

# BMJ Open Is sexual minority status associated with poor sleep quality among adolescents? Analysis of a national cross-sectional survey in Chinese adolescents

Pengsheng Li,<sup>1</sup> Yeen Huang,<sup>1</sup> Lan Guo,<sup>1</sup> Wanxin Wang,<sup>1</sup> Chuhao Xi,<sup>1</sup> Yiling Lei,<sup>1</sup> Min Luo,<sup>1</sup> Siyuan Pan,<sup>1</sup> Xueqing Deng,<sup>1,2</sup> Wei-hong Zhang,<sup>3</sup> Ciyong Lu<sup>1,2</sup>

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<sup>1</sup>Department of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou, China

<sup>2</sup>Guangdong Provincial Key Laboratory of Food, Nutrition and Health, Sun Yat-sen University, Guangzhou, China

<sup>3</sup>Epidemiology, Biostatistics and Clinical Research Center, School of Public Health, Université Libre de Bruxelles (ULB), Bruxelles, Belgium

## Correspondence to

Dr Ciyong Lu;  
[luciyong@mail.sysu.edu.cn](mailto:luciyong@mail.sysu.edu.cn)

## ABSTRACT

**Objectives** Recent studies have suggested that sexual minorities are more likely to have poor sleep quality. This study aims to explore sleep quality among sexual minority adolescents and examines the association between sexual minority status and sleep quality.

**Design** Cross-sectional survey.

**Setting** A total of 506 high schools in seven Chinese provinces.

**Participants** A total of 150 822 students in grades 7–12 completed the questionnaires, and 123 459 students who reported being aware of their sexual orientation were included in analyses.

**Main outcome measures** The Pittsburgh Sleep Quality Index, sexual attraction and school bullying victimisation.

**Results** Of the 123 459 students who were analysed, 5.00% self-reported as sexual minorities. Only 26.67% of sexual minority students slept 8 or more hours/day, which is less than their heterosexual peers (35.70%;  $\chi^2=130.04$ ,  $P<0.001$ ). Of the total sample, 22.41% of the students reported poor sleep quality, and this prevalence was significantly higher in sexual minority students than in heterosexual students (32.56% vs 21.87%;  $\chi^2=281.70$ ,  $P<0.001$ ). After controlling for social demographics, lifestyle and depressive symptoms, sexual minority students had higher odds of poor sleep quality (adjusted OR=1.41, 95% CI 1.31 to 1.51) than their heterosexual peers. The indirect effect of school bullying victimisation (standardised  $\beta$  estimate=0.007, 95% CI 0.006 to 0.009) was significant, indicating that school bullying victimisation partially mediated the association between sexual minority status and sleep quality.

**Conclusions** Our study suggested that poor sleep quality was common in sexual minority adolescents, and more attention should be paid to sleep problems in this population. Conducting interventions to reduce school bullying behaviours is an important step to improving sleep quality in sexual minority adolescents. Further, studies are warranted that focus on the risk factors and mechanisms of and interventions for sleep problems in sexual minority adolescents.

## INTRODUCTION

Health disparities exist between sexual minority adolescents (gay, lesbian, bisexual, and so

## Strengths and limitations of this study

- Our study explored the association between sexual minority status and poor sleep quality and the mediating effect of school bullying victimisation on the aforementioned association.
- A large sample rendered sufficient statistical power, and a random sample allowed us to conduct the between-groups analysis.
- Due to the cross-sectional nature of data, it is difficult to make causal inferences.
- In this school-based study, participants who were not included were the adolescents who had dropped out of school or were not present in school on the day the survey was administered.

on) and their heterosexual peers.<sup>1 2</sup> Sexual minority adolescents experience chronic stress from the associated social stigmas such as bullying, violence and discrimination, leading to an increased risk of poor health outcomes.<sup>3 4</sup> Multiple studies have found that sexual minority adolescents have higher rates of depression,<sup>3</sup> substance abuse,<sup>5</sup> suicide<sup>6</sup> and other health problems than heterosexual adolescents.<sup>1 7</sup>

Recently, concern about sleep quality among adolescents has increased. Sleep plays an important role in the development and maintenance of physical and mental health, especially in adolescents. Poor sleep quality increases the risk of mental and physical health consequences in adolescents, such as depression,<sup>8</sup> obesity<sup>9</sup> and substance use.<sup>10</sup> Given that adolescence is a transition period from childhood to adulthood and that adolescents face many social stressors in pubertal development, insufficient sleep and poor sleep quality are common among adolescents.<sup>11</sup> The results from a Youth Risk Behavior Survey (YRBS) conducted between 2007 and 2013 indicated that 65.5%–71.8% of

students reported sleeping 7 or less hours/day.<sup>12</sup> In addition, poor sleep quality is common during this period, accounting for 18%–40% of adolescents.<sup>10–13</sup> Additionally, previous evidence has suggested sexual minorities are more likely to report poor sleep quality; a prior study found that lesbian or bisexual female veterans were twice as likely as heterosexual veterans to have insufficient sleep<sup>14</sup>; a recent study conducted among US adults reported that sexual minorities were more likely to report short sleep duration, waking up at night and other sleep problems.<sup>15</sup> The results of a study conducted in France also found that poor sleep quality and short sleep duration are common among men who have sex with men.<sup>16</sup> However, few studies have been conducted to examine the relationships between sexual minority status and sleep quality among adolescents.

In a negative social climate of same-sex orientation, sexual minority adolescents are more likely to experience minority stress. Meyer's minority stress theory suggested that minority stress, including distal stress processes (such as bullying, discrimination and violence) and proximal stress processes (such as concealment, expectations of rejection and internalised homophobia), provides a framework to explore the health disparities among sexual minorities.<sup>4</sup> In this theory, these stress processes play a mediating role in the association between sexual minority status and health outcomes, such as depression,<sup>17</sup> suicide<sup>3</sup> and psychotic symptoms.<sup>18</sup> Bullying in school is one of the major social stressors for adolescents. Due to homophobia and heterosexism, sexual minority adolescents may suffer more victimisation in school.<sup>19</sup> Fedewa and Ahn<sup>20</sup> reported that compared with their heterosexual peers, sexual minorities are more likely to be involved in school bullying (OR=2.24, 95% CI 1.63 to 3.08). The results from a YRBS conducted between 2009 and 2011 indicated that approximately 6.7%–43.1% of sexual minorities reported different school bullying victimisation experiences.<sup>21</sup> Additionally, previous studies have also shown that bullying is an important risk factor for poor sleep quality among adolescents. Fekkes *et al*<sup>22</sup> found that students who have been bullied were more likely to complain about sleep problems (OR=2.38, 95% CI 1.90 to 2.98). Similarly, Zhou *et al*<sup>23</sup> reported that school bullying is a risk factor for poor sleep quality among Chinese adolescents. Therefore, sexual minority status may be associated with poor sleep quality among adolescents, and the differences in school bullying victimisation were likely to be an important driver of the disparities in sleep quality among sexual minority adolescents.

Under the influence of thousands of years of Confucianism, the attitude towards sexual minorities may be intolerant in Chinese social-cultural contexts.<sup>24</sup> As the core of Confucianism and traditional values, filial piety has an influence on the attitude towards same-sex orientation among Chinese youth,<sup>25</sup> and increases the pressure among sexual minorities.<sup>26</sup> Like their Western counterparts, Chinese sexual minority adolescents suffer from social stressors, such as discrimination, violence and

bullying.<sup>27</sup> Additionally, Chinese sexual minority adolescents are at a higher risk of poor health outcomes, such as suicide,<sup>6</sup> sexually transmitted diseases and substance abuse.<sup>28</sup> However, the information about sleep quality among Chinese sexual minority adolescents is still limited.

Therefore, we hypothesise that sexual minority adolescents may be more likely to report poor sleep quality than their heterosexual peers. Moreover, school bullying victimisation may also mediate the association between sexual minority status and poor sleep quality. To address this concern, we conducted this national probability survey in Chinese adolescents to achieve the following objectives: (1) to estimate the sleep quality in sexual minority adolescents; (2) to explore the association between sexual minority status and poor sleep quality; and (3) to explore the modification effect of school bullying victimisation in the association.

## METHODS

### Participants and procedures

We used the data from the 2015 School-Based Chinese Adolescents Health Survey (SCAHS), which is an ongoing large-scale health-related behaviour survey among Chinese adolescents in grades 7–12. The SCAHS has been conducted every 2 years since 2007,<sup>29,30</sup> and the 2015 survey was the latest version conducted in seven Chinese provinces.<sup>31</sup> This study used a multistage, stratified cluster sampling method to select participants. All 34 province-level regions in China were divided into three stratifications based on economic status. In each stratification, two or three provinces were selected randomly. The final seven provinces included Guangdong, Liaoning, Shandong, Hunan, Shanxi, Chongqing and Guizhou. In each of these seven provinces, cities were divided into three strata based on economic status, and in each stratum, two cities were selected. The local bureau of education provided a list of all schools serving students in grades 7–12 and the information for stratification. All eligible schools in each city were stratified by the type of school (junior high school, senior high school and vocational school) and the size of the school (small, middle and large). In each city, six to seven junior high schools, four to five senior high schools and two to three vocational schools were selected randomly. A total of 506 schools were ultimately selected. In each school, two classes were randomly selected from each grade, and all students in these classes were invited to participate in this study. A total of 150 822 students completed the questionnaires (response rate of 95.93%). Of the total sample, 27 363 (18.14%) students reported unsure sexual attraction. In this study, we were mainly interested in the association between sexual minority status and sleep quality. Thus, to avoid information bias,<sup>32</sup> these students were not included in the analysis. With the help of trained interviewers, each student completed a self-administered questionnaire within one class period. To protect the privacy of students, the questionnaire was completed anonymously and conducted in the absence

of a teacher. All data were collected between November 2014 and January 2015.

### Ethical statement

Each school and each student's parents provided informed consent before participating in this study.

### Measures

#### Sexual minority status

Sexual orientation was measured by asking a question about the students' sexual attraction.<sup>27 33</sup> 'In a romantic relationship, which kind of person are you attracted to?' The responses included 'opposite sex', 'same sex', 'equally opposite and same sex' and 'unsure'. In this study, the students who reported 'same sex' or 'equally opposite and same sex' attraction were classified as being a sexual minority.

#### Sleep quality

The Chinese version of the Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality over the previous month.<sup>34</sup> The PSQI contains seven components (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications and daytime dysfunction), and the score for each component ranges from 0 to 3 points. The global PSQI score ranges from 0 to 21, with higher scores indicating poorer sleep quality.<sup>34</sup> The PSQI has been demonstrated to be valid and reliable in the Chinese population.<sup>35</sup> In the Chinese population, a global PSQI score greater than 7 points indicates poor sleep quality.<sup>35</sup>

#### School bullying victimisation

School bullying victimisation was assessed according to the definition of bullying from the Olweus Bully/Victim Questionnaire.<sup>36 37</sup> After reading the definition of bullying, students were asked to answer the question, 'Have you been bullied at school in the previous month?'. The responses included 'none', '1–2 days', '3–5 days', '6–9 days', '10–19 days' and 'more than 20 times'. The students who reported being bullied with a frequency of 3 days or more were classified as victims.<sup>37 38</sup> Similar questions have been used in other studies among Chinese adolescents.<sup>38 39</sup>

#### Covariates

The social demographics of the students, including gender, age, household socioeconomic status (HSS), living arrangement and parental marital status, were investigated.<sup>10 40–43</sup> HSS was measured by asking about the student's perceptions of his or her household's current socioeconomic status, and responses included 'good', 'average' and 'poor'. Parental marital status was measured by asking about the student's parent's current marital status, and responses included 'harmonious', 'often quarrels' and 'separated or divorced'. Living arrangement was measured by asking who lived in the student's primary home, and responses were divided into 'two biological parents', 'only father or mother' and 'others'. Lifestyle

has also been reported to be associated with school bully victimisation and sleep quality and was thus taken into account.<sup>44–47</sup> Academic pressure was measured by asking about the student's personal appraisal of academic stress, and responses were divided into 'below average', 'average' and 'above average'. Smoking and alcohol use were measured by asking 'Have you smoked one or more cigarettes at least one day during the past month?' and 'Have you drunk at least one glass of alcohol at least one day during the past month?', respectively. Smoking and alcohol use for one or more days in the past month were considered to be current use.<sup>48</sup> Physical activity was measured by asking 'In the past week, how many days have you exercised longer than 60 min (sports such as running, swimming, basketball, and similar activities)?'.<sup>48</sup> The Chinese version of the Depression Self-Rating Scale for Children (DSRSC) was used to identify whether individuals had depressive symptoms.<sup>49 50</sup> The score range of the DSRSC is 0–54, and higher scores indicate more severe depressive symptoms. This scale has been demonstrated to be valid and reliable in the Chinese adolescent population, and DSRSC scores greater than 15 points indicate depressive symptoms.<sup>50</sup>

#### Statistical analysis

In this complex sampling design survey, the analysis accounted for the sampling design and included sampling strata, clusters and weights. The sampling weights were calculated based on gender, type of school and grade. Variance estimation was performed using the Taylor series linearisation. Sexual minority status, school bullying victimisation, poor sleep quality and other covariates were assessed using frequency tables for categorical variables and compared using the Rao-Scott  $\chi^2$  test. PSQI scores were summarised with means and SEs and compared using the t-test. Logistic regression analysis was used to examine the association between sexual minority status and poor sleep quality, and ORs were obtained with 95% CIs to evaluate the increased risk of poor sleep quality. Four sets of logistic regression models were used to evaluate the associations. The initial logistic regression model (model 1) was not adjusted for covariates. Model 2 was adjusted for social demographics and lifestyle variates. Model 3 was further adjusted for depressive symptoms. In model 4, we further adjusted for school bullying victimisation. The variables that were significant at the 0.10 level in the univariate logistic regression or that were widely reported in previous studies were entered into the multivariate logistic regression models (models 2–4). Because PSQI was used to measure sleep quality, to handle potential measuring errors, structural equation modelling (SEM) was performed to measure the mediating effect of school bullying victimisation on the association between sexual minority status and sleep quality. The interaction between sexual minority status and school bullying victimisation was tested before the estimation of mediating effect. In SEM, this part of the analysis also accounts for the sampling design. In this model, as a latent variable,

**Table 1** Characteristics of participants by sexual orientation (n=123 459)

Variates	Total, n (%)	Sexual minorities*, n (%)	Heterosexual, n (%)	$\chi^2$	P
Total	123 459 (100.0)	6685 (5.0)	116 774 (95.0)		
Gender				169.35	<0.001
Boys	59 826 (52.2)	2483 (41.4)	57 343 (52.8)		
Girls	63 633 (47.8)	4202 (58.6)	59 431 (47.2)		
Age (years)				43.44	<0.001
≤13	22 679 (19.4)	1319 (20.7)	21 360 (19.4)		
14–15	40 873 (33.9)	2364 (37.6)	38 509 (33.7)		
16–17	45 082 (33.8)	2387 (32.0)	42 695 (33.8)		
≥18	14 825 (12.9)	615 (9.7)	14 210 (13.1)		
HSS				60.73	<0.001
Good	24 268 (21.9)	1456 (24.2)	22 812 (21.8)		
Average	75 054 (60.9)	3748 (55.4)	71 306 (61.1)		
Poor	24 137 (17.2)	1481 (20.4)	22 656 (17.1)		
Living arrangement				13.31	0.001
Two biological parents	89 210 (74.5)	4669 (72.2)	84 541 (74.6)		
Only father or mother	14 800 (11.2)	903 (12.4)	13 897 (11.1)		
Others	19 449 (14.3)	1113 (15.4)	18 336 (14.3)		
Parental marital status				171.09	<0.001
Harmonious	73 413 (60.5)	3450 (53.1)	69 963 (60.9)		
Often quarrels	40 439 (32.6)	2416 (36)	38 023 (32.4)		
Separated or divorced	9607 (6.9)	819 (10.9)	8788 (6.7)		
Academic pressure				64.22	<0.001
Below average	18 111 (15.0)	1060 (16.1)	17 051 (14.9)		
Average	55 709 (45.7)	2648 (39.9)	53 061 (46.1)		
Above average	49 639 (39.3)	2977 (44)	46 662 (39.0)		
Smoking				10.89	0.001
No	116 144 (93.9)	6190 (92.6)	109 954 (94.0)		
Yes	7315 (6.1)	495 (7.4)	6820 (6.0)		
Alcohol use				121.33	<0.001
No	113 435 (82.6)	5072 (76.6)	96 909 (83.9)		
Yes	10 024 (17.4)	1613 (23.4)	19 865 (16.1)		
Physical activity (days)				24.62	<0.001
0	60 162 (47.5)	3404 (49.1)	56 758 (47.4)		
1–4	54 104 (44.8)	2704 (41.6)	51 400 (45.0)		
≥5	9193 (7.7)	577 (9.3)	8616 (7.6)		
Depressive symptoms				677.58	<0.001
No	99 637 (81.7)	4454 (67.6)	95 183 (82.4)		
Yes	23 822 (18.3)	2231 (32.4)	21 591 (17.6)		
School bullying victimisation				253.17	<0.001
No	113 435 (91.6)	5668 (83.9)	107 767 (92.0)		
Yes	10 024 (8.4)	1017 (16.1)	9007 (8.0)		

All numbers were unweighted, whereas all percentages were adjusted for sampling weights.

\*Sexual minorities included adolescents who reported same-sex or both-sex attraction.

HSS, household socioeconomic status.

sleep quality was measured by the seven components of PSQI. School bullying victimisation and sexual minority status were regarded as continuous variates and dichotomised variates, respectively. The SEM was performed

using the robust maximum-likelihood estimation. Standardised coefficients, and indirect and total effects were estimated, and the 95% CI was measured using the bootstrap method with 2000 resamplings. All data were

**Table 2** Self-reported sleep quality by sexual orientation (n=123 459)

Variates	Sexual minorities* ( $\bar{x}$ , SE)	Heterosexual ( $\bar{x}$ , SE)	t	P
Sleep duration (hour/day)	6.883 (0.023)	7.195 (0.013)	18.38	<0.001
PSQI components score				
Subjective sleep quality	1.300 (0.014)	1.190 (0.005)	10.62	<0.001
Sleep latency	0.948 (0.015)	0.780 (0.006)	13.90	<0.001
Sleep duration	1.059 (0.017)	0.827 (0.010)	18.24	<0.001
Habitual sleep efficiency	0.389 (0.011)	0.300 (0.003)	23.14	<0.001
Sleep disturbance	0.872 (0.010)	0.749 (0.003)	15.80	<0.001
Use of sleeping medication	0.076 (0.007)	0.013 (0.001)	11.07	<0.001
Daytime dysfunction	1.663 (0.017)	1.451 (0.008)	16.77	<0.001
Global PSQI score	6.311 (0.056)	5.310 (0.027)	23.14	<0.001
Poor sleep quality (PSQI>7, n, %) <sup>†</sup>	2289 (32.6)	26891 (21.9)	281.70 <sup>‡</sup>	<0.001

\*Sexual minorities included adolescents who reported same-sex or both-sex attraction.

<sup>†</sup>Poor sleep quality was defined as PSQI global score >7 and is presented as numbers (%).

<sup>‡</sup> $\chi^2$  test was used for poor sleep quality.

PSQI, Pittsburgh Sleep Quality Index.

analysed using SAS V.9.2 (SAS Institute) and Mplus V.7.4 (Muthén and Muthén). All statistical tests of hypotheses were two sided, and a P value less than 0.05 was considered statistically significant.

## RESULTS

### Characteristics of participants

Of the 123 459 students who were analysed, 5.0% self-reported as sexual minorities, and 95.0% self-reported as heterosexual (table 1). A total of 52.2% of the sample were boys, and 47.8% were girls. The mean (SE) age of the students was 15.30 (0.04) years. In this study, girls and younger students were more likely to report same-sex attraction, respectively ( $\chi^2=169.35$ ,  $P<0.001$  and  $\chi^2=43.44$ ,  $P<0.001$ ). Sexual minority students were more likely to come from families of good or poor socioeconomic status ( $\chi^2=60.73$ ,  $P<0.001$ ). The proportion of students who reported that their parents often quarrel and were separated or divorced was higher among sexual minority students ( $\chi^2=171.09$ ,  $P<0.001$ ). Sexual minority students were also more likely to report above average academic pressure, smoking, alcohol use, lack of physical activity and depressive symptoms. Compared with their heterosexual peers, sexual minority students were more likely to be bullied in school (8.0% vs 16.1%;  $\chi^2=253.17$ ,  $P<0.001$ ).

### Sleep quality in sexual minority and heterosexual students

Table 2 presents the sleep quality in sexual minority and heterosexual students. The mean sleep duration was significantly shorter in sexual minority students compared with heterosexual students (6.883 hours/day vs 7.195 hours/day;  $t=18.38$ ,  $P<0.001$ ). Our study also found that only 26.67% of sexual minority students slept 8 or

more hours/day, which is less than their heterosexual peers (35.70%). Sexual minority adolescents had significantly higher PSQI individual components and global PSQI scores ( $P<0.001$ ). Of the total sample population, 22.41% of the students reported poor sleep quality, and this prevalence was significantly higher in sexual minority students than heterosexual students (32.56% vs 21.87%;  $\chi^2=281.70$ ,  $P<0.001$ ).

### Association between sexual minority status and poor sleep quality

In the univariate logistic regression analysis (table 3, model 1) that did not adjust for covariates, sexual minority status (crude OR=1.72, 95% CI 1.62 to 1.84) was associated with poor sleep quality. After adjusting for social demographics and lifestyle variables (model 2), this association was similar to the results in model 1 (adjusted OR (AOR)=1.64, 95% CI 1.53 to 1.75). After further adjusting for depressive symptoms (model 3), sexual minority status was still associated with poor sleep quality, but the extent of this association was weakened (AOR=1.41, 95% CI 1.31 to 1.51). Based on model 3, after further adjusting for school bullying victimisation (model 4), the association between sexual minority status and poor sleep quality was further weakened (AOR=1.35, 95% CI 1.24 to 1.45).

### Mediating effects of school bullying victimisation

The mediating effects of school bullying victimisation on the association were further estimated in this study. First, the interaction between sexual minority status and school bullying victimisation was tested in model 4, and the interaction was not statistically significant ( $P=0.778$ ). The mediating effects of school bullying victimisation are shown in table 4. The indirect effect of school bullying victimisation (standardised  $\beta$  estimate=0.007, 95% CI 0.006 to 0.009) was significant, indicating that school

**Table 3** Association between sexual minority status and poor sleep quality\* (n=123 459)

Variates	Model 1 COR (95% CI)	Model 2 AOR (95% CI)	Model 3 AOR (95% CI)	Model 4 AOR (95% CI)
<b>Sexual minority status†</b>				
No	1.00	1.00	1.00	1.00
Yes	1.72 (1.62 to 1.84)	1.64 (1.53 to 1.75)	1.41 (1.31 to 1.51)	1.35 (1.26 to 1.45)
<b>Gender</b>				
Boys	1.00	1.00	1.00	1.00
Girls	1.10 (1.06 to 1.14)	1.17 (1.13 to 1.22)	1.13 (1.08 to 1.17)	1.18 (1.13 to 1.23)
<b>Age (year)</b>				
≤13	1.00	1.00	1.00	1.00
14–15	1.85 (1.72 to 1.98)	1.63 (1.53 to 1.74)	1.68 (1.57 to 1.80)	1.73 (1.62 to 1.86)
16–17	3.05 (2.84 to 3.27)	2.54 (2.37 to 2.72)	2.80 (2.61 to 3.01)	2.95 (2.75 to 3.17)
≥18	3.56 (3.26 to 3.88)	2.79 (2.56 to 3.03)	3.21 (2.95 to 3.51)	3.41 (3.12 to 3.71)
<b>HSS</b>				
Good	1.00	1.00	1.00	1.00
Average	1.43 (1.36 to 1.50)	1.09 (1.04 to 1.15)	1.06 (1.01 to 1.11)	1.05 (1.00 to 1.11)
Poor	2.29 (2.15 to 2.43)	1.32 (1.24 to 1.40)	1.18 (1.11 to 1.26)	1.15 (1.08 to 1.22)
<b>Living arrangement</b>				
Two biological parents	1.00	1.00	1.00	1.00
Only father or mother	1.22 (1.16 to 1.28)	1.03 (0.97 to 1.09)	0.99 (0.94 to 1.05)	0.99 (0.93 to 1.05)
Others	1.24 (1.19 to 1.30)	1.10 (1.05 to 1.15)	1.03 (0.98 to 1.08)	1.02 (0.97 to 1.07)
<b>Parental marital status</b>				
Harmonious	1.00	1.00	1.00	1.00
Often quarrels	1.55 (1.50 to 1.61)	1.48 (1.43 to 1.54)	1.34 (1.29 to 1.39)	1.31 (1.27 to 1.36)
Separated or divorced	1.72 (1.62 to 1.82)	1.52 (1.42 to 1.62)	1.40 (1.31 to 1.50)	1.38 (1.29 to 1.48)
<b>Academic pressure</b>				
Below average	1.00	1.00	1.00	1.00
Average	1.20 (1.13 to 1.27)	1.12 (1.06 to 1.19)	1.12 (1.05 to 1.18)	1.12 (1.05 to 1.18)
Above average	2.96 (2.79 to 3.15)	2.57 (2.42 to 2.72)	2.35 (2.21 to 2.50)	2.31 (2.18 to 2.45)
<b>Smoking</b>				
No	1.00	1.00	1.00	1.00
Yes	2.15 (2.01 to 2.30)	1.54 (1.43 to 1.65)	1.45 (1.35 to 1.56)	1.45 (1.34 to 1.56)
<b>Alcohol use</b>				
No	1.00	1.00	1.00	1.00
Yes	1.87 (1.79 to 1.95)	1.61 (1.54 to 1.69)	1.46 (1.40 to 1.53)	1.44 (1.37 to 1.50)
<b>Physical activity (days)</b>				
0	1.00	1.00	1.00	1.00
1–4	0.73 (0.71 to 0.76)	0.80 (0.77 to 0.83)	0.84 (0.81 to 0.87)	1.19 (1.15 to 1.24)
≥5	0.90 (0.84 to 0.97)	0.91 (0.85 to 0.98)	0.97 (0.91 to 1.04)	1.14 (1.06 to 1.23)
<b>Depressive symptoms‡</b>				
No	1.00		1.00	1.00
Yes	4.09 (3.93 to 4.25)	–	3.51 (3.38 to 3.66)	3.35 (3.22 to 3.49)
<b>School bullying victimisation</b>				
No	1.00			1.00
Yes	2.33 (2.21 to 2.46)	–	–	1.86 (1.75 to 1.97)

Model 1: Univariate logistic regression, not adjusted for covariate.

Model 2: Adjusted for gender, age, household socioeconomic status, living arrangement, parental marital status, academic pressure, smoking, alcohol use and physical activity.

Model 3: Adjusted for the covariates in model 2 + depressive symptoms.

Model 4: Adjusted for the covariates in model 3 + school bullying victimisation.

\*Poor sleep quality was defined as Pittsburgh Sleep Quality Index (PSQI) global score >7.

†Sexual minorities included adolescents who reported same-sex or both-sex attraction.

‡Depressive symptoms was defined as Depression Self-Rating Scale for Children (DSRSC) score >15.

AOR, adjusted OR; COR, crude OR; HSS, household socioeconomic status.

bullying victimisation partially mediated the association between sexual minority status and sleep quality.

## DISCUSSION

Using the data from the 2015 SCAHS, which is a large and nationally representative sample ( $n=123\,459$ ), we found that sexual minority students were more likely to report poor sleep quality. We also found that school bullying victimisation partially mediated the association between sexual minority status and poor sleep quality. To the best of our knowledge, this is the first study to explore sleep quality among sexual minority adolescents.

Sexual minority students experienced a shorter sleep duration than their heterosexual peers. Moreover, 32.6% of sexual minority students reported poor sleep quality, which was higher than that of their heterosexual peers (21.87%). After controlling for social demographics, lifestyle and depressive symptoms, sexual minority students had higher odds of poor sleep quality than their heterosexual peers (AOR=1.41, 95% CI 1.31 to 1.51). Our results were similar to those of previous studies conducted among sexual minority adults.<sup>14–16</sup> Chen and Shiu reported that there was an increased risk of sleep problem, including short sleep duration, feeling unrested and waking up at night, among American sexual minority adults.<sup>15</sup> Our findings suggest that sleep problems in sexual minority adolescents are a serious concern. An insufficient amount of sleep and poor sleep quality have a negative effect on development and social function<sup>9 13</sup> and increase the risk of other health outcomes, such as depression,<sup>8</sup> anxiety<sup>51</sup> and suicidal behaviours.<sup>41</sup> Therefore, these findings merit further study on sleep problems in sexual minority adolescents.

Sexual minority stress theory links sexual minority status to health outcomes. In the sexual minority stress model, stressful events related to sexual minority status, including school bullying victimisation, increase the risk of poor health outcomes.<sup>4</sup> For example, previous

studies have found that school bullying victimisation mediates the association between sexual minority status and other health outcomes, such as depression, suicide<sup>3</sup> and alcohol use.<sup>52</sup> In this study, school bullying victimisation mediated the association between sexual minority status and poor sleep quality. Consistent with previous studies,<sup>21 22</sup> we found that sexual minority students had twice the odds of school bullying victimisation compared with their heterosexual peers. Moreover, previous studies demonstrated that school bullying victimisation increased the risk of poor sleep quality among adolescents.<sup>22 23 53 54</sup> Our finding also supported the association between school bullying victimisation and poor sleep quality. Such an association could be explained by altered hypothalamic-pituitary-adrenal (HPA) axis functioning resulting from sexual minority stressors. Cortisol is one of the important products of HPA activation, and a previous study suggested that school bullying victims showed altered cortisol levels.<sup>55</sup> Moreover, cortisol also has an influence on slow wave sleep.<sup>56</sup> Therefore, school bullying victimisation may partially explain the association between sexual minority status and poor sleep quality among adolescents.

The mediating effects of school bullying victimisation suggest that it is important to intervene in school bullying behaviours in sexual minority adolescents. Thus, educators should realise the negative effects of school bullying behaviours towards sexual minority students, and effective interventions of bullying and other prejudicial events should be conducted in schools to reduce the negative effects. Moreover, a positive school environment has been shown to protect sexual minority students' mental health outcomes,<sup>57</sup> such as depression and suicide.<sup>58 59</sup> For example, gay-straight alliances and similar sexual minority support groups in schools would help reduce school bullying victimisation.<sup>60</sup> However,

**Table 4** Mediating effect of school bullying victimisation on the association between sexual minority status and poor sleep quality ( $n=123\,459$ )

Characteristic	Standardised estimate†	95% CI
<b>Path</b>		
Sexual minority status‡ → school bullying victimisation	0.061*	0.051 to 0.074
School bullying victimisation → sleep quality	0.119*	0.111 to 0.128
Sexual minority status → sleep quality	0.032*	0.024 to 0.040
<b>Standardised effect</b>		
Indirect effect	0.007*	0.006 to 0.009
Total effect	0.039*	0.031 to 0.047

Model fit indices: CFI=0.949; RMSEA=0.032, 90% CI 0.031 to 0.033; SRMR=0.014.

Arrows denote direction of effects.

\* $P<0.05$ .

†Adjusted for gender, age, household socioeconomic status, living arrangement, parental marital status, academic pressure, smoking, alcohol use, physical activity and depressive symptoms.

‡Sexual minorities included adolescents who reported same-sex or both-sex attraction.

CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual.

Chinese sexual minority adolescents suffer from stressors due to religion, homophobia and other conditions in the social environment and are impacted by Confucianism.<sup>27</sup> Filial piety is the core of Confucianism, and same-sex orientation is considered to be a betrayal of this traditional value.<sup>61</sup> Previous studies have suggested that filial piety still has an influence on young people's attitudes towards same-sex orientation.<sup>25 61</sup> Thus, in the Chinese social context, the effects of school bullying interventions should be evaluated in further studies.

School bullying victimisation may not be the only mechanism that increased the risk of poor sleep quality. Other stressful events related to sexual minority status, including discrimination<sup>62</sup> and violence,<sup>63</sup> may also be associated with poor sleep quality. Moreover, some psychological processes, such as cognitive, emotion regulation and social factors,<sup>64</sup> may also play a role in sexual minority sleep quality. In prior studies, the mediating or moderating effects of hopelessness<sup>65</sup> and avoidant coping strategies<sup>66</sup> on mental health outcome in sexual minorities have been well demonstrated; sexual minority adolescents in negative school climates or who lacked family support were also at an increased risk of poor health outcomes.<sup>67</sup> Thus, future studies are needed to test whether these potential mechanisms account for the association between school bullying victimisation and sleep quality.

There are several strengths in our study. First, we conducted the analysis using a large (n=123459) random sample. The large sample rendered sufficient statistical power, and a random sample allowed us to conduct the between-groups analysis.<sup>4</sup> Second, this is the first study to estimate the sleep quality in sexual minority adolescents and to examine the association between sexual minority status and sleep quality. However, several limitations of the study should be noted when interpreting the results. First, due to the cross-sectional nature of data, it is difficult to make causal inferences. Second, although there was a high response rate in this study, the students volunteered to participate in this study, and selection bias may thus exist. Third, to honour the students' privacy, we collected all information through self-reporting rather than through daily records or objective measurements. Therefore, we could not completely rule out the possibility of recall bias. Fourth, in this school-based study, we included only students who were present and did not include adolescents who had dropped out of school or were not present in school on the day the survey was administered.

## CONCLUSION

Sleep is important for the well-being and social functioning of adolescents. However, few studies have been conducted to test sleep quality in adolescents who identify as sexual minorities. Our study indicated that poor sleep quality is not rare in sexual minority adolescents. Due to our findings of a high prevalence of poor sleep quality, more attention should be given to sleep problems in sexual minority adolescents. In addition, conducting

interventions to reduce school bullying behaviours is an important step to improving sleep quality in sexual minority adolescents. Further studies that focus on the risk factors, mechanisms and interventions of sleep problems in sexual minority adolescents are warranted.

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