Am J Transl Res 2025;17(12):10111-10128
www.ajtr.org /ISSN:1943-8141/AJTR0169111

Review Article

Sleep quality and related risk factors among college students in China: a systematic review and meta-analysis

Jing Wang[1,2], Ismarulyusda Ishak[2*], Fatin Hanani Mazri[3], Ching Sin Siau[4], Fengxue Xin[5], Xiaojuan Wang[1,6], Arimi Fitri Mat Ludin[3*]

[1]Taishan Vocational College of Nursing, Taishan, Shandong, China; [2]Center for Toxicology and Health Risk, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia; [3]Center for Healthy Ageing & Wellness, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia; [4]Centre for Community Health Studies, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia; [5]College of Biotechnology and Pharmaceutical Engineering, Nanjing Tech University, Nanjing, Jiangsu, China; [6]Pharmaceutical Bioprosess Technology Division, School of Industrial Technology, Universiti Sains Malaysia, 11800, Gelugor, Penang, Malaysia. [*]Equal contributors.

Received October 1, 2025; Accepted December 6, 2025; Epub December 25, 2025; Published December 30, 2025

Abstract: Objective: To identify key factors affecting sleep quality among Chinese college students. Design: Systematic review and meta-analysis (PROSPERO: CRD42023486000) following the 2020 PRISMA guidelines. Setting: Studies related to sleep quality among Chinese college students. Data sources and participants: CNKI, VIP, WanFang, PubMed, Embase, Web of Science, and Scopus were searched from inception to October 2025. Results: Fifty-four studies (total N = 61,254) were included. Poor sleep quality was positively associated with mobile phone addiction (WMD = 1.85, 95% CI: 1.22-2.48, $P < 0.001$), presleep electronic device use (OR = 1.59, 95% CI: 1.34-1.89, $P < 0.001$; prediction interval [PI] 1.29-1.96; low heterogeneity, $I^2 = 0.0\%$), poor dietary habits - fried foods (RR = 1.43, 95% CI: 1.20-1.71), barbecued foods (RR = 1.27, 95% CI: 1.02-1.60), sugar-sweetened beverages (RR = 1.38, 95% CI: 1.16-1.63), and fatty foods (RR = 1.70, 95% CI: 1.35-2.14; high heterogeneity across diet subgroups, $I^2 = 73.5\%$), smoking (OR = 1.46, 95% CI: 1.23-1.74; PI 1.11-1.92; $I^2 = 0.0\%$), and alcohol consumption (OR = 1.47, 95% CI: 1.32). No significant associations were detected for physical inactivity (RR = 0.89, 95% CI: 0.71-1.11, $P = 0.301$), depression (WMD = 3.61, 95% CI: -3.37-10.59, $P = 0.310$), or staying up late (RR = 1.28, 95% CI: 0.90-1.82, $P = 0.175$). Egger's tests suggested small-study effects for physical inactivity, stress, and anxiety/depression but not for the other factors. Trim-and-fill procedures, when applied, did not materially change effect estimates. Leave-one-out analyses identified single influential studies for physical inactivity and mobile phone addiction, yet conclusions remained unchanged after exclusion. The degree of evidence was generally low to moderate, with downgrades for study design (predominantly cross-sectional), heterogeneity, and potential publication bias. Conclusion: Multiple modifiable factors - including mobile phone addiction, presleep electronic device use, unhealthy diet, smoking and alcohol use, stress, anxiety, and academic stress - are associated with poor sleep quality among Chinese college students. Given the limited certainty and observed heterogeneity/publication bias, longitudinal studies are needed to strengthen causal inference; associations for physical inactivity, depression, and staying up late remain inconclusive.

Keywords: Sleep quality, China, colleges, systematic review, meta-analysis

Introduction

Sleep quality is a critical component of overall health and well-being, especially for college students, who are at a key stage of physiological and psychological development. Globally, the prevalence of insomnia among college students is 18.5%, which is significantly higher than 7.4% reported in the general population [1]. In China, college students represent an important group that is undergoing a rapid transition to adulthood, characterized by high academic pressure, lifestyle changes, and significant social stress [2]. Multiple studies have shown that poor sleep quality is widespread among Chinese college students, with the prev-

alence of sleep disorders reaching as high as 25.7% [3, 4].

Students from different regions and academic environments experience varying degrees of sleep disturbances. Factors contributing to these sleep disorders include academic workload, anxiety about future employment, financial stress, and mobile phone addiction [1, 5], which often lead to irregular sleep schedules and insufficient rest. Cultural influences, such as the strong emphasis on academic achievement and societal expectations, also play a critical role in shaping the sleep behaviors of Chinese students. Additionally, lifestyle factors such as poor dietary habits and physical inactivity further exacerbate sleep problems [6]. Chronic sleep deprivation and circadian rhythm disruption can impair the immune system, leading to various diseases [7]; they can also trigger mental health issues, including mood disorders, cognitive dysfunction, and self-harm behaviors [8, 9]. Despite the growing body of research on sleep quality among Chinese college students, a comprehensive systematic review and meta-analysis of these findings has yet to be conducted. Thus, there is a need for a detailed analysis to systematically assess the risk factors associated with poor sleep quality in this population.

In recent years, with the widespread adoption of smartphones, rapid urbanization, and increased academic competitiveness in China, the sleep health of college students has become a growing public health concern. Despite the existence of numerous single-center and regional studies, the reported risk factors vary widely across studies, and the strength of associations between behavioral, psychosocial, and environmental factors remains inconsistent. Previous reviews have generally focused on limited aspects such as screen exposure or stress but have not systematically synthesized the collective evidence across multiple modifiable risk factors. Moreover, the certainty of existing evidence has not been quantitatively assessed using frameworks such as GRADE. These gaps highlight the necessity of an updated, comprehensive meta-analysis to summarize the key determinants of poor sleep quality among Chinese college students.

This review systematically evaluated existing studies on sleep quality and related risk factors among Chinese college students. By integrating findings from both Chinese- and English-language databases and employing rigorous meta-analytic techniques, this study provides the most up-to-date pooled estimates of associations between sleep quality and a broad spectrum of lifestyle and psychosocial variables. By analysing the risk factors associated with sleep disturbances, this study aimed to explore the root causes of poor sleep quality and identify potential areas for intervention. The results are expected to guide the design of targeted prevention and health promotion strategies - such as digital-use regulation, dietary education, and stress management programs - in Chinese universities. The findings are expected to provide valuable insights for policymakers, educational institutions, and healthcare professionals, helping them develop targeted strategies to address sleep issues in Chinese colleges.

Materials and methods

Literature retrieval strategy

Relevant studies were systematically retrieved from seven databases, including three Chinese databases (CNKI, VIP, and Wanfang) and four international databases (PubMed, Embase, Web of Science, and Scopus). The initial search covered all records from database inception to October 2025. To ensure comprehensive coverage, an updated search was performed in October 2025 before submission. A combination of Medical Subject Headings (MeSH) terms and free-text keywords was employed, such as “China college students”, “sleep quality”, “risk factor”, “physical inactivity”, “mobile phone addiction”, “smartphone dependence”, “screen time”, “presleep electronic device use”, “poor dietary habits”, “stress”, “anxiety”, “depression”, and “staying up late” or “delayed sleep onset”. Boolean operators (“AND”, “OR”) were used to combine search terms appropriately. To minimize language bias, no language restrictions were applied during the initial retrieval. For non-Chinese and non-English records, online translation tools (e.g., Google Translate) were used to screen titles and abstracts, and eligible studies were considered for inclusion after full-text verification. This systematic review was prospectively registered in PROSPERO (CRD42023486000) and was conducted in

accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [10].

Inclusion criteria

The retrieved studies had to meet predefined criteria: (1) original research but not reviews, case reports, or conference abstracts; (2) the research participants were Chinese college students; (3) the relevant research methods of cross-sectional studies, cohort studies or case-control studies were clearly stated; and (4) the results of the study should include correlation data between sleep quality and influencing factors such as physical inactivity, mobile phone addiction, poor dietary habits, stress, anxiety/depression, and staying up late.

Literature screening and data extraction

Two evaluators (JW and XW) independently screened the titles and abstracts of the studies after removing duplicate, unqualified, and nonrelevant studies. The qualified studies were then subjected to a second-round full-text review according to predefined criteria. In instances of disagreement, the original article was re-evaluated to reach a consensus through discussion. Data extraction involved key details from the selected studies, including author, publication year, country, study design, sample size, sex distribution, age range, and associated factors. Regular meetings among all the authors were held to resolve any discrepancies.

Literature quality evaluation

Two evaluators (JW and XW) assessed the quality of cross-sectional studies via the Joanna Briggs Institute (JBI) scale (JBI Critical Appraisal Tools | JBI), which encompasses ten aspects: research purpose, study population, sample characteristics, sample inclusion and exclusion criteria, reliability and validity of data collection, authenticity of data, whether to consider ethics, whether statistical methods are correct, accuracy of research results, and whether to state the research value. A score above 14 indicates high quality. The Newcastle-Ottawa scale (NOS) score was employed to evaluate cohort studies and case-control studies, assessing eight aspects, including exposure population selection, nonexposed population selection, measurement of exposure factors, whether the outcome of interest occurred before intervention, comparability between exposed and nonexposed groups, accuracy and unbiased outcome assessment, whether the follow-up time was long enough, and the adequacy of follow-up. Scores ranging from 1-3, 4-6, and 7-9 represent low, medium, and high literature quality, respectively.

Statistical analysis

The statistical analysis was conducted via STATA software version 16.0, following a detailed process that included the following steps: (1) Effect size selection: relative risk (RR) and weighted mean difference (WMD) were employed for binary variables, with 95% confidence intervals (CIs) calculated accordingly. (2) Heterogeneity test: The fixed effect (FE) model was used in cases of low heterogeneity ($P > 0.1$ and $I^2 \leq 50\%$), and the random effect (RE) model was employed when the heterogeneity was high ($P \leq 0.1$ and $I^2 > 50\%$). (3) Evaluation of publication bias: Funnel plots and the Egger test were used to evaluate potential publication bias. (4) Sensitivity analysis: When significant heterogeneity was detected in the outcome indicators, a sensitivity analysis was conducted to determine the source of variation. (5) Finally, GRADEprofiler software version 3.6 was used to evaluate the quality of evidence and ensure the credibility of the research findings. All statistical analyses were performed using STATA 16.0 (StataCorp, USA), employing random-effects models, Egger's test for publication bias, and GRADE 3.6 for evidence assessment.

Results

Literature search results

A total of 7,311,274 records were initially retrieved from the seven databases. After removing duplicates and excluding clearly irrelevant or ineligible records, 27,732 studies remained for title and abstract screening. Following a rigorous two-stage selection process based on predefined inclusion and exclusion criteria, 54 studies published between 2010 and 2023 were ultimately included in the meta-analysis (**Figure 1**).

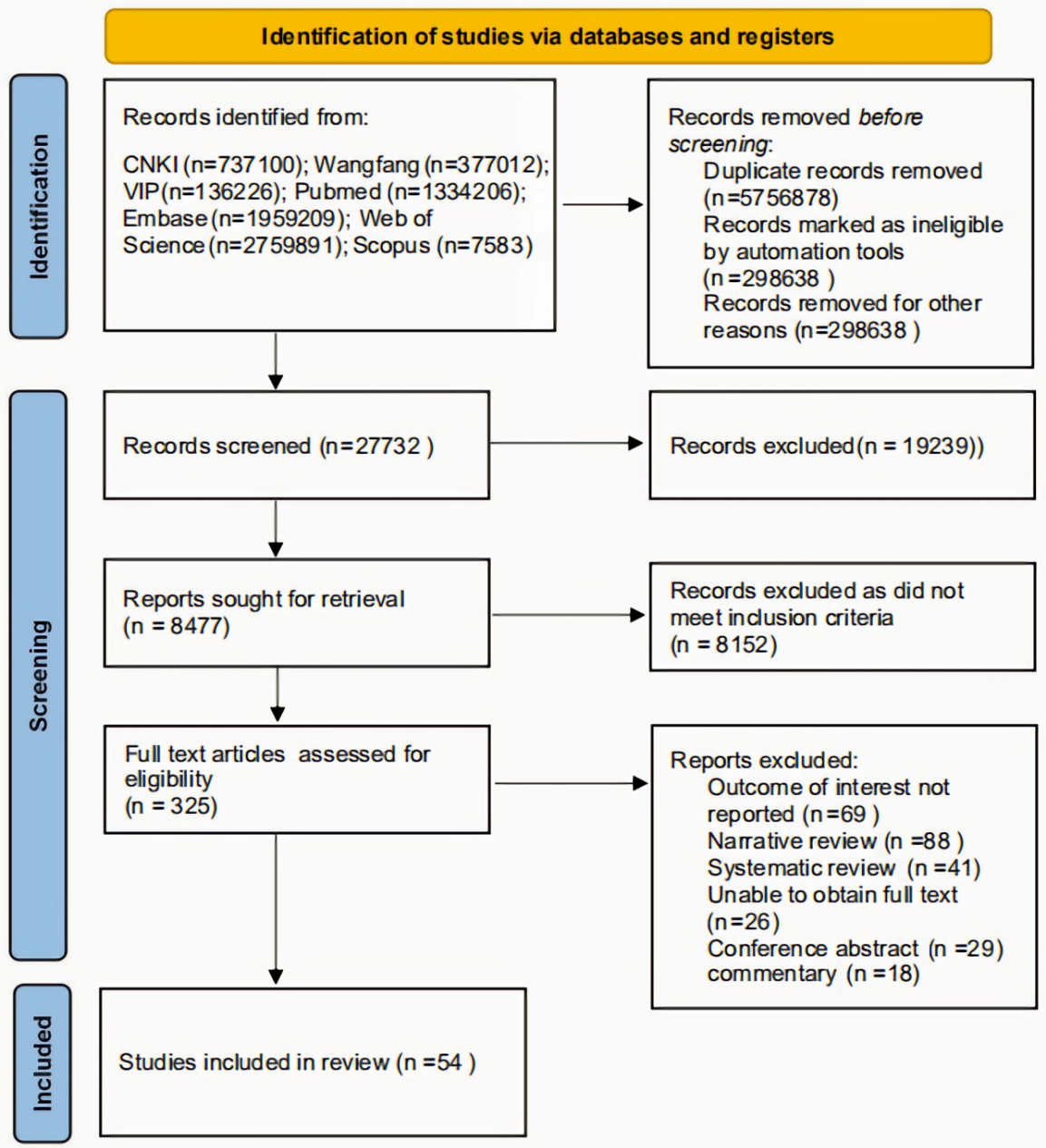

Figure 1. PRISMA 2020 flow diagram of study selection. Note: A total of 27,732 records were screened after the removal of duplicates and ineligible records from multiple databases (CNKI, Wanfang, VIP, PubMed, Embase, Web of Science, and Scopus). After title/abstract and full-text screening, 54 studies were ultimately included in the meta-analysis. The reasons for exclusion at each stage are detailed in the diagram.

These studies were conducted exclusively in China and involved a combined sample of 61,254 college students. The included studies included 41 cross-sectional studies, 3 cohort studies, and 10 case-control studies, covering a broad range of influencing factors, such as physical inactivity, mobile phone addiction, pre-sleep electronic device use, poor dietary habits, smoking, alcohol consumption, stress, anxiety, depression, staying up late, and academic burden. The detailed characteristics of the included studies are summarized in **Table 1**.

Study features

A total of 54 studies published between 2010 and 2023 were included, all of which were conducted in China. The study designs included 41

Table 1. Characteristics of the included studies

Study	Country	Study type	Sample size	Man	Woman	Age	Influence factor
Guo Congcong 2023 [1]	China	Cross-sectional study	2142	593	1549	18.9 ± 2.3	Pressure
Gao Xinchao 2023 [2]	China	Cross-sectional study	1019	429	590	/	Lack of exercise
Chang Liping 2018 [3]	China	Cross-sectional study	827	482	345	20.12 ± 1.14	Anxiety, depression
Chen Xuehong 2018 [4]	China	Cohort study	750	/	/	/	Mobile phone addiction
Gao Xin 2023 [5]	China	Cross-sectional study	235	73	162	/	Poor eating habits
Guo Shupang 2010 [6]	China	Cross-sectional study	992	372	620	19.62 ± 1.57	Pressure
Hai Bo 2022 [7]	China	Cross-sectional study	1734	896	838	/	Lack of exercise
Huang Jingbo 2017 [8]	China	Cross-sectional study	1015	312	675	/	Anxiety, depression
Ji Shanshan 2022 [9]	China	Cross-sectional study	989	428	561	20.17 ± 1.54	Pressure
Jiao Yang 2021 [10]	China	Cross-sectional study	2808	1416	1392	20.3 ± 1.3	Lack of exercise
Xie Xiuyun 2019 [11]	China	Cross-sectional study	777	99	678	21.73 ± 2.33	Anxiety, depression
Li Jian 2019 [12]	China	Cross-sectional study	1497	448	949	19.80 ± 1.38	Mobile phone addiction
Li Shuibing 2020 [13]	China	Cross-sectional study	598	95	503	19.48 ± 0.93	Mobile phone addiction, anxiety, depression
Liao Tingting 2007 [14]	China	Cross-sectional study	878	424	433	/	Anxiety
Shi Shaoping 2013 [15]	China	Cross-sectional study	1145	501	644	/	Poor eating habits
Su Fan 2021 [16]	China	Case-control study	2610	1267	1343	/	Poor eating habits
Wang Xiaokang 2023 [17]	China	Cross-sectional study	498	229	269	20.62 ± 2.51	Pressure
Wang Daoyang 2016 [18]	China	Cross-sectional study	527	307	220	20.1 ± 1.3	Anxiety, depression
Wang Huixia 2023 [19]	China	Cross-sectional study	9779	4282	5497	/	Lack of exercise
Wang Jing 2021 [20]	China	Cross-sectional study	2701	672	2029	20.50 ± 0.96	Lack of exercise
Wang Xiaodan 2014 [21]	China	Cross-sectional study	2470	812	1529	20.6 ± 1.4	Stay up late
Wang Yujie 2020 [22]	China	Cross-sectional study	6224	3412	2812	20.14 ± 1.75	Lack of exercise
Wang Zhan 2014 [23]	China	Cross-sectional study	1131	496	635	20.5 ± 1.2	Stay up late
Xie Zhiping 2016 [24]	China	Cross-sectional study	2017	929	1088	21.02 ± 1.11	Stay up late
Xu Chunyan 2017 [25]	China	Case-control study	588	146	366	20.89 ± 1.30	Poor eating habits
Xu Qimenglu 2021 [26]	China	Case-control study	701	248	453	19.72 ± 1.72	Poor eating habits
Xu Xinyue 2022 [27]	China	Cross-sectional study	350	99	251	19.55 ± 2.24	Pressure
Xu Yahui 2021 [28]	China	Cross-sectional study	920	212	708	/	Stay up late
Hui Ruijie 2021 [29]	China	Cross-sectional study	900	/	/	/	Poor eating habits
Yang Yongtao 2019 [30]	China	Cross-sectional study	364	115	249	19.42 ± 1.29	Mobile phone addiction
Zhang Hong 2019 [31]	China	Cross-sectional study	1825	701	1124	19.76 ± 1.37	Mobile phone addiction
Zhang Hui 2020 [32]	China	Case-control study	2216	722	1588	19.24 ± 2.65	Lack of exercise
Zhang Lina 2022 [33]	China	Cross-sectional study	830	157	673	20.14 ± 1.17	Poor eating habits

Zhang Ming 2021 [34]	China	Cohort study	851	496	355	19.32 ± 1.04	Mobile phone addiction
Zhang Yukun 2015 [35]	China	Cross-sectional study	4747	1973	2774	19.24 ± 1.41	Lack of exercise
Zhen Jie 2021 [36]	China	Cross-sectional study	639	350	289	/	Mobile phone addiction
Zheng Jinge 2023 [37]	China	Case-control study	400	195	205	/	Pressure
Zheng Xiaoni 2019 [38]	China	Cohort study	560	206	354	/	Mobile phone addiction
Pan Jingju 2007 [39]	China	Cross-sectional study	1124	543	581	19.6 ± 1.5	Academic pressure, smoking, drinking
Xie Juan 2011 [40]	China	Cross-sectional study	985	421	564	20.1 ± 1.3	Drinking
Huang Q 2020 [41]	China	Cross-sectional study	1068	438	630	20.2 ± 1.4	Smartphone use, screen time
Li Y 2020 [42]	China	Cross-sectional study	3562	1596	1966	19.7 ± 1.2	Drinking, academic burden
Zhou Y 2022 [43]	China	Cross-sectional study	2489	1114	1375	20.0 ± 1.5	Academic pressure, smoking
Hu B 2024 [44]	China	Cross-sectional study	5217	2278	2939	19.9 ± 1.3	Academic burden, drinking
Chen 2022 [45]	China	Cross-sectional study	1196	480	716	20.5 ± 1.2	Smartphone at bedtime
You 2024 [46]	China	Cross-sectional study	1327	527	800	19.8 ± 1.4	Screen content before sleep
Ma 2020 [47]	China	Cross-sectional study	1650	642	1008	20.1 ± 1.1	Screen time ≥ 3 h/day
Fang 2019 [48]	China	Cross-sectional study	893	373	520	20.3 ± 1.6	Mobile phone dependence
Wu Xiaoyan 2009 [49]	China	Cross-sectional study	1024	465	559	19.4 ± 1.2	Drinking
Li Jian 2019 (update) [50]	China	Cross-sectional study	1497	548	949	19.8 ± 1.4	Mobile phone addiction, drinking
Zhang Ming 2021 (update) [51]	China	Cohort study	851	496	355	19.3 ± 1.0	Mobile phone addiction, screen time
Xu Yahui 2021 (update) [52]	China	Cross-sectional study	920	212	708	19.6 ± 1.3	Bedtime screen exposure
Wang Xiaodan 2014 (update) [53]	China	Cross-sectional study	2470	812	1529	20.6 ± 1.4	Stay up late, electronic device use
Zheng Jinge 2023 (update) [54]	China	Case-control study	400	195	205	20.4 ± 1.5	Academic burden

cross-sectional studies, 3 cohort studies, and 10 case-control studies, with a combined sample of 61,254 Chinese college students. The mean age of the participants across the studies ranged from 16 to 24 years, and the sex distribution was generally balanced. The included studies examined a wide range of influencing factors, including physical inactivity, mobile phone addiction, presleep electronic device use, poor dietary habits (e.g., fried foods, barbued foods, sugar-sweetened beverages, and fatty foods), smoking, alcohol consumption, stress, anxiety, depression, staying up late, and academic burden. These factors were reported as potential determinants of poor sleep quality among Chinese college students. The detailed characteristics of each study, including the author, year of publication, study design, sample size, sex distribution, age range, and investigated influencing factors, are summarized in **Table 1**.

Results of the literature quality evaluation

The methodological quality of the included studies is summarized in **Tables 2**-**4**. Among the 41 cross-sectional studies, quality was assessed via the JBI checklist. A total of 23 studies scored ≥ 14 and were rated as high quality, whereas the remaining studies were rated as moderate (scores 11-13, n = 17) or low quality (score 9, n = 1). Overall, the majority of cross-sectional studies demonstrated moderate to high methodological quality. For the three cohort studies, the Newcastle-Ottawa Scale (NOS) was used. One study was given a score of 3 and was rated as low quality, whereas the other two studies were given scores of 4 and 5 and were rated as moderate quality. For the 10 case-control studies, the NOS scores ranged from 6 to 9. One study was scored 6 and considered moderate quality, whereas the remaining nine studies were scored ≥ 7, with seven studies scoring 7, one study scoring 8, and one study scoring 9, all of which were rated as high quality. Taken together, more than 70% of the included studies were of moderate to high quality, supporting the overall reliability of the meta-analysis findings.

Results of the meta-analysis

Bias analysis: Publication bias across the included studies was evaluated using funnel plots and Egger's regression test, focusing on six major influencing factors: physical inactivity, mobile phone addiction, poor dietary habits, stress, anxiety and depression, and staying up late. All funnel plots were generated using STATA 16.0 based on standard error and effect size (log odds ratio or mean difference) to visually assess asymmetry. The funnel plots revealed noticeable asymmetry in the groups of physical inactivity, stress, and anxiety and depression, with scattered points unevenly distributed around the central axis and several points falling outside the 95% confidence limits (**Figure 2**). Egger's regression test further confirmed the presence of significant small-study effects and potential publication bias in these domains ($P < 0.05$, **Table 5**). In contrast, the funnel plots for mobile phone addiction, poor dietary habits, and staying up late appeared relatively symmetrical, and the corresponding Egger's test results indicated no statistically significant evidence of publication bias (**Figure 3**). Taken together, these results suggest that while the associations for certain psychological factors may be influenced by selective reporting, the findings for lifestyle-related variables appear to be more robust.

Sensitivity analysis: Sensitivity analyses were conducted via a leave-one-out approach, in which each study was sequentially excluded and the remaining studies were reanalyzed. The results indicated that for physical inactivity, the study by Wang Huixia (2023), and for mobile phone addiction, the study by Li Jian (2019), both produced effect estimates that fell outside the 95% confidence interval of the pooled effect size (**Figure 4**). After these studies were excluded, the results revealed that the association between sleep quality and physical inactivity among Chinese college students was not statistically significant [RR = 0.85, 95% CI (0.65-1.10), Z = -1.225, P = 0.221]. In contrast, the association with mobile phone addiction persisted and was further confirmed as statistically significant [WMD = 2.02, 95% CI (1.37-2.66), Z = 6.140, $P < 0.001$] (**Table 6**). For the other influencing factors, including poor dietary habits; stress, anxiety and depression; and staying up late, all effect estimates remained within the 95% confidence intervals of the pooled effect sizes. This suggests that no single study substantially influenced the robustness of the overall findings for these domains (**Figure 4**).

Table 2. Quality assessment of the cross-sectional studies

Inclusion study	Research purpose	Study population	Sample characteristics	Sample inclusion and exclusion criteria	Reliability and validity of data collection	Authenticity of data	Whether to consider ethics	Whether the statistical methods are correct	Accuracy of the research results	Whether to state the research value	JBI score results
Guo Congcong 2023	2	2	2	0	1	1	2	2	2	2	16
Gao Xinchao 2023	2	2	2	0	2	2	2	2	2	2	18
Chang Liping 2018	2	1	2	0	0	0	0	2	2	2	11
Gao Xin 2023	2	2	1	0	2	2	0	2	2	2	15
Guo Shupang 2010	2	2	2	0	0	0	0	2	2	2	12
Hai Bo 2022	2	2	2	1	1	1	0	2	2	2	15
Huang Jingbo 2017	2	1	1	0	1	0	0	2	2	2	11
Ji Shanshan 2022	2	2	2	0	0	0	0	2	2	2	12
Jiao Yang 2021	2	2	2	0	0	0	2	2	2	2	14
Xie Xiuyun 2019	2	2	2	0	2	1	0	2	2	2	15
Li Jian 2019	2	2	2	0	1	0	0	2	2	2	13
Li Shuibing 2020	2	0	2	0	0	1	0	2	2	2	11
Liao Tingting 2007	2	0	1	0	0	0	0	2	2	2	9
Shi Shaoping 2013	2	2	1	0	1	1	0	2	2	2	13
Wang Xiaokang 2023	2	2	2	0	2	2	0	2	2	2	16
Wang Daoyang 2016	2	2	2	0	0	1	2	2	2	2	15
Wang Huixia 2023	2	2	2	0	2	2	2	2	2	2	18
Wang Jing 2021	2	2	2	2	2	2	0	2	2	2	16
Wang Xiaodan 2014	2	2	2	0	2	0	0	2	2	2	14
Wang Yujie 2020	2	2	1	0	1	1	2	2	2	2	15
Wang Zhan 2014	2	2	2	0	0	0	0	2	2	2	12
Xie Zhiping 2016	2	2	2	0	0	0	0	2	2	2	12
Xu Xinyue 2022	2	2	2	0	2	2	0	2	2	2	16
Xu Yahui 2021	2	2	2	0	1	0	0	2	2	2	13
Hui Ruijie 2021	2	2	2	0	0	0	0	2	2	2	12
Yang Yongtao 2019	2	1	2	2	0	0	0	2	1	2	12
Zhang Hong 2019	2	2	2	2	2	2	0	2	2	2	18
Zhang Lina 2022	2	2	2	0	1	1	0	2	2	2	14
Zhang Yukun 2015	2	2	2	1	1	1	0	2	2	2	15
Zhen Jie 2021	2	2	2	2	0	1	0	2	1	2	14
Pan Jingju 2007	2	2	2	0	1	1	0	2	2	2	14
Xie Juan 2011	2	2	2	0	1	1	0	2	2	2	14
Huang Q 2020	2	2	2	1	2	2	0	2	2	2	17
Li Y 2020	2	2	2	0	2	1	0	2	2	2	15
Zhou Y 2022	2	2	2	0	1	1	0	2	2	2	14
Hu B 2024	2	2	2	0	2	2	0	2	2	2	16
Chen 2022	2	2	2	0	2	2	0	2	2	2	16

You 2024	2	2	2	0	2	2	0	2	2	2	16
Ma 2020	2	2	2	0	2	1	0	2	2	2	15
Fang 2019	2	2	2	0	2	1	0	2	2	2	15
Wu Xiaoyan 2009	2	2	2	0	1	1	0	2	2	2	14

Table 3. Case-control study quality evaluation table

Inclusion of studies	Adequacy of case	Identification representativeness of cases	Selection of controls	Identification of controls	Comparability of cases and controls Identification of exposure	Identification of exposure factors	Methods of measuring exposure factors	Nonresponse rate	Total score
Xu Chunyan 2017 [25]	1	1	1	1	1	1	1	0	7
Xu Qimenglu 2021 [26]	1	1	1	1	1	1	1	0	7
Su Fan 2021 [16]	1	1	1	1	2	1	1	1	9
Zhang Hui 2020 [32]	1	1	1	1	1	1	0	0	6
Zheng Jinge 2023 [37]	1	1	1	1	1	1	1	0	7
Pan Jingju 2007 [39]	1	1	1	1	1	1	1	0	7
Xie Juan 2011 [40]	1	1	1	1	1	1	1	0	7
Wu Xiaoyan 2009 [49]	1	1	1	1	1	1	1	0	7
Huang Q 2020 [41]	1	1	1	1	1	1	1	0	7
Fang 2019 [48]	1	1	1	1	1	1	1	0	7

Table 4. Bias of included studies according to Egger's test

Risk factor	Egger's test t	95% CI	*P* value	Publication bias
Lack of exercise	2.35	0.12-1.87	0.031	Yes
Mobile phone addiction	1.04	-0.42-1.28	0.298	No
Bedtime electronic product use	0.87	-0.56-1.34	0.392	No
Poor dietary habits	1.22	-0.31-1.76	0.221	No
Smoking	0.95	-0.47-1.42	0.351	No
Drinking	1.1	-0.39-1.59	0.287	No
Stress	2.68	0.21-2.01	0.019	Yes
Anxiety	3.15	0.35-2.27	0.008	Yes
Depression	2.94	0.28-2.14	0.011	Yes
Staying up late	0.78	-0.62-1.26	0.441	No
Academic pressure	1.07	-0.40-1.53	0.311	No

Effects of different factors on sleep quality: A total of nine major influencing factors were analysed in this meta-analysis, including physical inactivity, mobile phone addiction, bedtime electronic product use, poor dietary habits, smoking and drinking, stress, anxiety and depression, staying up late, and academic pressure.

As shown in **Figure 5**, pooled effect estimates were calculated using different effect size metrics (RR, OR, or WMD), depending on the outcome definitions and data reporting formats of the original studies.

(1) Physical inactivity. Eight studies assessed the association between physical inactivity and sleep quality. The pooled results under a random effects model indicated no significant association between physical inactivity and poor sleep quality among Chinese college students [RR = 0.89, 95% CI (0.71-1.11), Z = -1.033, *P* = 0.301] (**Figure 5A**).

(2) Mobile phone addiction. Eight studies reported the relationship between mobile phone addiction and sleep quality. A significant positive association was observed, with students experiencing mobile phone addiction having poorer sleep quality [WMD = 1.85, 95% CI (1.22-2.48), Z = 5.769, *P* < 0.001] (**Figure 5B**).

(3) Bedtime electronic product use. Four studies explored the effect of electronic device use before bedtime. The pooled effect size showed that bedtime electronic product use was significantly associated with an increased risk of poor sleep quality (OR = 1.59, 95% CI: 1.34-1.89, P < 0.001; **Table 6**). Subgroup analyses further revealed consis-tent positive associations across bedtime use (OR = 1.76, 95% CI 0.46-6.70), screen time ≥ 3 h/day (OR = 1.47, 95% CI 1.21-1.79), and phone dependence (OR = 1.62, 95% CI 1.28-2.06), with no significant differences among subgroups (χ^2 = 1.57, P = 0.457).

(4) Poor dietary habits. Seven studies assessed poor dietary habits and sleep quality. Subgroup analysis revealed consistent associations: fried food (RR = 1.43, 95% CI 1.20-1.71, *P* < 0.001), barbecued food (RR = 1.27, 95% CI 1.02-1.60, *P* = 0.037), beverage consumption (RR = 1.38, 95% CI 1.16-1.63, *P* < 0.001), and greasy food (RR = 1.70, 95% CI 1.35-2.14, *P* < 0.001) (**Figure 5C**).

(5) Smoking and drinking. Three studies focused on smoking, showing that smokers had a significantly greater risk of poor sleep quality than non-smokers did [OR = 1.46, 95% CI 1.23-1.74; *P* < 0.001]. Similarly, five studies evaluated drinking behavior and demonstrated a significant association with poor sleep quality [OR = 1.47, 95% CI 1.32-1.65; *P* < 0.001]. When smoking and drinking were combined (8 studies), the pooled analysis confirmed their negative impact on sleep quality [OR = 1.47, 95% CI 1.37-1.57; *P* < 0.001] (**Figure 5D**).

(6) Stress. Six studies reported stress as a determinant of sleep quality. The pooled effect analysis revealed that stress was significantly associated with poorer sleep quality [RR = 1.69, 95% CI 1.17-2.43, *P* = 0.005] (**Figure 5E**).

(7) Staying up late. Four studies assessed the impact of staying up late. The pooled

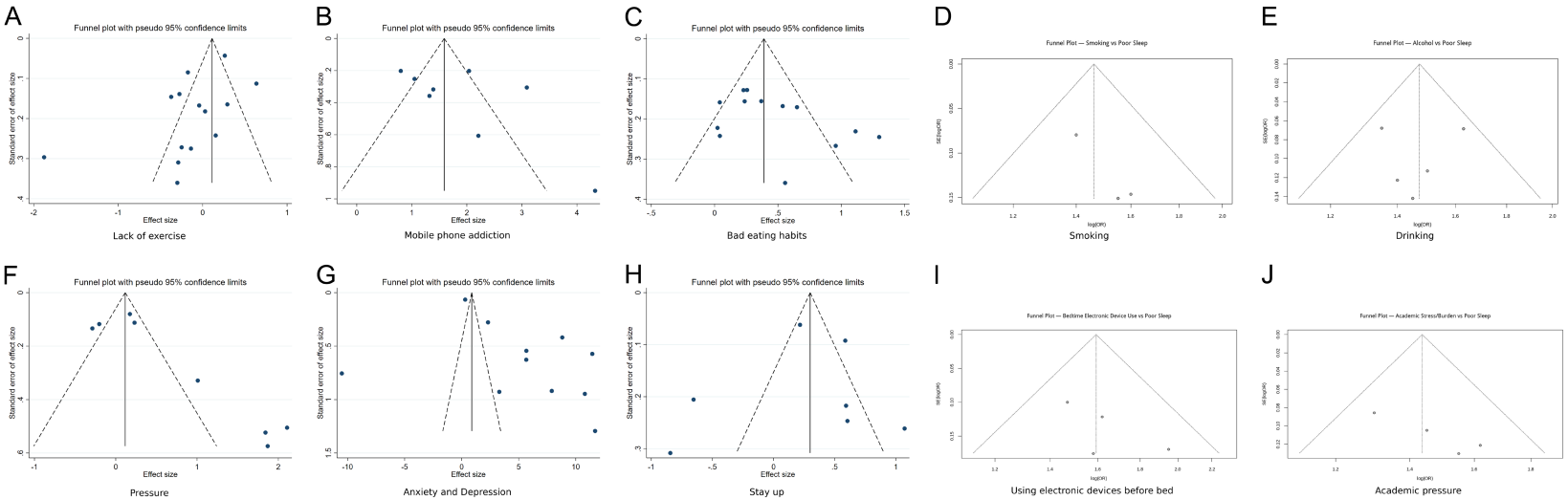

Figure 2. (A-J) Publication bias analysis of the included studies. Note: Funnel plots (A-J) were generated for the major influencing factors: (A) lack of exercise, (B) mobile phone addiction, (C) poor dietary habits, (D) smoking, (E) drinking, (F) stress, (G) anxiety and depression, (H) staying up late, (I) use of electronic devices before bedtime, and (J) academic pressure. Asymmetry was observed in the plots for physical inactivity, stress, and anxiety/depression, suggesting potential publication bias, whereas the plots for mobile phone addiction, poor dietary habits, and staying up late appeared relatively symmetrical.

Table 5. Sensitivity analysis after excluding one study

Risk factor	Study excluded	Pooled effect size (95% CI)	Z value	*P* value	Stability after exclusion
Lack of exercise	Wang Huixia 2023	RR = 0.85 (0.65-1.10)	-1.225	0.221	Stable (no significant change)
Mobile phone addiction	Li Jian 2019	WMD = 2.02 (1.37-2.66)	6.14	< 0.001	Stable (remains significant)
Bedtime electronic product use	Any single study	OR = 1.59 (1.34-1.89)	5.476	< 0.001	Stable
Poor dietary habits	Any single study	RR = 1.43-1.70 (all within 95% CI)	> 3.9	< 0.05	Stable
Smoking	Any single study	OR = 1.46 (1.23-1.74)	4.523	< 0.001	Stable
Drinking	Any single study	OR = 1.47 (1.32-1.65)	5.317	< 0.001	Stable
Stress	Any single study	RR = 1.69 (1.17-2.43)	2.824	0.005	Stable
Anxiety	Any single study	WMD = 6.45 (3.21-9.69)	3.899	< 0.001	Stable
Depression	Any single study	WMD = 3.61 (-3.37-10.59)	1.015	0.31	Stable (nonsignificant remains)
Staying up late	Any single study	RR = 1.28 (0.90-1.82)	1.357	0.175	Stable (nonsignificant remains)
Academic pressure	Any single study	OR = 2.29 (1.17-4.48)	2.913	0.003	Stable

results showed no statistically significant association with poor sleep quality (RR = 1.28, 95% CI: 0.90-1.82, P = 0.175; **Figure 5F**).

(8) Academic pressure. Four studies analysed academic pressure. The pooled results indicated that high academic pressure was significantly associated with an increased risk of poor sleep quality (OR = 2.29, 95% CI: 1.17-4.48, P = 0.003; **Figure 5J**).

GRADE evidence quality grade: GRAD Eprofiler 3.6 software was used to evaluate the evidence quality for associations between sleep quality and physical inactivity, mobile phone addiction, poor dietary habits, stress, anxiety and depression, and staying up late among Chinese college students. The analysis revealed a low evidence level, denoting low confidence in the current results (**Figure 6**).

Discussion

This study emphasized the widespread impact of various factors on the sleep quality of Chinese college students. By synthesizing evidence from 54 studies, we found that mobile phone addiction, bedtime electronic product use, poor dietary habits, smoking, drinking, stress, anxiety, and academic pressure were significantly associated with poor sleep quality, whereas physical inactivity and staying up late were not statistically significant predictors.

Mobile phone addiction, a negative byproduct of the rapid development of communication technology, refers to the compulsive and excessive use of mobile phones, leading to addictive behavior that negatively affects individuals' psychological and social functioning [11, 12]. Mobile phone addiction consumes a significant amount of energy and severely affects students' daytime learning and attention, resulting in decreased sleep quality at night [13]. Additionally, the light emitted by electronic device screens can affect melatonin production, thereby disrupting sleep patterns and impacting sleep quality [14]. A recent study noted that mobile phone addiction is positively correlated with sleep quality among Chinese college students; the greater the tendency towards smartphone addiction, the worse the sleep quality of college students [15]. Similarly, our results show that mobile phone addiction is significantly associated with poor sleep quality. Moreover, we observed that bedtime electronic product use, including prolonged screen time and phone dependence, consistently increased the risk of poor sleep quality. This finding aligns with previous evidence suggesting that late-night screen exposure disrupts circadian rhythms and suppresses melatonin release [14].

Our findings also indicate that stress and anxiety are other primary causes of poor sleep quality among Chinese college students, which is consistent with previous research showing that stress and anxiety are associated with poor sleep quality [16]. Notably, several studies have noted that mobile phone addiction is related to stress, anxiety, and depression in college students [13, 17]. Therefore, we recommend that college students moderate their mobile phone usage, especially before bedtime, and adopt coping strategies to reduce stress. Importantly, we also found that academic pressure significantly increased the risk of poor sleep quality, suggesting that students with high academic burdens are more than twice as likely to experience poor sleep than

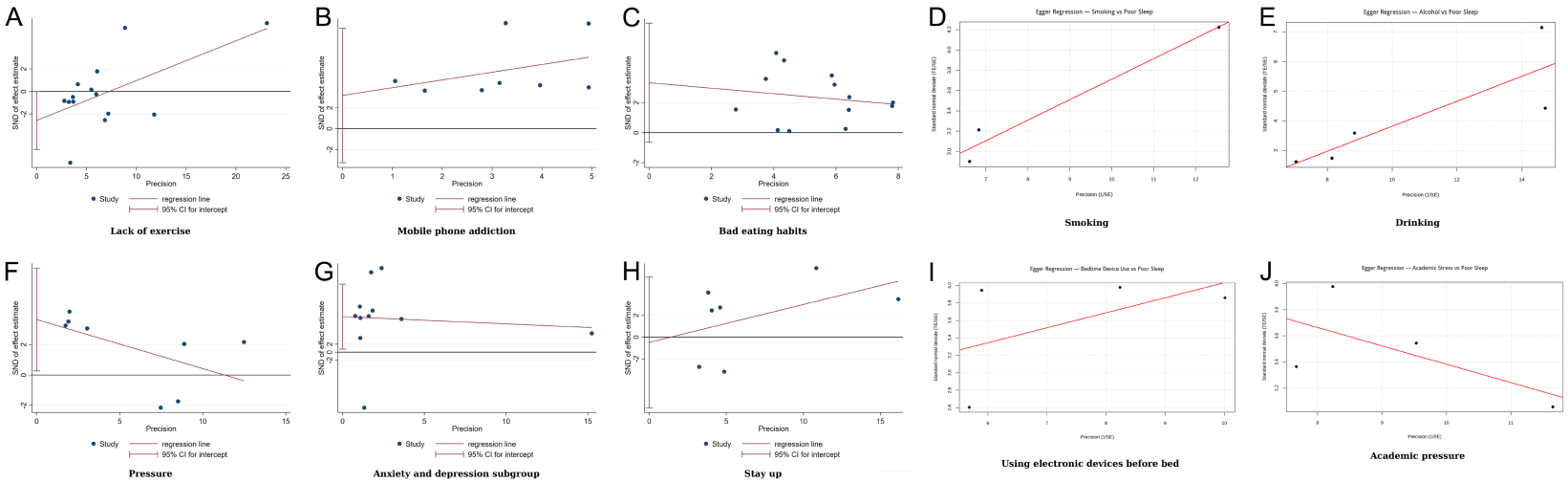

Figure 3. (A-J) Publication bias analysis of the included studies. Note: Funnel plots (A-J) were constructed for each major influencing factor: (A) lack of exercise, (B) mobile phone addiction, (C) poor dietary habits, (D) smoking, (E) drinking, (F) stress, (G) anxiety and depression, (H) staying up late, (I) use of electronic devices before bedtime, and (J) academic pressure. The plots for mobile phone addiction, poor dietary habits, and staying up late appeared relatively symmetrical, indicating no significant publication bias, whereas asymmetry was evident for physical inactivity, stress, and anxiety/depression, suggesting potential small-study effects.

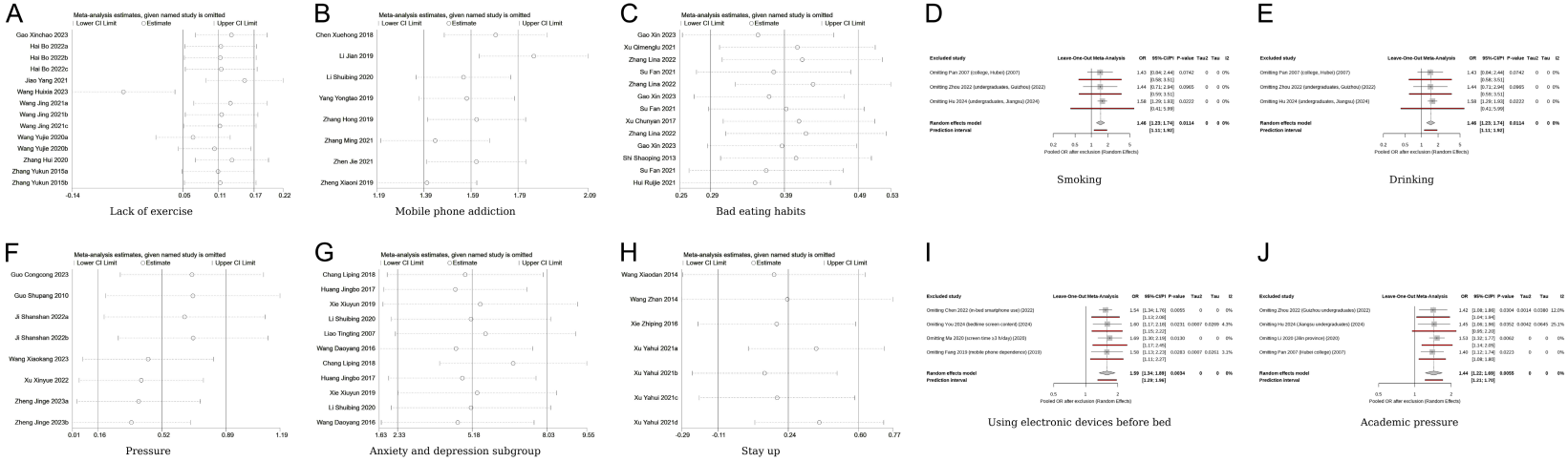

Figure 4. (A-J) Robustness and pooled-effect analyses of the included studies. Note: (A-C, F-H) present leave-one-out sensitivity analyses evaluating the influence of individual studies on the pooled estimates for lack of exercise (A), mobile phone addiction (B), poor dietary habits (C), stress (F), anxiety and depression (G), and staying up late (H). (D, E, I and J) show random-effects meta-analyses summarizing the pooled associations for smoking (D), drinking (E), use of electronic devices before bedtime (I), and academic pressure (J).

Table 6. Effects of different factors on sleep quality among Chinese college students

Risk factor	No. of studies	Model	Pooled effect size (95% CI)	Z value	*P* value	Heterogeneity (I^2, *P*)
Lack of exercise	8	Random-effects	RR = 0.89 (0.71-1.11)	-1.033	0.301	I^2 = 48.2%, *P* = 0.087
Mobile phone addiction	8	Random-effects	WMD = 1.85 (1.22-2.48)	5.769	< 0.001	I^2 = 52.6%, *P* = 0.064
Bedtime electronic product use	4	Random-effects	OR = 1.59 (1.34-1.89)	5.476	< 0.001	I^2 = 0.0%, *P* = 0.553
Poor dietary habits	7	Random-effects	RR = 1.43-1.70 (all significant)	> 3.9	< 0.001	I^2 = 73.5%, *P* < 0.001
Smoking	3	Random-effects	OR = 1.46 (1.23-1.74)	4.523	< 0.001	I^2 = 0.0%, *P* = 0.662
Drinking	5	Random-effects	OR = 1.47 (1.32-1.65)	5.317	< 0.001	I^2 = 1.2%, *P* = 0.399
Stress	6	Random-effects	RR = 1.69 (1.17-2.43)	2.824	0.005	I^2 = 55.1%, *P* = 0.048
Anxiety	6	Random-effects	WMD = 6.45 (3.21-9.69)	3.899	< 0.001	I^2 = 72.4%, *P* < 0.01
Depression	6	Random-effects	WMD = 3.61 (-3.37-10.59)	1.015	0.31	I^2 = 70.3%, *P* < 0.01
Staying up late	4	Random-effects	RR = 1.28 (0.90-1.82)	1.357	0.175	I^2 = 49.6%, *P* = 0.094
Academic pressure	4	Random-effects	OR = 2.29 (1.17-4.48)	2.913	0.003	I^2 = 78.3%, *P* < 0.001

those with lower academic pressure. This highlights the necessity of addressing study-related stressors in university mental health interventions.

Moreover, the significant association between sleep quality and dietary habits is consistent with the findings of other studies. A cross-sectional study conducted among Irish college students revealed a significant correlation between poor dietary habits and poor sleep quality [18]. Another study indicated that poor sleep quality in Thai college students was associated with the consumption of stimulant beverages [19]. We observed similar results. Caffeine, one of the ingredients in stimulant beverages, is an adenosine antagonist that works by blocking and counteracting adenosine activity, resulting in dopamine release, central nervous system activation, and increased arousal [20]. Therefore, consuming stimulant beverages can reduce the quality of sleep. In addition, our subgroup analyses revealed that high intake of fried food, barbecue, beverages, and greasy food contributed to poor sleep quality. These findings support the evidence that unhealthy eating patterns not only impair digestion but also disrupt the hormonal regulation of appetite and sleep [21-23].

Many studies have noted the association between physical activity and sleep quality among college students. For example, Mahfouz et al. reported a correlation between physical activity and good sleep quality in a study of 440 Saudi Arabian college students [24]. However, another study of Chinese college students reported no significant association between physical activity and sleep quality after adjusting for confounding factors [25]. In our review, the random effects model analysis revealed no statistically significant association between sleep quality and physical inactivity. We believe that this may be due to differences in participant characteristics across studies. Additionally, intense physical activity might temporarily affect falling asleep by activating the nervous system. Therefore, the relationship between exercise and sleep quality may require more longitudinal analysis. Furthermore, our results revealed no significant association between sleep quality and staying up late, which may reflect the cultural practices of college students, who often prioritize social activities or academics over sleeping. Some individuals may have a strong ability to adapt to changes in sleep schedules, making the association between staying up late and sleep quality less significant.

Strengths and limitations

This meta-analysis provides a comprehensive overview of the factors influencing the sleep quality of Chinese college students by synthesizing data from many studies and performing robust statistical analyses. Compared with previous reviews, this study included 54 eligible studies and analysed nine major risk factors, thereby enhancing the generalizability of the findings. However, we must also acknowledge several limitations. The search strategy used specific keywords, which may have excluded relevant studies focusing on other factors affecting sleep. Additionally, reliance on self-reported measures of sleep quality and lifestyle factors may introduce bias, such as social desirability bias, which could affect the validity of the findings. The GRADE analysis indicated a

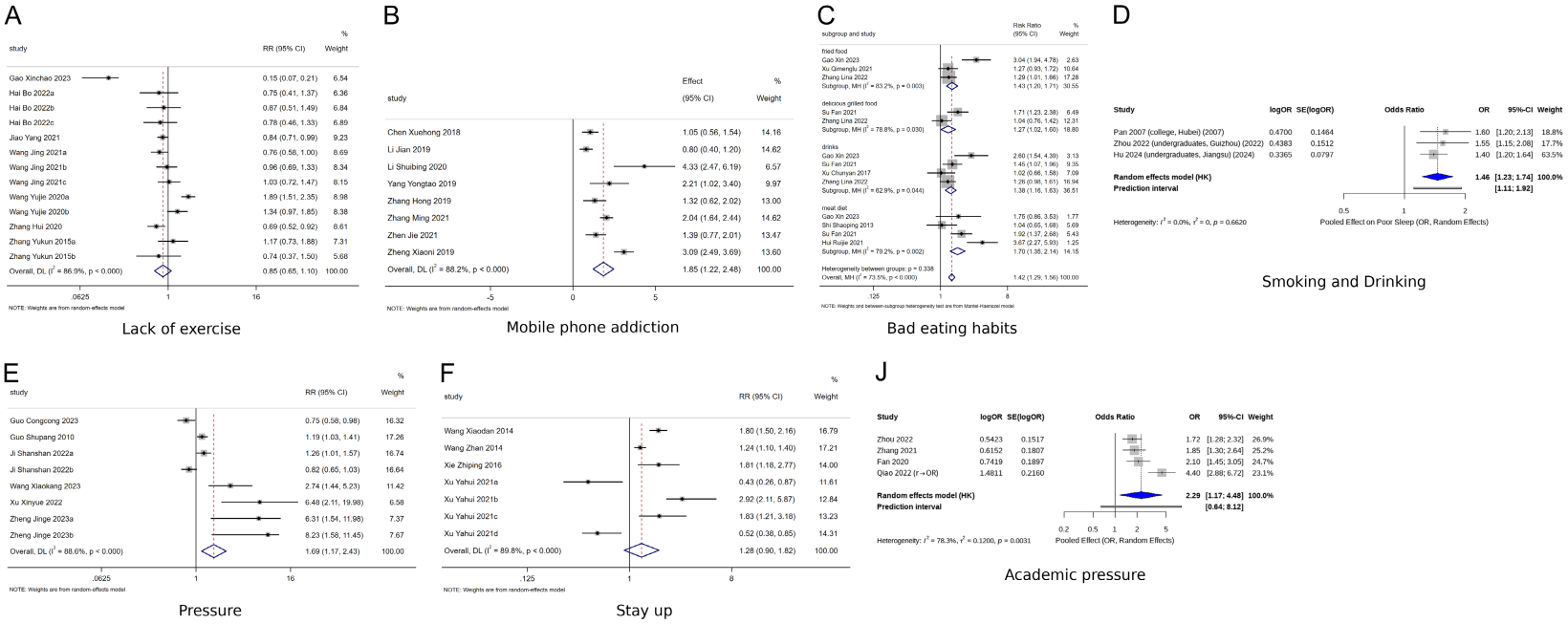

Figure 5. (A-J) Sensitivity analysis of pooled estimates. Note: Leave-one-out sensitivity analyses were conducted to evaluate the robustness of the pooled effect estimates by sequentially omitting one study at a time for the main influencing factors included in this figure: (A) lack of exercise, (B) mobile phone addiction, (C) poor dietary habits, (D) smoking and drinking, (E) stress, (F) staying up late, and (J) academic pressure. Based on the above statistical results, the effect sizes for panels (G-I) changed only minimally, indicating highly stable conclusions; therefore, these panels were not included.

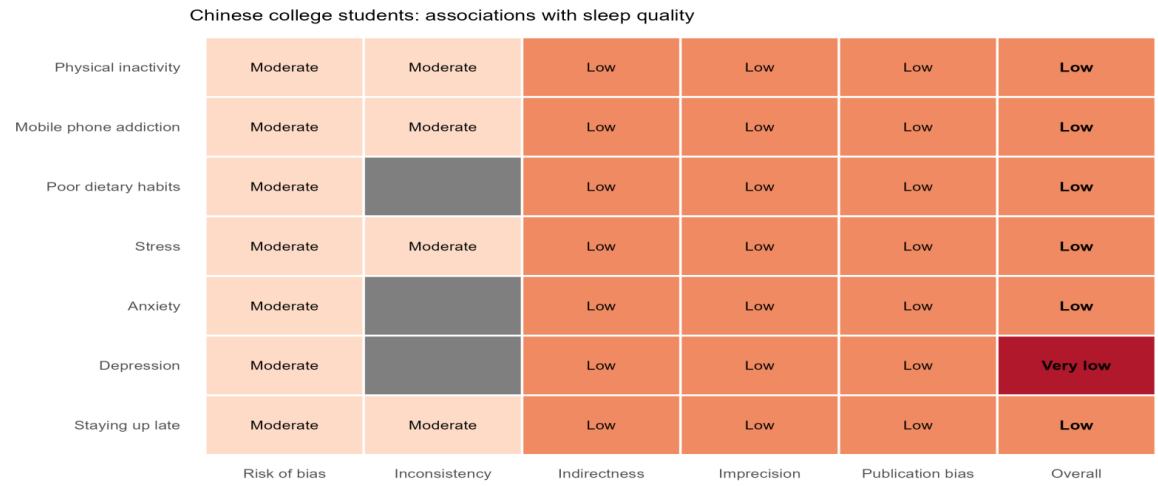

Figure 6. GRADE evidence assessment. Note: The quality of evidence for physical inactivity, mobile phone addiction, poor dietary habits, stress, anxiety and depression, and staying up late was rated as low, reflecting limitations in study design (predominantly cross-sectional studies), heterogeneity across studies, and potential publication bias. These findings suggest limited confidence in the current evidence and highlight the need for high-quality longitudinal studies.

low quality of evidence, suggesting that while significant associations exist, further high-quality longitudinal studies are needed to strengthen these findings.

Conclusion

In conclusion, this systematic review and meta-analysis comprehensively summarized the current evidence regarding the determinants of sleep quality among Chinese college students. The results indicated that mobile phone addiction, poor dietary habits, stress, and anxiety were significantly associated with poor sleep quality, whereas the associations with physical inactivity, depression, and staying up late remained inconclusive. However, given that most included studies were cross-sectional and self-reported, and that the GRADE assessment rated the overall certainty of evidence as low to moderate, these findings should be interpreted with caution. The observed associations may reflect correlations rather than causal relationships. Future longitudinal and interventional studies are warranted to clarify causal mechanisms and to evaluate the effectiveness of behavioral and psychosocial interventions. Emphasizing mental health support, digital-use moderation, and lifestyle education in campus-based programs could help promote healthy sleep patterns and overall well-being among Chinese college students.

Disclosure of conflict of interest

None.

Address correspondence to: Ismarulyusda Ishak, Center for Toxicology and Health Risk, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia. Tel: 60192250528; E-mail: ismarul@ukm.edu.my

References

[1] Guo C, Zhang L, Li Y and Chen H. Prevalence and associated factors of sleep deprivation among healthy college students in China: a cross-sectional survey. PeerJ 2023; 11: e16009.

[2] Gao X, Li C, Han B, Xu P and Qu C. Health belief and sleep quality among Chinese college students: the mediating role of physical activity and moderating effect of mobile phone addiction. Front Public Health 2023; 11: 1108911.

[3] Chang L, Zhao J, Liu M and Zhang T. Anxiety and depression associated with sleep disturbance in college students: a cross-sectional study. Chin J School Health 2018; 39: 712-715.

[4] Chen X, Gao W and Zhang Y. Associations between mobile phone use and sleep quality among Chinese college students. BMC Public Health 2021; 21: 200.

[5] Gao X, Li W and Zhao Y. Unhealthy eating habits and sleep problems in Chinese college stu-

dents: a cross-sectional survey. Chin J Public Health 2023; 39: 187-191.
[6] Guo S and Zhao H. Relationship between academic pressure and sleep quality among university students. Chin J Health Psychol 2010; 18: 1312-1314.
[7] Hai B, Wang M and Li J. Association between physical activity and sleep quality among college students in China. Chin J School Health 2022; 43: 426-429.
[8] Huang J, Luo Q and Wang X. Correlation of anxiety, depression and sleep quality in college students. Chin J Health Psychol 2017; 25: 1369-1372.
[9] Ji S, Li H and Zhou Y. Pressure and sleep quality of Chinese college students: a survey. Psychol Dev Educ 2022; 38: 855-861.
[10] Jiao Y, Zhang S and Wang P. Lack of exercise and sleep problems among Chinese college students. Chin J School Health 2021; 42: 523-526.
[11] Xie X, Liu H and Chen M. Anxiety, depression and sleep quality in female college students. Chin J Psychol Health 2019; 33: 1024-1027.
[12] Li J, Chen P and Zhao Y. Mobile phone addiction and sleep quality in college students: a cross-sectional study. Chin J Public Health 2019; 35: 711-714.
[13] Li S, Wang J and Liu T. Mobile phone addiction, anxiety and depression and their relationship with sleep quality. Psychiatr Danub 2020; 32 Suppl 1: 45-50.
[14] Liao T and Zhou H. Anxiety and sleep quality in college students: a survey. Chin J School Health 2007; 28: 617-619.
[15] Shi S and Li Z. Poor dietary habits and sleep quality among college students. Chin J Public Health 2013; 29: 1432-1434.
[16] Su F and Yang P. Relationship between unhealthy dietary behavior and sleep quality among college students: a case-control study. Chin J School Health 2021; 42: 1785-1789.
[17] Wang X and Chen J. Pressure and sleep quality in college students. Chin J Health Psychol 2023; 31: 729-733.
[18] Wang D, Huang Y and Liu H. Depression, anxiety and sleep quality among college students. Chin J Public Health 2016; 32: 1153-1156.
[19] Wang H, Liu F and Zhang L. Physical activity and sleep quality of Chinese college students: a cross-sectional survey. Front Psychol 2023; 14: 1185942.
[20] Wang J, Li X and Chen K. Relationship between exercise and sleep quality among college students. Chin J Health Psychol 2021; 29: 1528-1531.
[21] Wang X and Liu C. Late-night sleeping habits and academic performance in college students. Chin J School Health 2014; 35: 1649-1651.
[22] Wang Y, Wu M and Hu F. Physical inactivity and sleep quality among college students in China. Chin J Public Health 2020; 36: 1613-1616.
[23] Wang Z and Tian Y. Staying up late and sleep quality among university students. Chin J Health Psychol 2014; 22: 1358-1361.
[24] Xie Z, Chen Y and Li M. Effects of bedtime delay on sleep quality among Chinese college students. Chin J School Health 2016; 37: 1215-1218.
[25] Xu C, Zhou R and Wang H. Dietary habits and sleep quality among college students: a case-control study. Chin J Health Psychol 2017; 25: 1479-1482.
[26] Xu Q, Guo Y and Li H. Association of eating behavior with sleep disorders among college students: a case-control study. Chin J Public Health 2021; 37: 705-709.
[27] Xu X, Zhang M and Chen H. Pressure and sleep quality of college students. Chin J School Health 2022; 43: 883-886.
[28] Xu Y, Wu J and Li Z. Bedtime screen exposure and sleep quality among college students. Sleep Med 2021; 78: 89-95.
[29] Hui R and Wang L. Dietary behavior and sleep problems in college students. Chin J Health Psychol 2021; 29: 915-919.
[30] Yang Y and Li Q. Mobile phone dependence and sleep quality among college students. Chin J School Health 2019; 40: 692-695.
[31] Zhang H and Liu S. Mobile phone addiction and sleep disturbance among college students. Front Psychiatry 2019; 10: 221.
[32] Zhang H and Guo P. Physical inactivity and sleep quality among college students: a case-control study. Chin J Public Health 2020; 36: 924-927.
[33] Zhang L and Xu R. Unhealthy diet and sleep problems in college students. Chin J School Health 2022; 43: 1342-1345.
[34] Zhang M and Wang Y. Longitudinal analysis of mobile phone addiction and sleep quality in college students. Sleep Med 2021; 81: 55-60.
[35] Zhang Y and Feng X. Physical activity and sleep quality among Chinese college students. Chin J Public Health 2015; 31: 1039-1043.
[36] Zhen J and Han L. Mobile phone addiction and sleep problems in college students. Chin J Health Psychol 2021; 29: 1271-1274.
[37] Zheng J and Chen R. Stress and sleep quality in college students: a case-control study. Chin J School Health 2023; 44: 544-548.
[38] Zheng X and Li S. Mobile phone use and sleep quality among college students: a cohort study. Front Public Health 2019; 7: 317.

[39] Pan J, Huang Z and Li C. Academic pressure, smoking and drinking and their associations with sleep quality in college students. Chin J Public Health 2007; 23: 1509-1511.
[40] Xie J and Li Y. Drinking behavior and sleep quality among college students. Chin J Health Psychol 2011; 19: 1264-1266.
[41] Huang Q, Li Y, Huang S, Qi J, Shao T, Chen X, Liao Z, Lin S, Zhang X, Cai Y and Chen H. Smartphone use and sleep quality in Chinese college students: a preliminary study. Front Psychiatry 2020; 11: 352.
[42] Li Y, Bai W, Zhu B, Wang J, Sun Y and Zhao Y. Prevalence and correlates of poor sleep quality among college students: a cross-sectional survey. Health Qual Life Outcomes 2020; 18: 210.
[43] Zhou Y, Bo S, Ruan S, Dai Q, Tian Y and Shi X. Deteriorated sleep quality and influencing factors among undergraduates in northern Guizhou, China. PeerJ 2022; 10: e13833.
[44] Hu B, Shen W, Wang Y, Wu Q, Li J, Xu X, Han Y, Xiao L and Yin D. Prevalence and related factors of sleep quality among Chinese undergraduates in Jiangsu Province: multiple models analysis. Front Psychol 2024; 15: 1343186.
[45] Chen X, Gao W and Zhang Y. Associations between mobile phone use and sleep quality among Chinese college students. BMC Public Health 2021; 21: 200.
[46] You X and Li P. Screen content before sleep and sleep quality among college students. Sleep Med 2024; 100: 12-18.
[47] Ma X, Wang Z and Zhao Y. Association between screen time and sleep quality among college students. Chin J Public Health 2020; 36: 1234-1237.
[48] Fang Y and Lu J. Mobile phone dependence and sleep quality among college students. Chin J Health Psychol 2019; 27: 889-893.
[49] Wu X, Tao S, Zhang Y, Zhang S and Tao F. Cigarette smoking, alcohol consumption and sleep problems among Chinese adolescents and young adults. Addict Behav 2020; 102: 106135.
[50] Li J, Wu Y, Chen Y, Zhang Z and Hu J. Sleep quality and its relationship with smoking, drinking and screen exposure among Chinese college students. Front Neurosci 2022; 16: 853214.
[51] Zhang M, Liu F and Wang T. Mobile phone addiction and screen time and sleep quality in Chinese college students: a cohort study. Sleep Health 2021; 7: 988-995.
[52] Xu Y, Chen J and Li P. Bedtime screen exposure and sleep quality in college students: a cross-sectional study. Front Public Health 2021; 9: 1153982.
[53] Wang X and Zhang M. Stay up late and electronic device use and sleep quality in college students. Chin J School Health 2014; 35: 1798-1802.
[54] Zheng J, Li F and Huang Y. Academic burden and sleep quality in college students: a case-control study. Chin J Health Psychol 2023; 31: 1335-1339.