



## Sleep duration and self-rated health in Chinese university students

Lu Li<sup>1,2</sup> · Ka-In Lok<sup>2,3</sup> · Song-Li Mei<sup>4</sup> · Xi-Ling Cui<sup>5</sup> · Lin Li<sup>6</sup> · Chee H. Ng<sup>7</sup> · Gabor S. Ungvari<sup>8,9</sup> · Yu-Ping Ning<sup>1</sup> · Feng-Rong An<sup>10</sup> · Yu-Tao Xiang<sup>2</sup>

Received: 10 January 2019 / Revised: 17 April 2019 / Accepted: 23 April 2019 / Published online: 31 May 2019  
© Springer Nature Switzerland AG 2019

### Abstract

**Purpose** Little is known about the association between sleep duration and health status in Chinese university students. This study examined the association between sleep duration and self-rated health in university students in China.

**Methods** Altogether, 2312 subjects (928 in Macao, 446 in Hong Kong, and 938 in mainland China) were recruited. Standardized measures of sleep and self-reported health were administered. Sleep duration was categorized in the following way: < 6 h/day, 6 to < 7 h/day, 7–9 h/day, and > 9 h/day.

**Results** Overall, 71% of university students reported poor health, 53% slept 7–9 h/day, 14% slept less than 6 h/day, 32% slept 6 to < 7 h/day, and 1% slept > 9 h/day. Univariate analysis revealed that compared to students with medium sleep duration (7–9 h/day), those with short sleep duration (< 6 h/day and 6 to < 7 h/day) were more likely to report poor health. Multivariate logistic regression analysis found that after controlling for age, gender, body mass index, university location, being a single child, religious beliefs, interest in academic major, academic pressure, nursing major, pessimism about the future, and depression, sleep duration of less than 6 h/day (odds ratio (OR) 1.98, 95% confidence interval (CI) 1.34–2.92,  $p < 0.01$ ) was independently and significantly associated with poor self-reported health.

**Conclusions** Poor health status is common in Chinese university students, which appears to be closely associated with short sleep duration. Further longitudinal studies are warranted to gain a better understanding of the interaction between sleep patterns and health status in university students.

**Keywords** Sleep duration · Self-rated health · University students · China

---

Lu Li, Ka-In Lok, Song-Li Mei and Xi-Ling Cui contributed equally to this work.

---

✉ Feng-Rong An  
afrylm@sina.com

✉ Yu-Tao Xiang  
xyutly@gmail.com

<sup>1</sup> The Affiliated Brain Hospital of Guangzhou Medical University (Guangzhou Huai Hospital), Guangzhou, China

<sup>2</sup> Unit of Psychiatry, Institute of Translational Medicine, Faculty of Health Sciences, University of Macau, 3/F, Building E12, Avenida da Universidade, Taipa SAR, Macau, China

<sup>3</sup> Kiang Wu Nursing College of Macau, Macao, SRA, China

<sup>4</sup> School of Public Health, Jilin University, Changchun, China

<sup>5</sup> Department of Business Administration, Hong Kong Shue Yan University, Hong Kong, SAR, China

<sup>6</sup> Department of Pharmacy, The First Affiliated Hospital of Zhejiang University, Hangzhou, China

<sup>7</sup> Department of Psychiatry, University of Melbourne, Melbourne, Victoria, Australia

<sup>8</sup> University of Notre Dame Australia, Perth, Australia

<sup>9</sup> Division of Psychiatry, University of Western Australia School of Medicine, Perth, Australia

<sup>10</sup> The National Clinical Research Center for Mental Disorders & Beijing Key Laboratory of Mental Disorders, Beijing Anding Hospital & the Advanced Innovation Center for Human Brain Protection, Capital Medical University, Beijing, China

## Background

The association between sleep duration and health status is well recognized. Both short and long sleep duration are associated with negative health outcomes, such as cardiovascular events [1], hypertension, diabetes [2], obesity [3], metabolic syndrome [4], psychological and behavioral problems [5], and even increased mortality [6].

Self-rated health (SRH) is based on standardized questions asking individuals to evaluate their general health status. It is considered to be a simple but accurate reflection of a person's objective health status with satisfactory psychometric properties [7–9].

The impact of sleep duration on SRH has been studied mostly in middle-aged and older adults in Western countries [6, 10] and has shown mixed results [11]. For example, in a US study involving 1139 older adults (aged  $\geq 75$ ), longer sleep duration significantly predicted poor SRH [12]. In another US study of 20,663 adults, compared to those with medium sleep duration (7 h/day), those with short or long sleep duration were more likely to report poor health [9]. A study of 63,408 Australian adults found that short sleep (< 6 h/day) and long sleep ( $\geq 9$  h/day) duration were associated with poor SRH in those aged 45–74 years, while only long sleep duration ( $\geq 9$  h/day) was associated with poor SRH in adults aged  $\geq 75$  years [13].

Adequate sleep duration varies with age; for example, 8–10 h/day is considered adequate for teenagers, while 7–9 h/day is adequate for young adults (18–25 years) and adults (26–64 years), and 7–8 h/day for older adults ( $\geq 65$  years) [14]. Given the different sleep patterns across the life span, the association between sleep pattern and SRH needs to be explored in different age groups separately. To date, relatively few studies have examined the association between sleep duration and SRH in young adults. One study involving 689 young adults in Croatia [15] found that both short sleep (< 7 h/day) and long sleep ( $> 10$  h/day) duration were less likely to have good SRH. Another large study of 17,465 university students across 24 countries [16] found that those who slept less than 7 h/day were more likely to report poor health, while no significant association was found between long sleep duration and poor SRH.

Emerging evidence shows that socio-cultural, economic, and ethnic factors may significantly influence sleep patterns including short and long sleep duration [17–19]. Therefore, the association between sleep duration and SRH needs to be studied across different cultures. To date, little is known about the association between sleep duration and SRH in young Chinese adults. As this population is transitioning from adolescence to adulthood, university students experience many challenges, such as leaving home and coping with high academic pressures, all of which could increase the risk of sleep problems. Thus, this study examined the independent association between sleep duration and SRH in university students in China.

## Methods

### Study setting and participants

This study was conducted in two universities in Macao (University of Macau and Kiang Wu Nursing College of Macau), one university in Hong Kong (Hong Kong Shue Yan University), and two universities in mainland China (Jilin University and Beijing Union Nursing University) between June and December 2016. According to the number of students in each participating university, 1 to 5 residential colleges or grades in each university were randomly selected: 2 residential colleges in University of Macau, 4 grades in Kiang Wu Nursing College of Macau, 4 grades in Hong Kong Shue Yan University, 1 college in Jilin University, and 5 grades in Beijing Union Nursing University. All students in the selected colleges or grades were invited to take part in the survey which was completed anonymously and confidentially. Subjects who agreed to participate were given the study questionnaires and were asked to return the completed questionnaires within a week on a voluntary basis. The included subjects were (1) students aged 18 years and above, (2) fluent in Chinese language (Cantonese or Mandarin), and (3) able to provide written consent and complete the interview. There were no exclusion criteria in this study. Following other studies [20–22], at least 2500 students were invited to participate in this study.

### Assessment instruments and evaluation

A data collection sheet was designed to record basic demographic characteristics. Following other studies, SRH was assessed with a standardized question [9, 13]: “How would you perceive your health status?” with three options (“good,” “fair,” or “bad”). Those who answered “bad” or “fair” were classified as having poor SRH.

Sleep duration was measured using the following question: “On average, how many hours do you sleep per day in last month?” [15, 16]. According to previous studies [14], 7–9 h/day was considered adequate sleep duration for university students. Participants' responses were classified into four groups: < 6 h/day, 6 to < 7 h/day, 7–9 h/day, and  $> 9$  h/day. The presence and severity of depressive symptoms were measured with the Beck Depression Inventory (BDI-II) [23]. A higher total score indicates more severe depressive symptoms. In this study, a total BDI score  $\geq 14$  points indicated moderate-severe depressive symptoms (depression hereafter) [24].

The study protocol was approved by the Clinical Research Ethics Committee of the University of Macao. All participants provided written informed consent.

## Statistical analysis

Data analyses were performed using SPSS, Version 21.0 (Statistical Package for the Social Sciences, Chicago, Illinois, USA) for Windows. Comparison between students with good and poor SRH in terms of socio-demographic and clinical characteristics was conducted using the independent sample *t*-test and chi-square test, as appropriate. Multiple logistic regression analysis with the “enter” method was performed to determine the independent relationships between the SRH status and sleep

duration; 7–9 h/day was set as the reference group for sleep duration. Two models were conducted. In model 1, the odds ratios (ORs) were calculated for the association between sleep duration and SRH. In model 2, the independent association (adjusted OR) between sleep duration and SRH was calculated after controlling the confounders, including age, gender, body mass index (BMI), being a single child, university location, academic pressure, nursing major, interest in academic major, religious beliefs, pessimistic perspective, and depression. Significance level was set as 0.05 (two-sided).

**Table 1** Characteristics of study participants

| Study variables                      | Total (n = 2312) |        | Poor (n = 1650) |        | Good (n = 662) |        |
|--------------------------------------|------------------|--------|-----------------|--------|----------------|--------|
|                                      | N                | %      | N               | %      | N              | %      |
| <b>Sleep duration***</b>             |                  |        |                 |        |                |        |
| < 6 h                                | 338              | 14.60% | 292             | 17.70% | 45             | 6.87%  |
| 6 to < 7 h                           | 735              | 31.79% | 537             | 32.54% | 198            | 29.92% |
| 7–9 h                                | 1221             | 52.82% | 809             | 49.03% | 412            | 62.29% |
| > 9 h                                | 18               | 0.79%  | 12              | 0.73%  | 6              | 0.92%  |
| <b>University location***</b>        |                  |        |                 |        |                |        |
| Mainland China                       | 938              | 40.57% | 571             | 34.61% | 367            | 55.43% |
| Macao                                | 928              | 40.14% | 722             | 43.76% | 206            | 31.12% |
| Hong Kong                            | 446              | 19.29% | 357             | 21.64% | 89             | 13.44% |
| <b>Gender*</b>                       |                  |        |                 |        |                |        |
| Male                                 | 592              | 25.61% | 402             | 24.36% | 190            | 28.70% |
| Female                               | 1720             | 74.39% | 1248            | 75.64% | 472            | 71.30% |
| <b>Single child***</b>               |                  |        |                 |        |                |        |
| Yes                                  | 1295             | 56.01% | 983             | 59.58% | 312            | 47.13% |
| No                                   | 1017             | 43.99% | 667             | 40.42% | 350            | 52.87% |
| <b>Religious beliefs</b>             |                  |        |                 |        |                |        |
| Yes                                  | 317              | 13.71% | 221             | 13.39% | 96             | 14.51% |
| No                                   | 1995             | 86.29% | 1429            | 86.61% | 566            | 85.52% |
| <b>Interest in academic major***</b> |                  |        |                 |        |                |        |
| Yes                                  | 1105             | 47.79% | 710             | 43.03% | 395            | 59.67% |
| No                                   | 1207             | 52.21% | 940             | 56.97% | 267            | 40.33% |
| <b>Academic pressure***</b>          |                  |        |                 |        |                |        |
| Much pressure                        | 607              | 26.25% | 485             | 29.39% | 122            | 18.48% |
| Little or none                       | 1705             | 73.75% | 1165            | 70.61% | 540            | 81.55% |
| <b>Nursing students</b>              |                  |        |                 |        |                |        |
| Yes                                  | 478              | 20.67% | 358             | 21.70% | 120            | 18.13% |
| No                                   | 1834             | 79.33% | 1292            | 78.30% | 542            | 81.87% |
| <b>Perspective on future***</b>      |                  |        |                 |        |                |        |
| Pessimistic                          | 1445             | 62.50% | 1162            | 70.42% | 283            | 42.76% |
| Optimistic                           | 867              | 37.50% | 488             | 29.58% | 379            | 57.27% |
| <b>Depression***</b>                 |                  |        |                 |        |                |        |
| Yes                                  | 668              | 28.9%  | 588             | 35.64% | 80             | 12.08% |
| No                                   | 1644             | 71.1%  | 1062            | 64.36% | 582            | 87.91% |
|                                      |                  |        |                 |        |                |        |
| Age***                               | 20.26            | 1.6    | 20.33           | 1.6    | 20.07          | 1.59   |
| BMI                                  | 20.64            | 3.2    | 20.64           | 3.36   | 20.64          | 2.76   |

BMI body mass index

\**P* < 0.05; \*\**P* < 0.01; \*\*\**P* < 0.001

## Results

Of the 2523 students invited (University of Macau:  $n = 724$ ; Kiang Wu Nursing College of Macau:  $n = 266$ ; Hong Kong Shue Yan University:  $n = 463$ ; Jilin University:  $n = 800$ ; Beijing Union Nursing University:  $n = 270$ ), 2334 students agreed to participate in the study, giving a response rate of 92.5%. Twenty-two questionnaires were not completed and hence were not included for analyses. There was no significant difference between those who agreed and those who refused to participate in terms of gender and age. Seventy-one percent of the participants had poor SRH, while 53% slept 7–9 h/day, 14% slept less than 6 h/day, 32% slept 6 to < 7 h/day, and 1% slept > 9 h/day.

Table 1 shows the basic demographic and clinical characteristics of the whole sample and also separately by SRH. Table 2 shows the association between sleep duration and SRH. In model 1, univariate logistic regression analyses

revealed that students sleeping less than 6 h/day (OR 3.27, 95% confidence interval (CI) 2.34–4.58,  $P < 0.001$ ) and 6 to < 7 h/day (OR 1.38, 95% CI 1.12–1.69,  $P = 0.002$ ) were more likely to have poor SRH. After controlling for covariates, only sleep duration of less than 6 h/day (OR 1.98, 95% CI 1.34–2.92,  $p < 0.01$ ) was independently and significantly associated with poor SRH in model 2.

## Discussion

To the best of our knowledge, this was the first study that examined the association between sleep duration and SRH in Chinese university students. In this study, 71% of university students reported poor health, which is higher than the figure reported (14.7%) in a US survey of 20,663 participants aged  $\geq 18$  years using the same measure [9]. Further, the U-shaped association

**Table 2** Odds ratios for poor self-rated health among study participants ( $n = 2312$ )

| Study variables            |                       | Model 1<br>OR (95% CI) | Model 2<br>OR (95% CI) |
|----------------------------|-----------------------|------------------------|------------------------|
| Sleep duration             | < 6 h                 | 3.27*** (2.34–4.58)    | 1.98** (1.34–2.92)     |
|                            | 6 to < 7 h            | 1.38** (1.12–1.69)     | 1.18 (0.94–1.49)       |
|                            | 7–9 h (Ref.)          | 1.0                    | 1.0                    |
|                            | > 9 h                 | 1.02 (0.38–2.73)       | 0.63 (0.22–1.82)       |
| University location        | Mainland China (Ref.) |                        | 1.0                    |
|                            | Macao                 |                        | 2.36*** (1.85–3.01)    |
|                            | Hong Kong             |                        | 1.50* (1.08–2.09)      |
| Gender                     | Female (Ref.)         |                        | 1.0                    |
|                            | Male                  |                        | 0.73* (0.57–0.94)      |
| Single child               | No (Ref.)             |                        | 1.0                    |
|                            | Yes                   |                        | 1.23 (0.99–1.51)       |
| Religious beliefs          | No (Ref.)             |                        | 1.0                    |
|                            | Yes                   |                        | 0.82 (0.61–1.11)       |
| Interest in academic major | No (Ref.)             |                        | 1.0                    |
|                            | Yes                   |                        | 0.67** (0.54–0.84)     |
| Academic pressure          | Little or none (Ref.) |                        | 1.0                    |
|                            | Much stress           |                        | 1.30* (1.007–1.70)     |
| Nursing students           | No (Ref.)             |                        | 1.0                    |
|                            | Yes                   |                        | 1.49*** (1.13–1.96)    |
| Perspective on future      | Pessimistic (Ref.)    |                        | 1.0                    |
|                            | Optimistic            |                        | 0.33*** (0.26–0.41)    |
| Depression***              | No (Ref.)             |                        | 2.74*** (2.04–3.67)    |
|                            | Yes                   |                        |                        |
| Age                        |                       |                        | 1.09** (1.02–1.17)     |
| BMI                        |                       |                        | 1.02 (0.99–1.05)       |

BMI body mass index, CI confidence interval, Ref reference category in logistic regression analysis

Model 1: associations between sleep duration and self-rated health

Model 2: associations between sleep duration and self-rated health adjusted for age, BMI, gender, being a single child, religious beliefs, university location, interest in academic major, academic pressure, nursing major, perspective on future and depression

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$

between sleep duration and health was not evident in our analyses; i.e., compared to subjects with sleep duration of 7–9 h/day, those with less than 6 h/day were more likely to have poor SRH, but longer sleep duration was not associated with poor SRH.

Although the direction of association between sleep duration and SRH could not be established due to the cross-sectional study design, it is likely that the relationship is bi-directional. Poor SRH could be determined by short sleep duration; for example, those with short sleep duration are more likely to encounter fatigue and disrupted restorative sleep-related biological processes [25]. Short sleep duration appears not only to increase the risk of mortality [6], but also has the negative effects on endocrine functions [26], immune system [27], blood glucose regulation [28], and mood and cognitive functions [29]. In contrast, poor health could also lead to short or long sleep duration [30]. However, this is less likely in this study since university students are less likely to have medical conditions. In addition, previous studies have also found that the association between short sleep duration and poor SRH could be mediated by other factors [31], such as BMI [32], lack of physical exercise [17], mental health problems [13], alcohol consumption, and smoking.

The association between sleep duration and SRH is inconsistent in the literature. For example, a US study involving 20,663 adults found short ( $\leq 5$  h/day and  $\leq 6$  h/day) and long ( $\geq 8$  h/day and  $\geq 9$  h/day) sleep duration were associated with poor SRH [9]. A Korean general population study involving 15,252 subjects also found that both short ( $\leq 5$  h/day) and long ( $\geq 9$  h/day) sleep duration were associated with poor SRH [33]. However, a study involving 1139 older adults (aged  $\geq 75$  years) found that longer sleep duration was associated with poor SRH [12], but no significant association was found between long sleep duration and poor SRH in a study of young adults [16]. In a study of 17,465 university students across 24 countries, only short duration ( $> 6$  h/day and 6–7 h/day) was associated with poor health status, but no association between long sleep duration and poor health status was found. The inconsistent results are probably due to the different patterns affecting the different ages of the participants; i.e., the risk of functional limitations and medical comorbidities increases with age. In younger adults, there is likely to be a lack of an association between long sleep duration and poor SRH as found in this study [31].

The strengths of this study include the large sample size, multi-center design, use of standardized instruments, and multivariate analyses. However, there are several limitations. First, the causality between sleep duration and SRH could not be examined due to the cross-sectional design. Second, the information was self-reported, which may bias the findings to an unknown extent. Third, data on relevant factors, such as smoking, alcohol consumption, and physical activity were not collected. Finally, napping was not assessed or implied in the question about sleep duration.

In conclusion, poor SRH is common among university students in China, which appears to be closely associated with short sleep duration. Further longitudinal studies are warranted to gain a better understanding of the interaction between sleep patterns and health status in university students.

**Funding** The study was funded by the University of Macau (MYRG2015-00230-FHS; MYRG2016-00005-FHS), the National Key Research & Development Program of China (No. 2016YFC1307200), the Beijing Municipal Administration of Hospitals Incubating Program (No. PX2016028), and the Beijing Municipal Administration of Hospitals' Ascent Plan (No. DFL20151801).

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

## References

1. Krittawong C, Tunhasiriwet A, Wang Z, Zhang H, Farrell AM, Chirapongsathorn S, Sun T, Kitai T, Argulian E (2017) Association between short and long sleep durations and cardiovascular outcomes: a systematic review and meta-analysis. *Eur Heart J Acute Cardiovasc Care*:2048872617741733
2. Buxton OM, Marcelli E (2010) Short and long sleep are positively associated with obesity, diabetes, hypertension, and cardiovascular disease among adults in the United States. *Soc Sci Med* 71:1027–1036
3. Patel SR, Hu FB (2008) Short sleep duration and weight gain: a systematic review. *Obesity (Silver Spring)* 16:643–653
4. Iftikhar IH, Donley MA, Mindel J, Pleister A, Soriano S, Magalang UJ (2015) Sleep duration and metabolic syndrome. An updated dose-risk meta-analysis. *Ann Am Thorac Soc* 12:1364–1372
5. Zhai L, Zhang H, Zhang D (2015) Sleep duration and depression among adults: a meta-analysis of prospective studies. *Depress Anxiety* 32:664–670
6. da Silva AA, de Mello RG, Schaan CW, Fuchs FD, Redline S, Fuchs SC (2016) Sleep duration and mortality in the elderly: a systematic review with meta-analysis. *BMJ Open* 6:e008119
7. Crossley TF, Kennedy S (2002) The reliability of self-assessed health status. *J Health Econ* 21:643–658
8. Geiger SD, Sabanayagam C, Shankar A (2012) The relationship between insufficient sleep and self-rated health in a nationally representative sample. *J Environ Public Health*:518263
9. Shankar A, Charumathi S, Kalidindi S (2011) Sleep duration and self-rated health: the national health interview survey 2008. *Sleep* 34:1173–1177
10. Mossey JM, Shapiro E (1982) Self-rated health: a predictor of mortality among the elderly. *Am J Public Health* 72:800–808
11. Frange C, de Queiroz SS, da Silva Prado JM, Tufik S, de Mello MT (2014) The impact of sleep duration on self-rated health. *Sleep Sci* 7:107–113

12. Chasens ER, Yang K, Baniak LM, Choi J, Imes CC (2018) Sleep and other correlates of high-level health in older adults. *Geriatr Nurs* 39:344–349
13. Magee CA, Caputi P, Iverson DC (2011) Relationships between self-rated health, quality of life and sleep duration in middle aged and elderly Australians. *Sleep Med* 12:346–350
14. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L, Hazen N, Herman J, Katz ES, Kheirandish-Gozal L, Neubauer DN, O'Donnell AE, Ohayon M, Peever J, Rawding R, Sachdeva RC, Setters B, Vitiello MV, Ware JC, Adams Hillard PJ (2015) National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep Health* 1:40–43
15. Stefan L, Jurank D, Prosoli R, Baric R, Sporis G (2017) Self-reported sleep duration and self-rated health in young adults. *J Clin Sleep Med* 13:899–904
16. Steptoe A, Peacey V, Wardle J (2006) Sleep duration and health in young adults. *Arch Intern Med* 166:1689–1692
17. Stranges S, Dorn JM, Shipley MJ, Kandala NB, Trevisan M, Miller MA, Donahue RP, Hovey KM, Ferrie JE, Marmot MG, Cappuccio FP (2008) 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* 168:1353–1364
18. Bin YS, Marshall NS, Glozier N (2012) Secular trends in adult sleep duration: a systematic review. *Sleep Med Rev* 16:223–230
19. Hale L, Do DP (2007) Racial differences in self-reports of sleep duration in a population-based study. *Sleep* 30:1096–1103
20. Yang CM, Wu CH, Hsieh MH, Liu MH, FH. L (2003) Coping with sleep disturbances among young adults: a survey of first-year college students in Taiwan. *Behav Med* 29:133–138
21. Zhang YX (2006) 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* 20:15–18
22. Ma YH (2009) Investigation of health risk behavior among college students in Zhejiang and Guangxi areas [in Chinese]. *Chinese Journal of Health Education* 25:890–893
23. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J (1961) An inventory for measuring depression. *Arch Gen Psychiatry* 4:561–571
24. Pan XF, Wen Y, Zhao Y, Hu JM, Li SQ, Zhang SK, Li XY, Chang H, Xue QP, Zhao ZM, Gu Y, Li CC, Zhang YQ, Sun XW, Yang CX, Fu C (2016) Prevalence of depressive symptoms and its correlates among medical students in China: a national survey in 33 universities. *Psychol Health Med* 21:882–889
25. Goldman SE, Ancoli-Israel S, Boudreau R, Cauley JA, Hall M, Stone KL, Rubin SM, Satterfield S, Simonsick EM, Newman AB (2008) Sleep problems and associated daytime fatigue in community-dwelling older individuals. *J Gerontol A Biol Sci Med Sci* 63:1069–1075
26. Leproult R, Van Cauter E (2010) Role of sleep and sleep loss in hormonal release and metabolism. *Endocr Dev* 17:11–21
27. Suarez EC (2008) Self-reported symptoms of sleep disturbance and inflammation, coagulation, insulin resistance and psychosocial distress: evidence for gender disparity. *Brain Behav Immun* 22:960–968
28. Keckeis M, Lattova Z, Maurovich-Horvat E, Beiting PA, Birkmann S, Lauer CJ, Wetter TC, Wilde-Frenz J, Pollmacher T (2010) Impaired glucose tolerance in sleep disorders. *PLoS One* 5:e9444
29. Hughes AJ, Parminter BA, Haselkorn JK, Lovera JF, Bourdette D, Boudreau E, Cameron MH, Turner AP (2017) Sleep and its associations with perceived and objective cognitive impairment in individuals with multiple sclerosis. *J Sleep Res* 26:428–435
30. Wang S, Li B, Wu Y, Ungvari GS, Ng CH, Fu Y, Kou C, Yu Y, Sun HQ, Xiang YT (2017) Relationship of sleep duration with sociodemographic characteristics, lifestyle, mental health, and chronic diseases in a large Chinese adult population. *J Clin Sleep Med* 13:377–384
31. Alvarez GG, Ayas NT (2004) The impact of daily sleep duration on health: a review of the literature. *Prog Cardiovasc Nurs* 19:56–59
32. Yamada C, Moriyama K, Takahashi E (2012) Self-rated health as a comprehensive indicator of lifestyle-related health status. *Environ Health Prev Med* 17:457–462
33. Kim JH, Kim KR, Cho KH, Yoo KB, Kwon JA, Park EC (2013) The association between sleep duration and self-rated health in the Korean general population. *J Clin Sleep Med* 9:1057–1064

**Publisher's note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.