Assessment Tools and Influencing Factors for Insomnia in Chinese Adolescents: A Scoping Review Postprint

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Abstract

Background Previous studies have found that adolescence is associated with physiological changes in sleep, and there are significant differences in sleep duration among adolescents in different regions. Chinese adolescents have short sleep duration and high academic pressure, making them susceptible to insomnia, which subsequently affects their physical and mental health development.

Objective To systematically review the assessment tools and influencing factors of insomnia among Chinese adolescents, and to provide directions for future research in this field.

Methods This study was conducted in October 2022. Five databases were systematically searched: Web of Science Core Collection, PubMed, CNKI, Wanfang Data Knowledge Service Platform, and VIP Database, with the search period spanning from database inception to March 1, 2023. Two researchers independently screened articles related to insomnia among Chinese adolescents aged 12-18 years and extracted information on authors, publication year, region, study type, sample size, assessment tools, prevalence, and influencing factors.

Results A total of 1,440 articles were retrieved through database searches, with 39 articles ultimately meeting the inclusion criteria, including 34 English articles and 5 Chinese articles, encompassing 23 studies with sample sizes ranging from 62 to 33,692. The majority of study types were cross-sectional (15 studies). The 23 studies utilized a total of 8 insomnia assessment tools, with 1 study providing objective measurement data for insomnia, and 3 studies involving the localization evaluation or development of scales. A total of 5 self-report tools were tested and provided reliability and validity data, with internal consistency reliability ranging from 0.50 to 0.83, 2-week test-retest reliability ranging from 0.40 to 0.82, and area under the receiver operating characteristic curve ranging

from 0.79 to 0.85. The influencing factors of insomnia among Chinese adolescents are complex and diverse, including demographic factors (age, gender, etc.), physiological factors (genetics, physical health status, etc.), psychological factors (anxiety, depression, etc.), and behavioral factors (exercise, smoking, etc.).

Conclusion The assessment tools for insomnia among Chinese adolescents are diverse and the influencing factors are complex. Currently, there is insufficient testing of the reliability and validity of assessment tools, a scarcity of objective measurement data for insomnia, and the causal relationship between insomnia and influencing factors remains unclear, warranting further research in the future.

Full Text

The Assessment Tools and Influencing Factors of Insomnia in Chinese Adolescents: A Scoping Review

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Abstract

Background: Previous research has indicated that adolescence is associated with physiological changes in sleep patterns, and significant variations exist in sleep duration among adolescents from different regions. Chinese adolescents face short sleep durations and intense academic pressures, which can lead to insomnia and affect their physical and mental health development. **Objective:** To systematically review the assessment tools and influencing factors of insomnia in Chinese adolescents and provide guidance for future research in this field. **Methods:** Initiated in October 2022, this study conducted a systematic search across five databases: Web of Science Core Collection, PubMed, China National Knowledge Infrastructure, Wanfang, and VIP Database, covering records from inception to March 1, 2023. Two researchers independently screened articles related to insomnia in Chinese adolescents aged 12 to 18 and extracted the following information: authors, publication year, region, research design, sample size, assessment tools, prevalence, and influencing factors. **Results:** A total of 1,440 articles were retrieved, with 39 articles ultimately included—34 in English and 5 in Chinese—covering 23 studies. Sample sizes ranged from 62 to 33,692. Cross-sectional studies were the most common design (15 studies). The 23 studies utilized eight different insomnia assessment tools. Only one study provided

objectively measured sleep data, while three studies involved localized assessment or development of self-report tools, providing reliability and validity data for five instruments. Internal consistency reliability ranged from 0.50 to 0.83, two-week test-retest reliability from 0.40 to 0.82, and Area Under the Curve from 0.79 to 0.85. The influencing factors of insomnia in Chinese adolescents were diverse and complex, including demographic factors (age, gender, etc.), physiological factors (genetics, health status, etc.), psychological factors (anxiety, depression, etc.), and behavioral factors (exercise, smoking, etc.). **Conclusion:** The assessment tools and influencing factors of insomnia in Chinese adolescents are diverse. However, there is insufficient validation of the reliability and validity of assessment tools, a severe lack of objectively measured sleep data, and the causal relationship between insomnia and its influencing factors remains unclear. Further research is still required.

Keywords: Insomnia; Adolescent health; Assessment tools; Root cause analysis; Scoping review

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1. Materials and Methods

This study employed the PRISMA extension for scoping reviews (PRISMA-ScR) by Tricco et al. [**?**] as its methodological framework.

1.1 Research Questions

This study addressed two research questions: What are the assessment tools for insomnia in Chinese adolescents? What are the influencing factors of insomnia in Chinese adolescents?

1.2 Inclusion and Exclusion Criteria

Inclusion criteria: (1) Chinese or English literature; (2) Study subjects were Chinese adolescents aged 12–18, or data for this age group could be extracted separately; (3) Research focused on insomnia, where sleep problems involved only insomnia, or data for pure insomnia patients could be extracted separately.

Exclusion criteria: (1) Duplicate publications; (2) Reviews, dissertations, conference proceedings, and qualitative studies; (3) Articles where full text was unavailable; (4) Articles with missing or erroneous data where authors did not provide reasonable explanations; (5) Studies involving patients with comorbidities (e.g., epilepsy), neurodevelopmental disorders (e.g., autism), or clinically diagnosed psychiatric disorders (e.g., depression, anxiety).

1.3 Literature Search Strategy

This study was conducted in October 2022. The searched databases included Web of Science Core Collection, PubMed, China National Knowledge Infras-

tructure, Wanfang Data Knowledge Service Platform, and VIP Database, with search dates from inception to March 1, 2023. For Chinese databases, using CNKI as an example, the search strategy was: (SU%= 'insomnia' + 'chronic insomnia') AND (SU%= 'adolescents' + 'adolescence' + 'high school students' + 'middle school students'). For English databases, using Web of Science Core Collection as an example, the search strategy was: #1 TS=((insomnia*)) OR TS=(chronic insomnia*); #2 ((((TS=(adolescen*)) OR TS=(teenager*)) OR TS=(juvenil*)) OR TS=(high school student*)) OR TS=(middle school student*); #3 (TS=(China)) OR TS=(Chinese); #4 (#1 AND #2 AND #3).

1.4 Literature Screening

Retrieved literature titles and abstracts were managed and deduplicated using Endnote software. Two researchers independently conducted initial screening by reviewing titles and abstracts according to the inclusion and exclusion criteria, followed by full-text review for secondary screening. After completing the secondary screening, the two researchers cross-checked their results, with disagreements resolved by consulting experienced researchers in the team. The literature screening process is shown in [Figure 1: see original paper].

1.5 Data Extraction

Two researchers independently extracted data from the included literature, with disagreements discussed with experienced team members. Extracted information included authors, publication year, region, research design, sample size, assessment tools, prevalence, and influencing factors.

2. Results

2.1 Basic Characteristics of Included Literature

A total of 39 articles met the inclusion criteria [**?**], including 34 English articles and 5 Chinese articles. These 39 articles originated from 23 studies. For clarity, we focused on the number of research projects meeting inclusion criteria rather than the number of published papers; thus, multiple papers from the same parent study were integrated. One study [**?**] investigated insomnia among adolescents in Guangdong Province and Macao Special Administrative Region, two studies [**?**, **?**] had nationwide samples, and the remaining 20 studies focused on Hong Kong Special Administrative Region (n=5) [**?**, **?**, **?**, **?**, **?**], Shandong Province (n=3) [**?**, **?**, **?**], Guangdong Province (n=3) [**?**], Shanghai (n=2) [**?**, **?**], Guangxi Zhuang Autonomous Region (n=2) [**?**, **?**], Sichuan Province (n=2) [**?**, **?**], Zhejiang Province (n=1) [**?**], Shaanxi Province (n=1) [**?**], and Hainan Province (n=1) [**?**]. Cross-sectional studies were the predominant design (n=15) [**?**, **?**, **?**, **?**, **?**, **?**, **?**, **?**, **?**, **?**], followed by cohort studies (n=4) [**?**, **?**, **?**, **?**], case-control studies (n=1) [**?**], randomized controlled trials (n=1) [**?**], and mixed-methods studies (n=2) [**?**, **?**]. Sample sizes across the 23 studies ranged from 62 to 33,692 (see).

2.2 Assessment Tools for Insomnia in Chinese Adolescents

2.2.1 Basic Features This study identified eight insomnia assessment tools, which can be divided into two categories: diagnostic criteria from commonly used disease manuals or guidelines (2 tools) and self-report instruments (6 tools). Three studies identified insomnia patients through clinical interviews [**?**, **?**, **?**], with two studies [**?**, **?**] employing diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) and one study [**?**] using criteria from the Chinese Guidelines for the Diagnosis and Treatment of Insomnia Disorders. In addition to clinical interviews, the remaining 20 studies used self-report tools, employing six different instruments: the Insomnia Severity Index (ISI) (n=7) [**?**, **?**, **?**, **?**], self-developed insomnia assessment tools (n=6) [**?**, **?**, **?**, **?**, **?**], the Youth Self-Rating Insomnia Scale (YSIS) (n=2) [**?**, **?**], the Athens Insomnia Scale (AIS) (n=2) [**?**, **?**], the Pittsburgh Sleep Quality Index (PSQI) (n=2) [**?**, **?**], and the Adolescent Health Questionnaire (AHQ) (n=1) [**?**].

The assessment content of these tools for Chinese adolescents included difficulty falling asleep, difficulty maintaining sleep, early morning awakening, daytime functional impairment, bedtime, wake time, sleep onset time, and sleep satisfaction. Three studies [**?**, **?**, **?**] involved localized assessment or development of scales and provided reliability and validity data, while the remaining studies directly adopted assessment tools without psychometric testing. These three studies examined five self-report tools (ISI, AIS, Sleep Quality Index [SQI], YSIS, and AHQ). Internal consistency reliability ranged from 0.50 to 0.83, two-week test-retest reliability from 0.40 to 0.82, and Area Under the Receiver Operating Characteristic Curve (AUC) from 0.79 to 0.85. Additionally, only one study [**?**] reported objectively measured sleep features; all other studies relied on subjective self-reported sleep characteristics.

2.2.2 Scale Descriptions The ISI assesses the severity of subjective insomnia over the past two weeks, comprising 7 items with total scores ranging from 0 to 28. It covers sleep difficulty severity, sleep satisfaction, daytime functional impairment, and sleep-related worry. The ISI has been validated in Chinese adolescents, with a Cronbach' s α coefficient of 0.83, two-week test-retest reliability of 0.79, and an optimal cutoff score of ISI $\geq$ 9 [**?**].

The AIS evaluates the frequency of poor sleep occurring three or more times per week over the past month. It consists of 8 items with total scores from 0 to 24, covering sleep onset, nocturnal awakening, early morning awakening, total sleep time, overall sleep quality, daytime mood, daytime physical functioning, and daytime sleepiness. The AIS has been validated in Chinese adolescents, with a Cronbach' s α coefficient of 0.81, two-week test-retest reliability of 0.80, and an optimal cutoff score of AIS $\geq$ 7 [**?**].

The PSQI assesses sleep quality over the past month, comprising 19 items with seven components and total scores from 0 to 21: subjective sleep quality, sleep

latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Descriptions of YSIS and AHQ are provided below.

2.2.3 Localization Cultural differences across regions may affect adolescents' perception, description, or manifestation of insomnia, necessitating appropriate cultural adaptation and validation of assessment tools to ensure their applicability in different cultural contexts. Among all included studies, four involved localization, evaluation, or development of assessment tools: one study [**?**] applied Chinese insomnia guidelines, one study [**?**] compared the psychometric properties of three tools (ISI, AIS, and SQI) for assessing insomnia in Chinese adolescents, and two studies [**?**, **?**] reported developing self-report scales suitable for Chinese adolescents (YSIS and AHQ).

Chung et al. [**?**] compared the psychometric properties of Chinese versions of ISI, AIS, and SQI, finding all three to be reliable and valid assessment tools for adolescent insomnia. The correlation coefficients with DSM-IV were 0.37, 0.30, and 0.39, respectively. Cronbach' s α reliabilities were 0.83, 0.81, and 0.65, and two-week test-retest reliabilities were 0.79, 0.80, and 0.72, respectively. ROC curve analysis showed AUC values of 0.85, 0.80, and 0.85, with optimal cutoff scores of ISI $\geq$ 9, AIS $\geq$ 7, and SQI $\geq$ 5.

Liu et al. [**?**] developed the YSIS, which includes 8 items covering difficulty falling asleep, difficulty maintaining sleep, early morning awakening, non-restorative sleep, poor sleep quality, insufficient sleep, sleep dissatisfaction, and daytime functional impairment. The YSIS demonstrated internal consistency reliability of 0.80 and two-week test-retest reliability of 0.82. ROC curve analysis showed an AUC of 0.79, with cutoff scores of 22, 26, and 30 for mild, moderate, and severe insomnia, respectively.

Liu et al. [**?**] developed the AHQ, with all sleep items derived from child and adolescent sleep-related questionnaires, including weekday/weekend bedtime/wake time/sleep duration, sleep latency, sleep need, sleep quality, and sleep satisfaction. The internal consistency of insomnia and sleep-related breathing items was 0.50 and 0.71, respectively. Two-week test-retest reliability, calculated from two randomly selected high school classes (n $\geq$ 87), was 0.40 and 0.49 for insomnia and sleep-related breathing items, respectively. No ROC curve analysis data were reported.

2.3 Influencing Factors of Insomnia in Chinese Adolescents

2.3.1 Demographic Factors The prevalence of insomnia increased significantly with older age [**?**, **?**, **?**], and females were more likely to experience insomnia than males [**?**, **?**]. Zhang et al. [**?**] found that insomnia prevalence across Tanner stages 1–5 during puberty was 3.9%, 4.3%, 7.3%, 7.9%, and 10.9%, respectively, with a female predisposition emerging in late puberty (Tanner stages 4 and 5). High school students were more prone to insomnia than middle school

students [?], and adolescents in Guangdong Province had higher insomnia rates than those in Macao (22.9% vs. 16.5%) [?]. Higher insomnia prevalence was also observed among boarding students [?], those living far from school [?], and rural adolescents [?]. Left-behind adolescents showed significantly higher insomnia symptoms than non-left-behind adolescents (26.3% vs. 19.0%), with symptoms increasing with longer separation duration [?].

2.3.2 Physiological Factors Adolescents with poor physical health [?, ?] were prone to insomnia. Those experiencing frequent pain [?] also showed significantly increased insomnia risk, with a bidirectional relationship between frequent pain and insomnia. Adolescents with a family history of insomnia [?, ?] were more likely to experience insomnia. Wing et al. [?] found heritability estimates of $(0.48\$\pm0.13)for current insomnia disorder and (0.61\pm0.11)for lifetime insomnia disorder; after exclu$ for current and lifetime insomnia, respectively. Menarche was associated with increased insomnia symptom risk, though this effect disappeared in late adolescence [?]. Evening chronotype adolescents were more likely to experience insomnia than morning or intermediate types [?]. Daytime sleepiness showed a positive correlation with insomnia, with a bidirectional relationship [?].

2.3.3 Psychological Factors Poor mental health status [?] showed a positive correlation with insomnia. Adolescents with depression [?, ?, ?, ?, ?], anxiety [?, ?, ?, ?], high stress [?, ?], or traumatic experiences [?, ?, ?, ?] had significantly increased insomnia prevalence, with all these factors demonstrating bidirectional relationships with adolescent insomnia. Adolescents experiencing high-intensity life events [?] showed increased insomnia prevalence, as did those with fear related to COVID-19 [?].

2.3.4 Behavioral Factors Adolescents who did not exercise [?, ?] or had long sedentary time [?] showed significantly increased insomnia risk. Gaming disorder [?] or problematic internet use [?, ?] was positively correlated with insomnia. Adolescents with napping habits [?] also showed increased insomnia prevalence. One study [?] found smoking was associated with increased insomnia risk, while another [?] suggested the relationship between smoking and insomnia was influenced by smoking status: current smoking was positively associated with difficulty maintaining sleep but negatively associated with difficulty falling asleep and early morning awakening, whereas experimental smoking (smoking once or a few times) was positively correlated with all three insomnia manifestations. One study [?] found alcohol consumption was associated with increased insomnia risk, while another [?] suggested the relationship was influenced by drinking frequency: weekly drinkers were prone to difficulty maintaining sleep, while less-than-weekly drinkers showed positive correlations with all three insomnia manifestations. Adolescents who consumed coffee [?], had self-selected diets [?], or had poor nutritional status [?] also showed increased insomnia risk.

3. Discussion

3.1 Assessment Tools

The prevalence of insomnia among Chinese adolescents varies considerably across studies (4.2%–54.15%), likely due to inconsistent assessment tools and criteria. This study found that the most commonly used assessment tools were the ISI and self-developed insomnia assessment tools. For example, the ISI assesses the severity of insomnia, while self-developed tools measure the frequency of insomnia clinical manifestations. The ISI includes evaluations of daytime functional impairment, sleep satisfaction, and sleep-related worry in addition to clinical manifestations, whereas self-developed tools focus solely on clinical manifestations.

Consistency and accuracy of assessment tools are crucial for obtaining reliable data. Using appropriate assessment tools is fundamental to understanding the epidemiological characteristics of insomnia in Chinese adolescents, identifying risk factors, evaluating treatment effects, formulating public health policies, and promoting international collaboration and comparative research. To better understand the epidemiological features of insomnia in Chinese adolescents, future research should clarify the definition of insomnia, attend to differences between assessment tools, and articulate the purpose of tool selection. Since cultural differences across regions may affect adolescents' perception, description, or manifestation of insomnia, tool selection should also consider cultural adaptability and psychometric properties. However, this review found that few studies examined the reliability and validity of assessment tools.

Furthermore, among all included studies, only one [**?**] reported objectively measured sleep features, indicating a severe shortage of objective sleep data. Objective sleep measurement data are significant for insomnia research as they can avoid self-report bias and employ consistent indicators across studies, including sleep onset time, wake time, sleep latency, time in bed, deep sleep duration, light sleep duration, and rapid eye movement sleep, thereby facilitating dialogue between different studies. Traditional polysomnography provides precise sleep data and is considered the gold standard for objective sleep measurement, but its high cost and space limitations hinder application. Recent rapid development of intelligent wearable devices (e.g., actigraphy, forehead sleep monitors, smart wristbands) has made large-scale objective sleep measurement possible, as these devices can monitor sleep cycles in real-time through built-in sensors (e.g., accelerometers, heart rate monitors, blood oxygen sensors).

3.2 Influencing Factors

The influencing factors of insomnia in Chinese adolescents are diverse and complex, involving demographic, physiological, psychological, and behavioral factors. Therefore, improving the current situation of adolescent insomnia requires multidisciplinary collaboration, multi-system coordination, and multi-faceted efforts.

Integrating medical and psychological expertise. Adolescent insomnia is influenced by both physiological and psychological factors, necessitating joint efforts from clinical medical experts and psychologists to provide comprehensive treatment. Clinicians can treat physical diseases, improve somatic discomfort, relieve pain, and prescribe appropriate medication for adolescents with insomnia. Psychologists focus on identifying and addressing psychological and behavioral factors contributing to insomnia, improving sleep quality by modifying sleep-disruptive behaviors and thought patterns, and alleviating psychological distress.

Involving family, education, and healthcare systems. Sleep hygiene education for adolescents should not be limited to a single system but should involve multi-system integration and joint efforts to provide multi-level support. Strengthening primary healthcare services to integrate diagnosis, treatment, referral, and health management for common and frequently occurring diseases can optimize the primary care environment for sleep and enhance primary care physicians' ability to diagnose and treat adolescent insomnia. Promoting sleep health education in schools through classroom teaching, thematic education, and daily activities can improve students' awareness of sleep health. Vigorous development of sleep medicine and related research fields should be encouraged, establishing collaborative and data-sharing mechanisms for adolescent insomnia in China to promptly track prevalence trends, influencing factors, and regional differences, with active translation of research findings into practical guidelines to guide sleep health interventions in schools and medical institutions.

Adolescents' self-management. On the one hand, adolescents themselves need to strengthen sleep health awareness, establish regular sleep patterns, develop habits of going to bed and waking at consistent times to shape healthy circadian rhythms, maintain healthy diets and appropriate exercise to enhance physical fitness and immunity, correctly perceive academic pressure, and learn to adjust negative emotions. On the other hand, governments need to improve monitoring systems for adolescent sleep conditions, conduct regular sleep and mental health screenings, and integrate resources from school health promotion programs, community street and social media science popularization, and adolescent medical and health services to provide appropriate sleep education resources for adolescents, timely assessment and psychological support for those at high risk of insomnia, and professional diagnosis and treatment services for adolescents troubled by insomnia.

3.3 Future Research Directions

First, due to inconsistent assessment tools and criteria across studies, the prevalence of insomnia among Chinese adolescents varies widely (4.2%-54.15%). To more accurately understand the epidemiological characteristics of insomnia in Chinese adolescents, future research should establish collaborative and data-sharing mechanisms, conduct comprehensive and objective examinations of assessment tools' psychometric properties, select appropriate tools, establish stan-

dardized data collection procedures, and increase objective sleep data (e.g., polysomnography, actigraphy, forehead sleep monitors) to avoid participants' self-report bias and enhance comparability between studies.

Second, although many influencing factors have been identified, the research methods are relatively homogeneous, primarily cross-sectional studies, which limits the ability to determine causality. Cross-sectional studies collect data at a single time point and are vulnerable to confounding variables, making it difficult to establish causal relationships between variables. Longitudinal studies can help reveal developmental trajectories of insomnia over time and the long-term effects of different factors, enabling identification of early warning signals for insomnia in Chinese adolescents. Therefore, more longitudinal studies are needed to elucidate the underlying mechanisms.

Third, there is a significant gap in treatment research for insomnia in Chinese adolescents. Among the 23 included studies, only one [**?**] addressed insomnia treatment. Future research should pay greater attention to treatment, comprehensively considering China' s cultural background, social environment, education system, and family values to explore the effectiveness and feasibility of cognitive behavioral therapy, pharmacological treatment, and traditional Chinese medicine methods (e.g., acupuncture, massage, herbal medicine), and design appropriate treatment protocols for Chinese adolescents.

This study summarized the assessment tools and influencing factors of insomnia in Chinese adolescents, finding diverse tools and complex influencing factors. However, current research lacks adequate validation of tool reliability and validity, suffers from severe shortages of objective measurement data, and relies predominantly on cross-sectional designs that cannot reveal causal relationships or developmental trajectories. Future research should validate existing tools, provide objective measurement data, employ more diverse methodologies such as longitudinal studies to explore influencing factors, and address the significant gap in treatment research. We call for more scholars to focus on developing appropriate treatment protocols for Chinese adolescents with insomnia.

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References

[**?**] COLRAIN I M, BAKER F C. Changes in sleep as a function of adolescent development J. Neuropsychol Rev, 2011, 21(1): 5-21. DOI:10.1007/s11065-010-9155-5.

[?] ILLINGWORTH G. The challenges of adolescent sleep J. Interface Focus, 2020, 10(3): 20190080. DOI:10.1098/rsfs.2019.0080.

[?] JOHNSON E O, ROTH T, SCHULTZ L, et al. Epidemiology of DSM-IV insomnia in adolescence: lifetime prevalence, chronicity, and an emergent gender difference J. Pediatrics, 2006, 117(2): e247-256. DOI:10.1542/peds.2004-2629.

[?] DE ZAMBOTTI M, GOLDSTONE A, COLRAIN I M, et al. Insomnia disorder in adolescence: diagnosis, impact, and treatment J. Sleep medicine reviews, 2018, 39: 12-24. DOI:10.1016/j.smrv.2017.06.009.

[?] BADIN E, HADDAD C, SHATKIN J P. Insomnia: the sleeping giant of pediatric public health J. Current psychiatry reports, 2016, 18: 1-8. DOI:10.1007/s11920-016-0687-0.

[?] BLAKE M J, TRINDER J A, & ALLEN N B. Mechanisms underlying the association between insomnia, anxiety, and depression in adolescence: implications for behavioral sleep interventions J. Clinical psychology review, 2018, 63: 25-40. DOI:10.1016/j.cpr.2018.05.006.

[?] OLDS T, BLUNDEN S, PETKOV J, et al. The relationships between sex, age, geography and time in bed in adolescents: a meta-analysis of data from 23 countries J. Sleep medicine reviews, 2010, 14(6): 371-378. DOI:10.1016/j.smrv.2009.12.002.

[?] LIU X C, LIU L L, OWENS J A, et al. Sleep patterns and sleep problems among schoolchildren in the United States and China J. Pediatrics, 2005, 115(s1): 241-249. DOI:10.1542/peds.2004-0815F.

[?] CHEN T, WU Z, SHEN Z, et al. Sleep duration in Chinese adolescents: biological, environmental, and behavioral predictors J. Sleep medicine, 2014, 15(11): 1345-1353. DOI:10.1016/j.sleep.2014.05.018.

[?] TAN C. Parental responses to education reform in Singapore, Shanghai and Hong Kong J. Asia Pacific Education Review, 2019, 20(1): 91-99. DOI:10.1007/s12564-018-9571-4.

[?] TRICCO A C, LILLIE E, ZARIN W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation J. Annals of internal medicine, 2018, 169(7): 467-473. DOI:10.7326/m18-0850.

[?] CHUNG K F, KAN K K K, YEUNG W F. Assessing insomnia in adolescents: comparison of insomnia severity index, Athens insomnia scale and sleep quality index J. Sleep medicine, 2011, 12(5): 463-470. DOI:10.1016/j.sleep.2010.09.019.

[?] CHUNG K F, KAN K K K, YEUNG W F. Insomnia in adolescents: prevalence, help-seeking behaviors, and types of interventions J. Child and Adolescent Mental Health, 2014, 19(1): 57-63. DOI:10.1111/camh.12009.

[?] ZHANG J H, LAM S P, LI S X, et al. Insomnia, sleep quality, pain, and somatic symptoms: sex differences and shared genetic components J. Pain, 2012, 153(3): 666-673. DOI:10.1016/j.pain.2011.12.003.

[?] WING Y K, ZHANG J H, LAM S P, et al. Familial aggregation and heritability of insomnia in a community-based study J. Sleep medicine, 2012, 13(8): 985-990. DOI:10.1016/j.sleep.2012.04.013.

[?] ZHANG J H, LAM S P, LI S X, et al. A community-based study on the association between insomnia and hypothalamic-pituitary-adrenal axis: sex and pubertal influences J. The Journal of Clinical Endocrinology & Metabolism, 2014, 99(6): 2277-2287. DOI:10.1210/jc.2013-3728.

[?] ZHANG J H, CHAN N Y, LAM S P, et al. Emergence of sex differences in insomnia symptoms in adolescents: a large-scale school-based study J. Sleep, 2016, 39(8): 1563-1570. DOI:10.5665/sleep.6022.

[?] LI S X, CHAN N Y, YU M W M, et al. Eveningness chronotype, insomnia symptoms, and emotional and behavioural problems in adolescents J. Sleep medicine, 2018, 47: 93-99. DOI:10.1016/j.sleep.2018.03.025.

[?] CHEN S J, ZHANG J H, LI S X, et al. The trajectories and associations of eveningness and insomnia with daytime sleepiness, depression and suicidal ideation in adolescents: a 3-year longitudinal study J. Journal of affective disorders, 2021, 294: 533-542. DOI:10.1016/j.jad.2021.07.033.

[?] MAK K K, HO S Y, THOMAS G N, et al. Smoking and sleep disorders in Chinese adolescents J. Sleep medicine, 2010, 11(3): 268-273. DOI:10.1016/j.sleep.2009.07.017.

[?] HUANG R, HO S Y, LO W S, et al. Alcohol consumption and sleep problems in Hong Kong adolescents J. Sleep medicine, 2013, 14(9): 877-882. DOI:10.1016/j.sleep.2013.03.022.

[?] ZHANG J H, LAM S P, LI S X, et al. Longitudinal course and outcome of chronic insomnia in Hong Kong Chinese children: a 5-year follow-up study of a community-based cohort J. Sleep, 2011, 34(10): 1395-1402. DOI:10.5665/sleep.1286.

[?] LIU X C, CHEN H, LIU Z Z, et al. Early menarche and menstrual problems are associated with sleep disturbance in a large sample of Chinese adolescent girls J. Sleep, 2017, 40(9). DOI:10.1093/sleep/zsx107.

[?] LIU B P, WANG X T, LIU Z Z, et al. Stressful life events, insomnia and suicidality in a large sample of Chinese adolescents J. Journal of affective disorders, 2019, 249: 404-409. DOI:10.1016/j.jad.2019.02.047.

[?] LIU X C, YANG Y Y, LIU Z Z, et al. Psychometric properties of youth self-rating insomnia scale (YSIS) in Chinese adolescents J. Sleep and Biological Rhythms, 2019, 17: 339-348. DOI:10.1093/sleep/zsz067.751.

[?] LIU X C, YANG Y Y, LIU Z Z, et al. A longitudinal study of bidirectional associations between frequent pain and insomnia symptoms in adolescents J. Sleep Health, 2022, 8(5): 467-474. DOI:10.1016/j.sleh.2022.05.009.

[?] LIU X C, YANG Y Y, LIU Z Z, et al. Associations between insomnia, daytime sleepiness, and depressive symptoms in adolescents: a three-wave longitudinal study J. Journal of Clinical Medicine, 2022, 11(23): 6912. DOI:10.3390/jcm11236912.

[?] LIU Z Z, JIA C X, LIU X C. Excessive daytime sleepiness mediates the relationship between insomnia symptoms and suicidal behavior in adolescents J. Sleep, 2022, 45(11): zsac221. DOI:10.1093/sleep/zsac221.

[?] YANG Y Y, LIU X C, LIU Z Z, et al. Life stress, insomnia, and anxiety/depressive symptoms in adolescents: a three-wave longitudinal study J. Journal of Affective Disorders, 2023, 322: 91-98. DOI:10.1016/j.jad.2022.11.002.

[?] LIU X C, UCHIYAMA M, OKAWA M, et al. Prevalence and correlates of self-reported sleep problems among Chinese adolescents J. Sleep: Journal of Sleep Research & Sleep Medicine, 2000.

[?] LIU X C, ZHOU H B. Sleep duration, insomnia and behavioral problems among Chinese adolescents J. Psychiatry research, 2002, 111(1): 75-85. DOI:10.1016/S0165-1781(02)00104-8.

[?] LIU X C, ZHAO Z T, JIA C, et al. Sleep patterns and problems among Chinese adolescents J. Pediatrics, 2008, 121(6): 1165-1173. DOI:10.1542/peds.2007-1464.

[?] LIU X C, ZHAO Z T, JIA C X. Insomnia symptoms, behavioral/emotional problems, and suicidality among adolescents of insomniac and non-insomniac parents J. Psychiatry research, 2015, 228(3): 797-802. DOI:10.1016/j.psychres.2015.05.023.

[?] LI J B, LAU J T F, MO P K H, et al. Insomnia partially mediated the association between problematic Internet use and depression among secondary school students in China J. Journal of behavioral addictions, 2017, 6(4): 554-563. DOI:10.1556/2006.6.2017.085.

[?] LUO C L, ZHANG J H, PAN J Y. One-year course and effects of insomnia in rural Chinese adolescents J. Sleep, 2013, 36(3): 377-384. DOI:10.5665/sleep.2454.

[?] LUO C L, PAN J Y, CHEN W J, et al. Investigation and analysis of insomnia status and related factors among adolescents in Longmen County, Guangdong J. Chinese Journal of Clinical Psychology, 2012, 20(3): 401-403. DOI:10.16128/j.cnki.1005-3611.2012.03.033.

[?] PAN J Y, CHOU M F, ZHANG J, et al. Sleep patterns, insomnia, and daytime sleepiness between Guangdong and Macau Chinese adolescents: a cross-cultural comparison study J. Biological rhythm research, 2012, 43(5): 527-539. DOI:10.1080/09291016.2011.614791.

[?] LIU S, JIANG Y R, LIN Q M, et al. Study on the correlation between negative emotions and insomnia symptoms among middle school students

in Shanghai J. Chinese Journal of Child Health Care, 2019, 27(9): 936-940. DOI:10.11852/zgetbjzz2019-0162.

[?] LIU Y J, WANG R X, GONG R J, et al. The trajectories and associations of insomnia symptoms with addictive behaviours in adolescents: A two-year longitudinal study J. Journal of Sleep Research, 2023: e13817. DOI:10.1111/jsr.13817.

[?] WEI Q Y, PAN Y L, ZHANG S J, et al. Epidemiology of childhood trauma and its association with insomnia and psychotic-like experiences in Chinese Zhuang adolescents J. Frontiers in Psychiatry, 2022, 13. DOI:10.3389/fpsyt.2022.974674.

[?] WEI Q Y, ZHANG S J, PAN Y L, et al. Epidemiology of gaming disorder and its effect on anxiety and insomnia in Chinese ethnic minority adolescents J. BMC psychiatry, 2022, 22(1): 1-9. DOI:10.1186/s12888-022-03894-3.

[?] LU C P, CHI X L, LIANG K X, et al. Moving more and sitting less as healthy lifestyle behaviors are protective factors for insomnia, depression, and anxiety among adolescents during the COVID-19 pandemic J. Psychology research and behavior management, 2020: 1223-1233. DOI:10.2147/PRBM.S284103.

[?] CHI X L, LIANG K X, CHEN S T, et al. Mental health problems among Chinese adolescents during the COVID-19: The importance of nutrition and physical activity J. International Journal of Clinical and Health Psychology, 2021, 21(3): 100218. DOI:10.1016/j.ijchp.2020.100218.

[?] TANG W J, DAI Q, WANG G, et al. Impact of parental absence on insomnia and nightmares in Chinese left-behind adolescents: A structural equation modeling analysis J. Children and Youth Services Review, 2020, 114: 105076. DOI:10.1016/j.childyouth.2020.105076.

[?] GENG F L, LIANG Y X, LI Y Y, et al. Bidirectional associations between insomnia, posttraumatic stress disorder, and depressive symptoms among adolescent earthquake survivors: a longitudinal multiwave cohort study J. Sleep, 2019, 42(11): zsz162. DOI:10.1093/sleep/zsz162.

[?] XU O, QI P, ZHU Q S. Effect of cognitive behavioral therapy combined with virtual reality technology in the treatment of adolescent insomnia patients J. Chinese General Practice, 2022, 25(11): 1378-1382. DOI:10.12114/j.issn.1007-9572.2021.01.412.

[?] WANG L N, LEI H, JIANG H, et al. Correlation between internet gaming disorder and sleep quality among middle school students in Xi' an J. Chinese Journal of School Health, 2022, 43(7): 1046-1050. DOI:10.16835/j.cnki.1000-9817.2022.07.021.

[?] DUAN F F, WANG P P, ZHENG Q L, et al. Correlation analysis between sleep quality and school bullying victimization among middle school students in Sanya J. Chinese General Practice, 2021, 24(26): 3330-3337. DOI:10.12114/j.issn.1007-9572.2021.01.011.

[?] LIU S H, ZOU S Q, ZHANG D, et al. Problematic internet use and academic engagement during the COVID-19 lockdown: the indirect effects of depression, anxiety, and insomnia in early, middle, and late adolescence J. Journal of Affective Disorders, 2022, 309: 9-18. DOI:10.1016/j.jad.2022.04.043.

[?] ZHOU S J, WANG L L, WANG T T, et al. Associations between experienced aggression, poor sleep, and suicide risk among Chinese adolescents J. Sleep, 2022, 45(6): zsac048. DOI:10.1093/sleep/zsac048.

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Note: Figure translations are in progress. See original paper for figures.