a sleep latency longer than 30 minutes, which is also consistent with previous findings.[49,51] Western university students often got up later and had better sleep quality on weekends.[7,52] In this study, the mean sleep time of students on school days was 6.71 hours and 8.36 hours at weekends. The discrepancy in sleep duration between school days and weekend nights was 1.65 hours. Moreover, the mean wake-up time was 8:04 AM on weekdays and 9:52 AM on weekends. The results support the view that university students often shorten their sleep during the weekdays and then attempt to sleep longer on weekends.[53,54]

Several limitations should be acknowledged. First, the 57 studies only covered 20 of the 33 provinces, autonomous regions, municipalities, or Special Administrative Region in China. Second, as in most observational studies in sleep medicine, sleep information was only based on subjective assessment reported by participants, which may lead to recall bias. In addition, different measures on sleep were used across studies,

which could lead to heterogeneity. Third, heterogeneity could not be adequately adjusted for by subgroup analyses, which is consistent with the notion that heterogeneity cannot be avoided in a meta-analysis of epidemiological surveys.[55,56]

In conclusion, short sleep duration and unhealthy sleep pattern are common in Chinese university students. Its associated sociocultural factors warrant further investigation. Given its harmful effects, efforts should be undertaken to reduce the unhealthy sleep patterns in Chinese university students. In addition, objective measurement of sleep patterns, such as nocturnal polysomnography and actigraphy, should be used in future studies.

ABBREVIATIONS

CI, confidence interval
CNKI, Chinese National Knowledge Infrastructure
ES, effect size
NSF, National Sleep Foundation
SE, standard error
SMD, standardized mean difference
STROBE, Strengthening the Reporting of Observational Studies in Epidemiology

REFERENCES

1. Exelmans L, Van den Bulck J. Bedtime mobile phone use and sleep in adults. *Soc Sci Med.* 2016;148:93–101.
2. Brunborg GS, Mentzoni RA, Molde H, et al. The relationship between media use in the bedroom, sleep habits and symptoms of insomnia. *J Sleep Res.* 2011;20(4):569–575.
3. Xu XL, Zhu RZ, Sharma M, Zhao Y. The influence of social media on sleep quality: a study of undergraduate students in Chongqing, China. *J Nurs Care.* 2015;4:253.
4. 2005 Adult Sleep Habits and Styles. National Sleep Foundation website. https://sleepfoundation.org/sleep-polls-data/sleep-in-america-poll/2005-adult-sleep-habits-and-styles. Accessed July 31, 2017.
5. Fukuda K, Ishihara K. Age-related changes of sleeping pattern during adolescence. *Psychiatry Clin Neurosci.* 2001;55(3):231–232.
6. Liu X, Uchiyama M, Okawa M, Kurita H. Prevalence and correlates of self-reported sleep problems among Chinese adolescents. *Sleep.* 2000;23(1):27–34.
7. Lund HG, Reider BD, Whiting AB, Prichard JR. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Health.* 2010;46(2):124–132.
8. Hicks RA, Pellegrini RJ. The changing sleep habits of college students. *Percept Mot Skills.* 1991;72(3 Pt 2):1106.
9. Hicks RA, Fernandez C, Pellegrini RJ. Striking changes in the sleep satisfaction of university students over the last two decades. *Percept Mot Skills.* 2001;93(3):660.
10. Sweileh WM, Ali IA, Sawalha AF, Abu-Taha AS, Zyoud SH, Al-Jabi SW. Sleep habits and sleep problems among Palestinian students. *Child Adolesc Psychiatry Ment Health.* 2011;5(1):25.
11. Stranges S, Dorn JM, Shipley MJ, et al. Correlates of short and long sleep duration: a cross-cultural comparison between the United Kingdom and the United States: the Whitehall II Study and the Western New York Health Study. *Am J Epidemiol.* 2008;168(12):1353–1364.
12. Sun W, Yu Y, Yuan J, et al. Sleep duration and quality among different occupations--China national study. *PloS One.* 2015;10(3):e0117700.
13. Bin YS, Marshall NS, Glozier N. Secular trends in adult sleep duration: a systematic review. *Sleep Med Rev.* 2012;16(3):223–230.
14. Hale L, Do DP. Racial differences in self-reports of sleep duration in a population-based study. *Sleep.* 2007;30(9):1096–1103.
15. Gaziano TA, Pagidipati N. Scaling up chronic disease prevention interventions in lower- and middle-income countries. *Annu Rev Public Health.* 2013;34:317–335.
16. Akerstedt T, Nilsson PM. Sleep as restitution: an introduction. *J Intern Med.* 2003;254(1):6–12.
17. Li Y, Vgontzas AN, Fernandez-Mendoza, J et al. Insomnia with physiological hyperarousal is associated with hypertension. *Hypertension.* 2015;65(3):644–650.
18. Warner S, Murray G, Meyer D. Holiday and school-term sleep patterns of Australian adolescents. *J Adolesc.* 2008;31(5):595–608.
19. Pilcher JJ, Walters AS. How sleep deprivation affects psychological variables related to college students' cognitive performance. *J Am Coll Health.* 1997;46(3):121–126.
20. Watanabe M, Kikuchi H, Tanaka K, Takahashi M. Association of short sleep duration with weight gain and obesity at 1-year follow-up: a large-scale prospective study. *Sleep.* 2010;33(2):161–167.
21. Vgontzas AN, Liao D, Bixler EO, Chrousos GP, Vela-Bueno A. Insomnia with objective short sleep duration is associated with a high risk for hypertension. *Sleep.* 2009;32(4):491–497.
22. Lin CL, Tsai YH, Yeh MC. The relationship between insomnia with short sleep duration is associated with hypercholesterolemia: a cross-sectional study. *J Adv Nurs.* 2016;72(2):339–347.
23. Wheaton AG, Chapman DP, Croft JB. School start times, sleep, behavioral, health, and academic outcomes: a review of the literature. *J Sch Health.* 2016;86(5):363–381.
24. Itani O, Jike M, Watanabe N, Kaneita Y. Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression. *Sleep Med.* 2017;32:246–256.
25. Liu X, Chen H, Bo QG, Fan F, Jia CX. Poor sleep quality and nightmares are associated with non-suicidal self-injury in adolescents. *Eur Child Adolesc Psychiatry.* 2017;26(3):271–279.
26. Bin YS, Marshall NS, Glozier N. Sleeping at the limits: the changing prevalence of short and long sleep durations in 10 countries. *Am J Epidemiol.* 2013;177(8):826–833.
27. Shankar A, Koh WP, Yuan JM, Lee HP, Yu MC. Sleep duration and coronary heart disease mortality among Chinese adults in Singapore: a population-based cohort study. *Am J Epidemiol.* 2008;168(12):1367–1373.
28. Ferrie JE, Shipley MJ, Akbaraly TN, Marmot MG, Kivimaki M, Singh-Manoux A. Change in sleep duration and cognitive function: findings from the Whitehall II Study. *Sleep.* 2011;34(5):565–573.
29. Silva AA, Mello RG, Schaan CW, Fuchs FD, Redline S, Fuchs SC. Sleep duration and mortality in the elderly: a systematic review with meta-analysis. *BMJ Open.* 2016;6(2):e008119.
30. Kalmbach DA, Pillai V, Arnedt JT, Drake CL. DSM-5 insomnia and short sleep: comorbidity landscape and racial disparities. *Sleep.* 2016;39(12):2101–2111.
31. Gallicchio L, Kalesan B. Sleep duration and mortality: a systematic review and meta-analysis. *J Sleep Res.* 2009;18(2):148–158.
32. Steptoe A, Peacey V, Wardle J. Sleep duration and health in young adults. *Arch Intern Med.* 2006;166(16):1689–1692.
33. Grandner MA, Kripke DF. Self-reported sleep complaints with long and short sleep: a nationally representative sample. *Psychosom Med.* 2004;66(2):239–241.
34. Hirshkowitz M, Whiton K, Albert SM, et al. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep Health.* 2015;1:40–43.
35. Von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Prev Med.* 2007;45(4):247–251.
36. Wan Y, Hu Q, Li T, et al. Prevalence of autism spectrum disorders among children in China: a systematic review. *Shanghai Arch Psychiatry.* 2013;25(2):70–80.
37. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ.* 2003;327(7414):557–560.

38. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ.* 1997;315(7109):629–634.
39. Forquer LM, Camden AE, Gabriau KM, Johnson CM. Sleep patterns of college students at a public university. *J Am Coll Health.* 2008;56(5):563–565.
40. Kabrita CS, Hajjar-Muca TA, Duffy JF. Predictors of poor sleep quality among Lebanese university students: association between evening typology, lifestyle behaviors, and sleep habits. *Nat Sci Sleep.* 2014;6:11–18.
41. Ban DJ, Lee TJ. Sleep duration, subjective sleep disturbances and associated factors among university students in Korea. *J Korean Med Sci.* 2001;16(4):475–480.
42. Fakhari A, Kheradmand N, Dolatkhah N. Sleep duration the night before an exam and its relationship to students' exam scores. *Brit J Med Medical Res.* 2016;15:1–6.
43. Cai H, Shu XO, Xiang YB, et al. Sleep duration and mortality: a prospective study of 113 138 middle-aged and elderly Chinese men and women. *Sleep.* 2015;38(4):529–536.
44. Webb E, Ashton CH, Kelly P, Kamali F. Alcohol and drug use in UK university students. *Lancet.* 1996;348(9032):922–925.
45. Veldi M, Aluoja A, Vasar V. Sleep quality and more common sleep-related problems in medical students. *Sleep Med.* 2005;6(3):269–275.
46. Taylor DJ, Bramoweth AD. Patterns and consequences of inadequate sleep in college students: substance use and motor vehicle accidents. *J Adolesc Health.* 2010;46(6):610–612.
47. Waqas A, Khan S, Sharif W, Khalid U, Ali A. Association of academic stress with sleeping difficulties in medical students of a Pakistani medical school: a cross sectional survey. *PeerJ.* 2015;3:e840.
48. Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Acad Med.* 2006;81(4):354–373.
49. Tsai LL, Li SP. Sleep patterns in college students: gender and grade differences. *J Psychosom Res.* 2004;56(2):231–237.
50. Hershner SD, Chervin RD. Causes and consequences of sleepiness among college students. *Nat Sci Sleep.* 2014;6:73–84.
51. Ohayon MM, Zulley J. Correlates of global sleep dissatisfaction in the German population. *Sleep.* 2001;24(7):780–787.
52. Buboltz WC Jr, Brown F, Soper B. Sleep habits and patterns of college students: a preliminary study. *J Am Coll Health.* 2001;50(3):131–135.
53. Mirghani HO, Mohammed OS, Almurtadha YM, Ahmed MS. Good sleep quality is associated with better academic performance among Sudanese medical students. *BMC Res Notes.* 2015;8:706.
54. Hicks RA, Fernandez C, Pellegrini RJ. The changing sleep habits of university students: an update. *Percept Mot Skills.* 2001;93(3):648.
55. Winsper C, Ganapathy R, Marwaha S, Large M, Birchwood M, Singh SP. A systematic review and meta-regression analysis of aggression during the first episode of psychosis. *Acta Psychiatr Scand.* 2013;128(6):413–421.
56. Long J, Huang G, Liang W, et al. The prevalence of schizophrenia in mainland China: evidence from epidemiological surveys. *Acta Psychiatr Scand.* 2014;130(4):244–256.
57. Xue SP, Fu JC. Investigation on sleep quality and sleep regularity of college students in Inner [in Chinese]. *Chinese Journal of Nervous and Mental Diseases.* 1998:49–50.
58. Yang CM, Wu CH, Hsieh MH, Liu MH, Lu FH. Coping with sleep disturbances among young adults: a survey of first-year college students in Taiwan. *Behav Med.* 2003;29(3):133–138.
59. Duan QB. Investigation and analysis of life style and health condition of students of chengdu information engineering institute [in Chinese]. *Journal of Beijing University of Physical Education.* 2004;27:1480–1481.
60. Cheng P. Investigation on sleep, breakfast and early intention of college students in Guangdong Province. *Continuing Education Research.* 2004:106–108.
61. Ma HL. Analysis of sleep status and influencing factors of 1128 medical students [in Chinese]. *Chinese Journal of Health Statistics.* 2005;22:424–425.
62. Chen W, Shen YT. Investigation on sleep status of college and high school students [in Chinese]. *Zhonghua Yu Fang Yi Xue Za Zhi.* 2005;39(1):48–50.
63. Xiao Q, Zhang XY. Sleep quality of the students of military medical school [in Chinese]. *Chinese Mental Health Journal.* 2005;19:61–63.
64. Yang K. The associations of self-reported sleep time, nap, height, weight and physical and mental state with cognition in Chinese college students [in Chinese]. Paper presented at: 4th Annual Conference of the Chinese Sleep Research Association; 2006; Guangxi, China.
65. Zhang YX. The relativity research of university students' sleep method and physical endowment health in the school in Jiangsu [in Chinese]. *Journal of Nanjing Institute of Physical Education.* 2006;20:15–18.
66. Yang JW, Li SR. Investigation on the current situation of study and sleep time of primary and middle school students in Jiangsu Province [in Chinese]. *Chinese Journal of School Doctor.* 2007;21:379–381.
67. Zhou JF, Zong ZH. Survey on health and health-related behaviors among college freshmen in Nanjing [in Chinese]. *Modern Preventive Medicine.* 2007;34:1403–1406.
68. Shao YS, Xiao Q. A survey on sleep conditions and attitudes of college students in Wuhan City [in Chinese]. *Chinese Journal of Rehabilitation.* 2007:15–17.
69. Pan JJ, Tan XD. Survey of sleeping quality and relevant influencing factors in college students [in Chinese]. *China Tropical Medicine.* 2007;7:845–847.
70. Wang FC, Yuan KQ. The analysis of the related influencing factors of the college students' sleeping quality in Henan Province [in Chinese]. *Fujian Sports Science and Technology.* 2007;26:50–55.
71. Chen YH. Correlates of sleep quality, stress and coping style in nursing undergraduates [in Chinese] [master's thesis]. Guangdong, China: Sun Yat-sen University; 2008.
72. Suen LK, Hon KL, Tam WW. Association between sleep behavior and sleep-related factors among university students in Hong Kong. *Chronobiol Int.* 2008;25(5):760–775.
73. Tsui YY, Wing YK. A study on the sleep patterns and problems of university business students in Hong Kong. *J Am Coll Health.* 2009;58(2):167–176.
74. Ma YH. Investigation of health risk behavior among college students in Zhejiang and Guangxi areas [in Chinese]. *Chinese Journal of Health Education.* 2009;25:890–893.
75. Kang JH, Chen SC. Effects of an irregular bedtime schedule on sleep quality, daytime sleepiness, and fatigue among university students in Taiwan. *BMC Public Health.* 2009;9:248.
76. Li MJ. Survey of Medical students' sleep [in Chinese]. *China Higher Medical Education.* 2009:70–71.
77. Gao L. Stressor to sleep quality in college students with intention to take postgraduate entrance examination [in Chinese]. *Chinese Journal of School Doctor.* 2009;23:44–45.
78. Xu XY, Ling D. Analysis of the detection rate and correlation factors of prehypertension in college students [in Chinese]. *Modern Preventive Medicine.* 2010;37:3401–3409.
79. Sing CY, Wong WS. Prevalence of insomnia and its psychosocial correlates among college students in Hong Kong. *J Am Coll Health.* 2010;59(3):174–182.
80. Xue L. Quality of life and its contributing factors in medical students in Anhui Province [in Chinese] [master's thesis]. Anhui, China: Anhui Medical University; 2011.
81. Jiang DX. Correlation analysis of sub-health status and health-related risk behaviors in college students [in Chinese]. *Journal of Southern Medical University.* 2011;31:61–64.
82. Zhang SL. Investigation and analysis on sleep quality of grade students in Guangdong Pharmaceutical College [in Chinese]. *China Foreign Medical Treatment.* 2011;27:33–34.
83. Mao SF. Investigation on students' physical fitness and life style in ethnic minority university students in Xinjiang [in Chinese] [master's thesis]. Hebei, China: Hebei Normal University; 2011.
84. Lu J. A study on sleep quality, personality types and anxiety and depression in Shihezi [in Chinese]. *Journal of Nongken Medicine.* 2012;34:366–368.
85. Jin XM, Li XM. Study on sleep quality of college students [in Chinese]. *Chinese Nursing Research.* 2012:17–21.
86. Zhang R, Wang YL. Research of contemporary college students' sleep quality and physical health. *Journal of Jiangsu Teachers University of Technology.* 2012;18:83–86.
87. Luo CH, Fan CX, Tian H. Relationship between fatigue and lifestyle and emotion management ability among university students [in Chinese]. *Chinese Journal of School Health.* 2012;33:1102–1104.

88. Zhang L. Studying on the symptoms and risk behaviors of sub-health among college students in Chongqing [in Chinese]. *Chinese Health Service Management.* 2012;2:145–147.
89. Zhang XY. Self-rated health status of college students in Tianjin and the contributing factors [in Chinese] [master's thesis]. Tianjin, China: Tianjin Medical University; 2009.
90. Zhang FL, Zhang TC. Survery on nutritional status and daily life style of college students in Xiangxi area [in Chinese]. *Chinese Journal of Health Education.* 2012;28:198–200.
91. Xie HC, Shi LQ, Shi XF. Analysis on health-related behavior of college students of traditional Chinese medicine Beijing University. *Journal of Traditional Chinese Medicine Management.* 2012;20:956–959.
92. Cheng SH, Shih CC, Lee IH, et al. A study on the sleep quality of incoming university students. *Psychiatry Res.* 2012;197(3):270–274.
93. Yu QC, Ma WJ. Effects of late exercise on sleep quality of college students [in Chinese]. *Chinese Journal of Preventive Medicine.* 2013;47:542–546.
94. Zhou W, Wang Z. Investigation about sleep situations of undergraduate students. *Modern Preventive Medicine.* 2013;40:1–4.
95. Shi SS. Lifestyle and physical fitness in college students in Xi'an [in Chinese] [master's thesis]. Shanxi, China: Xi'an Physical Education University; 2013.
96. Li DF. Survey of sleep status of female medical students in a higher vocational school and related factors [in Chinese]. *Chinese Journal of Woman and Child Health Research.* 2013;24:516–519.
97. Lin HY. The investigation the statues of fatigue in medical college students and the influencing factors [in Chinese]. *Journal of Changzhi Medical College.* 2013;27:175–177.
98. Li J. Sleep quality of higher vocational college students and relevant factors [in Chinese] [master's thesis]. Anhui, China: Anhui Medical University; 2013.
99. Wong ML, Lau EY, Wan JH, Cheung SF, Hui CH, Mok DS. The interplay between sleep and mood in predicting academic functioning, physical health and psychological health: a longitudinal study. *J Psychosom Res.* 2013;74(4):271–277.
100. Zuo GW, Liang LX. Prevalence and risk factors for functional dyspepsia in university students in Nanning. *World Chinese Journal of Digestology.* 2014;22:263–267.
101. Jin Y, Ding Z, Fei Y, et al. Social relationships play a role in sleep status in Chinese undergraduate students. *Psychiatry Res.* 2014;220(1-2):631–638.
102. Ni J, Wang Q. Tracing research on sub-health situation of some students in university [in Chinese]. *Journal of Jianghan University (Natural Science Edition).* 2014;42:67–73.
103. Zhang YY. Morning and evening jogging and primary sleep disorders in college students [in Chinese] [master's thesis]. Henan, China: Henan University; 2014.
104. Huang XH. Analysis of the causes of sleep disorders in college students and the countermeasures [in Chinese]. *Youth and Society.* 2014;3:61–62.
105. Cai HY. Investigation of the influence of network on college students' sleep quality [in Chinese]. *World Journal of Sleep Medicine.* 2014;1:358–361.
106. Chen Y, Li B. A study on the effects of day and night preference on sleep health and the countermeasures - based on the questionnaire survey of Tianjin college students. *Education and Talent.* 2014:88–90.
107. Chen WJ. Investigation and analysis on health behavior of college students in Guangdong Province [in Chinese]. *Med Educ.* 2015:275–276.
108. Chen Q. Investigation on status quo about health-related behaviors of 439 medical students [in Chinese]. *Health Education and Health Promotion.* 2015;10:36–39.
109. Shen JB. The effect of reasonable sleep on the physical constitution of college students [in Chinese]. *Martial Arts Science.* 2015;12:125–128.
110. Qian YK, Li TZ, Wu TD, Wu XJ. Anxiety of college students in Xuzhou and its influencing factors [in Chinese]. *Jiangsu Journal of Preventive Medicine.* 2015;26:127–129.
111. Li M. Comparison of sleep status among college students with and without social anxiety [in Chinese]. *Medical Journal of Chinese People's Health.* 2015;27:81–82.
112. Wang L, Qin P, Zhao Y, et al. Prevalence and risk factors of poor sleep quality among inner Mongolia medical university students: a cross-sectional survey. *Psychiatry Res.* 2016;244:243–248.

SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication March 10, 2017
Submitted in final revised form June 28, 2017
Accepted for publication July 6, 2017
Address correspondence to: Dr. Yu-Tao Xiang, 3/F, Building E12, Faculty of Health Sciences, University of Macau, Avenida da Universidade, Taipa, Macau SAR, China; Tel: +853-8822-4223; Fax: +853-2288-2314; Email: xyutly@gmail.com
or Dr. Fu-Jun Jia, Guang Dong Mental Health Centre, Guangdong province, China; Email: jiafujun@126.com

DISCLOSURE STATEMENT

The study was supported by the University of Macau (SRG2014-00019-FHS; MYRG2015-00230-FHS; MYRG2016-00005-FHS). The University of Macau had no role in the study design, generating or interpreting the results, or publication of the study. All authors have seen and approved the manuscript. The authors report no conflicts of interest in regard to conducting this study and preparing the manuscript.