


# Prevalence and Correlates of Insomnia Symptoms in Older Chinese Adults During the COVID-19 Outbreak: A Classification Tree Analysis

Journal of Geriatric Psychiatry and Neurology  
2022, Vol. 0(0) 1–6  
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DOI: 10.1177/08919887221078561  
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## Abstract

**Objective:** To examine prevalence and correlates of insomnia symptoms in older Chinese adults (OCAs) during the COVID-19 outbreak. **Background:** During the COVID-19 pandemic, insomnia is a major health concern of elderly individuals, but its subtypes have not been investigated. **Methods:** Altogether, 590 OCAs (50+ years) were recruited via snowball sampling during the COVID-19 outbreak. Standardized self-report questions were used to assess the presence of difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS), and early morning awakening (EMA). Classification tree analysis (CTA) was used to identify correlates of insomnia. **Results:** The one-month prevalence (95% confidence interval) of any subtype of insomnia symptoms was 23.4% (20.0–26.8%), with DIS, DMS, and EMA being 15.4% (12.5–18.3%), 17.1% (14.1–20.2%), and 11.2% (8.64–13.7%), respectively. Worry about being infected with COVID-19 emerged as the most salient correlate of insomnia ( $P < .001$ ); compared to participants who were not worried about being infected, those who were worried and very worried were 3.2-fold (24.3% vs 7.5%) and 5.5-fold (24.3% vs 7.5%) more likely to have insomnia, respectively. Among participants in the “very worried” branch, those residing in Wuhan were 1.8-fold more likely to have insomnia than those residing in other places (50.0% vs 27.5%,  $P = .011$ ). Among participants in the “worried” branch, unemployed persons were 2.0-fold more likely to have insomnia than employed persons (37.0% vs 18.1%,  $P < .001$ ). **Conclusions:** Insomnia symptoms were prevalent among OCAs during the COVID-19 outbreak. Selective intervention programs targeting elderly individuals who are worried about being infected, living in the epicenter of COVID-19, and unemployed might be effective.

## Keywords

insomnia, elderly, COVID-19, prevalence, classification tree

## Introduction

Older adults are a vulnerable subgroup of the population affected by the ongoing COVID-19 pandemic. For example, in China, like in many other countries, 53.6% of the patients with confirmed COVID-19 and 93.7% of deaths due to COVID-19 are individuals aged 50 years and older.<sup>1</sup> As a result, older adults are more likely to be advised to stay indoors, and people are more likely to maintain social distancing with older adults during the COVID-19 pandemic. For example, after the COVID-19 outbreak in China began, for a long time, routine family visits to see older adults living in nursing homes were not allowed, and older adults were less likely to attend hospitals to receive treatment in a timely manner because of fears of contracting COVID-19. Therefore, there have been increasing concerns regarding the poor mental health, loneliness,

suicide risk, and sleep problems in older adults during the COVID-19 pandemic.<sup>2</sup>

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Received 4/25/2021. Received revised 5/13/2021. Accepted 5/24/2021.

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The pandemic has disrupted many routines of people. Despite longer sleep duration during the stay-at-home period than before the pandemic, people still reported deteriorated subjective sleep quality due to the cooccurring depressed mood, anxiety, and fears of economic loss.<sup>3,4</sup> Since the pandemic, there have been many studies examining sleep problems in the general populations of various countries<sup>5,6</sup>; nevertheless, few of them have focused on older adults. Furthermore, prevalence estimates of sleep problems in the elderly population vary widely across existing studies. For example, the prevalence rates of insomnia were 22.4–67.0%, 35.7–39.8%, and 37.9% in studies that used the Pittsburgh Sleep Quality Index, Insomnia Severity Index, and Athens insomnia scale, respectively, to screen for insomnia in older adults amid the COVID-19 pandemic.<sup>7–13</sup> Because the management of insomnia and the risk of developing other mental health problems differ across insomnia subtypes,<sup>14</sup> the clinical relevance of the above prevalence data, based on cutoff scores of self-report scales, is very limited.

In the clinical research literature, traditional regression methods (i.e., multiple logistic regression analysis) are commonly used to identify factors associated with clinical outcomes. Accordingly, a variety of factors have been found to be associated with insomnia in the general population during the pandemic, including rural residence, poor knowledge of COVID-19 prevention, poor physical health, poor emotional health, intolerance to uncertainty, COVID-19-related worry, loneliness, and depressive symptoms.<sup>9,10,12,15</sup> However, these traditional statistical findings may not be easily applied to routine clinical and primary care practice because the research results are not presented in a user-friendly format for healthcare workers with limited statistical understanding.<sup>16</sup> In contrast, classification tree analysis (CTA) is well suited for identifying subgroups at higher risk for a target outcome and nonlinear interactions between factors when predicting a binary outcome; in particular, its findings on correlates could be presented in a more user-friendly way than the findings of traditional methods.<sup>16,17</sup>

The COVID-19 outbreak has overwhelmed healthcare systems and exhausted the medical resources of many countries. In this context, intervention programs targeting subgroups at elevated risk for insomnia, rather than only individuals with a single risk factor, would produce larger effects than universal programs. Considering that CTA is well suited for investigating this situation and that correlates of insomnia in the elderly population during the pandemic have been insufficiently studied, the present study used CTA to examine the prevalence of insomnia symptoms, including difficulty initiating sleep (DIS), difficulty maintaining

sleep (DMS), and early morning awakening (EMA), and correlates of insomnia symptoms.

## Methods

### Participants

The study sample was 590 older adults from a large-scale online survey that investigated mental health, insomnia symptoms, and the use of mental health services in the Chinese general population during the COVID-19 outbreak period in China.<sup>18</sup> Participants who were aged 50 years and older and voluntarily took part in the survey were included in the current analysis. Persons who reported having been infected with COVID-19 were excluded. For logistical reasons, snowball sampling via social media platforms was used to recruit participants. Details of the sampling have been reported elsewhere.<sup>19,20</sup>

The Ethics Committee of Wuhan Mental Health Center approved the survey protocol before the formal survey. All participants signed informed consent online before completing the questionnaire.

### Instruments

The survey questionnaire was completed by participants online. Sociodemographic variables in the questionnaire were sex, age, marital status, education, employment status, and current residence location (Wuhan vs other places).

Worry about COVID-19. Two questions in which participants indicated a rating on a three-point scale (1 = not worried, 2 = worried, 3 = very worried) were used to assess participants' worry about being infected with COVID-19 and worry about family members being infected with COVID-19: "Are you worried about being infected with COVID-19?" and "Are you worried about your family members being infected with COVID-19?"

COVID-19 impact. A question in which participants indicated a rating on a four-point scale (1 = none, 2 = mild, 3 = medium, 4 = severe) was used to assess the extent of the negative impact of the COVID-19 outbreak on the daily life of respondents: "How severe is the negative impact of the COVID-19 outbreak on your daily life?"

Insomnia symptoms. In accordance with previous studies,<sup>21,22</sup> three basic forms of insomnia symptoms during the past month were investigated by asking how often the interviewee had difficulties in falling asleep (DIS), experienced difficulties in maintaining sleep and woke up often (DMS), and woke up at midnight or early morning and then had difficulties in falling asleep again (EMA). Each question had three answer options: no, sometimes, or often. If a participant answered "often" to

**Table 1.** Sociodemographic Characteristics, COVID-19-Related Worry, and COVID-19 Impact of Older Chinese Adults During the COVID-19 Outbreak, n (%).

Variable		Total Sample (n = 590)	Without Insomnia Symptoms (n = 452)	With Insomnia Symptoms (n = 138)	$\chi^2$	P
Age-group	50–59 years	487 (82.5)	379 (83.8)	108 (78.3)	2.292	.130
	60+ years	103 (17.5)	73 (16.2)	30 (21.7)		
Gender	Male	219 (37.1)	173 (38.3)	46 (33.3)	1.106	.293
	Female	371 (62.9)	279 (61.7)	92 (66.7)		
Marital status	Married	531 (90.0)	415 (91.8)	116 (84.1)	7.067	.008
	Others <sup>a</sup>	59 (10.0)	37 (8.2)	22 (15.9)		
Education	Senior middle school and below	158 (26.8)	115 (25.4)	43 (31.2)	1.762	.184
	College degree and above	432 (73.2)	337 (74.6)	95 (68.8)		
Employed	Yes	403 (68.3)	326 (72.1)	77 (55.8)	13.017	<.001
	No	187 (31.7)	126 (27.9)	61 (44.2)		
Current residence place	Wuhan	227 (38.5)	154 (34.1)	73 (52.9)	15.832	<.001
	Other places	363 (61.5)	298 (65.9)	65 (47.1)		
Worry about being infected	Not worried	159 (26.9)	147 (32.5)	12 (8.7)	44.267	<.001
	Worried	304 (51.5)	230 (50.9)	74 (53.6)		
	Very worried	127 (21.5)	75 (16.6)	52 (37.7)		
Worry about family being infected	Not worried	89 (15.1)	81 (17.9)	8 (5.8)	21.408	<.001
	Worried	290 (49.2)	229 (50.7)	61 (44.2)		
	Very worried	211 (35.8)	142 (31.4)	69 (50.0)		
Negative impact of COVID-19	Mild	79 (13.4)	72 (15.9)	7 (5.1)	23.330	<.001
	Medium	303 (51.4)	242 (53.5)	61 (44.2)		
	Severe	208 (35.3)	138 (30.5)	70 (50.7)		

<sup>a</sup>“Others” included re-married, co-habiting, separated, divorced, and widowed.

the question, he/she was considered to have a corresponding subtype of insomnia.

### Statistical Analysis

IBM SPSS software version 22.0 package (SPSS Inc., Chicago, Illinois, United States) was used for all analyses. Prevalence rates of any insomnia symptoms, DIS, DMS, and EMA were calculated. To characterize older adults with any insomnia symptoms, we compared sociodemographic and COVID-19-related variables between participants with and without insomnia symptoms by using the Chi-square test.

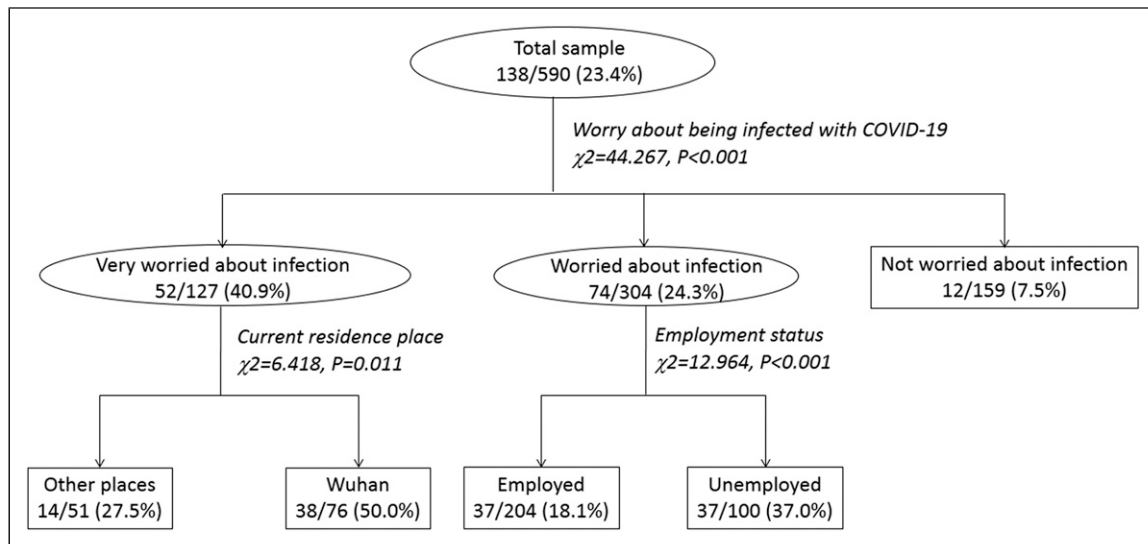
We used the exhaustive Chi-squared automatic interaction detection (exhaustive CHAID) growing method to perform CTA. The significance levels for splitting nodes and merging categories were set at  $P < .05$  and were adjusted by using a Bonferroni method. By default, the maximum number of levels of growth beneath the root node was set at 3, and the minimum node sizes were set at 100 for parent nodes and 50 for child nodes. The target category of the dependent variable in the CTA was the presence of any insomnia symptoms, and all socio-demographic and COVID-19-related variables were considered input variables. The CTA model was established by

comparing Chi-square statistics of all possible categories in relation to insomnia symptoms. As a result, the elderly sample in our study was divided into branch-like segments that constructed an inverted tree with a root node, internal nodes, and end nodes. Meanwhile, correlates of insomnia symptoms were automatically identified, in the order of importance, from the root node to end nodes in the classification tree.<sup>23</sup> Because CTA is robust for investigating interactions between factors,<sup>24</sup> the tree provided a direct pathway for understanding the underlying mechanisms of insomnia.

### Results

The mean age of the 590 older adults was 55.3 years (standard deviation [SD] = 5.5, range: 50–87), and 219 (37.1%) were men. The numbers of participants who were not worried, worried, and very worried about being infected with COVID-19 were 159 (26.9%), 304 (51.5%), and 127 (21.5%), respectively. Other detailed socio-demographic and COVID-19-related characteristics are displayed in Table 1.

The numbers of participants with DIS, DMS, EMA, and at least one subtype of insomnia symptoms were 91, 101, 66, and 138, respectively. The corresponding prevalence



**Figure 1.** Classification tree for correlates of insomnia symptoms in older Chinese adults during the COVID-19 outbreak.

rates of DIS, DMS, EMA and at least one subtype of insomnia symptoms were 15.4% (95% confidence interval [CI]: 12.5–18.3%), 17.1% (95%CI: 14.1–20.2%), 11.2% (95%CI: 8.64–13.7%), and 23.4% (95%CI: 20.0–26.8%), respectively.

As shown in Table 1, compared to participants without insomnia, those with insomnia were significantly more likely to have a marital status of “others,” be unemployed, reside in Wuhan, worry about being infected, worry about family members being infected, and be severely impacted by the pandemic ( $P \leq .008$ ).

Significant correlates of insomnia symptoms are depicted in Figure 1. Worry about being infected with COVID-19 was the most salient correlate of insomnia ( $\chi^2 = 44.267$ ,  $P < .001$ ); compared to participants who were not worried about being infected with COVID-19, those who were worried and very worried were 3.2-fold (24.3% vs 7.5%) and 5.5-fold (24.3% vs 7.5%) more likely to have insomnia, respectively. Among participants in the “very worried” branch of the classification tree, relative to those who resided in other places, those who resided in Wuhan were 1.8-fold more likely to have insomnia (50.0% vs 27.5%,  $\chi^2 = 6.418$ ,  $P = .011$ ). Among participants in the “worried” branch, relative to those who were employed, those who were unemployed were 2.0-fold more likely to have insomnia (37.0% vs 18.1%,  $\chi^2 = 12.964$ ,  $P < .001$ ).

## Discussion

To the best of our knowledge, this is the first study that examined the prevalence of three basic forms of insomnia symptoms and their associated factors amid the COVID-19 pandemic in the elderly population. The methodology

strength of the current study is the use of CTA, which makes it easy to identify homogeneous subpopulations at elevated risk for insomnia symptoms.

The main finding of this study is the 23.4% prevalence of any subtype of insomnia symptoms, with 15.4%, 17.1%, and 11.2% prevalence of DIS, DMS, and EMA, respectively. These rates in older Chinese adults during the COVID-19 outbreak were much higher than the corresponding rates of 9.2%, 7.0%, 8.0%, and 4.9%, respectively, in the Chinese general population<sup>25</sup>; 8.0%, 3.5%, 5.2%, and 4.3%, respectively, in young Chinese rural residents<sup>26</sup>; and 16.9%, 10.8%, 6.3%, and 2.1%, respectively, in Chinese adolescents.<sup>27</sup> The high prevalence of insomnia symptoms suggests an elevated risk of insomnia symptoms in older Chinese adults during the COVID-19 outbreak.

In addition to the abovementioned cooccurring psychosocial problems during the outbreak, we speculated that stress reactions may account for the high prevalence of insomnia symptoms in the elderly population because the ongoing COVID-19 pandemic is an unprecedented global crisis and there is convincing evidence that exposure to stressful events causes insomnia.<sup>28</sup> Pathophysiological studies have revealed that stress is associated with hyperarousal and increases the infusion of corticotropin-releasing hormone via activation of the hypothalamic–pituitary–adrenal axis, which further disrupts sleep–wake–circadian systems and results in insomnia.<sup>29,30</sup>

Although participants with and without insomnia symptoms significantly differed in terms of six variables in the univariate analysis (Table 1), only three variables were kept in the CTA model, with worry about being infected with COVID-19 being the strongest correlate and residing

in Wuhan and unemployment being the other two correlates. The unemployment-insomnia association in the elderly population was expected since previous studies have confirmed the elevated risk of insomnia in individuals of low socioeconomic status.<sup>25,31</sup> The increased prevalence of insomnia in older adults who were worried about being infected is consistent with the increased risk of sleep problems in Greek residents with COVID-19-related worry,<sup>15</sup> which reflects the negative impact of the pandemic on the sleep health of older adults. Because of the high infection rate of COVID-19 and the stringent mass quarantine (i.e., lockdown) in Wuhan relative to other places in China, Wuhan residents had a higher likelihood of experiencing stress and mental health problems.<sup>18</sup> For similar reasons, older adults residing in Wuhan were more likely to experience insomnia than those residing in other places. Interestingly, findings from our CTA model showed that the elevated risk of insomnia in older adults who were worried about being infected was further amplified by residing in Wuhan and being employed, suggesting the interactions between worry about being infected and place of residence and employment status.

A few limitations should be considered when interpreting our findings. First, our CTA is exploratory and lacks independent validation. Although a simple approach to identify older adults at increased risk for insomnia was provided in this study, more research is needed to validate the accuracy of this approach in other elderly cohorts. Second, the data were collected cross-sectionally, so the causal associations between identified correlates and insomnia need to be examined in prospective studies. Third, because we considered that mental health problems such as depressive and anxiety symptoms cooccurred with insomnia during the outbreak—together as stress reactions, not risk factors resulting in insomnia—mental health problems were not included in the analysis. The contribution of mental health problems to insomnia risk needs further examination. Finally, our sample of older adults was recruited via convenience sampling, so the sample representativeness might be limited.

In this study, nearly one out of every four older Chinese adults suffered from insomnia symptoms, which suggests a high risk of insomnia symptoms in older adults during the COVID-19 outbreak. Mental health services for this population amid the pandemic should include expanded psychosocial support, periodic screening for insomnia symptoms to ensure early identification of older adults with severe insomnia symptoms, and psychiatric assessment and treatment when necessary. Our findings on correlates of insomnia symptoms suggest that asking individuals about their level of worry of being infected may be the most sensitive method to identify older adults at risk for insomnia. The higher prevalence of insomnia symptoms in several cohorts of older adults suggests that

selective intervention programs targeting older adults who are worried about being infected, living in the epicenter of the COVID-19 pandemic, and unemployed would be more effective for preventing insomnia.

### Acknowledgments

The authors thank all the research staff for their team collaboration work and participants involved in this study for their cooperation and support.

### Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the National Natural Science Foundation of China (grant number: 71774060) and 2015 Irma and Paul Milstein Program for Senior Health Awards from the Milstein Medical Asian American Partnership Foundation. The two funding sources listed had no role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

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### References

1. The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Chin J Epidemiol.* 2020;41(2):145-151.
2. Wand APF, Zhong BL, Chiu HFK, Draper B, De Leo D. COVID-19: the implications for suicide in older adults. *Int Psychogeriatr.* 2020;32(10):1225-1230.
3. De Pue S, Gillebert C, Dierckx E, Vanderhasselt MA, De Raedt R, Van den Bussche E. The impact of the COVID-19 pandemic on wellbeing and cognitive functioning of older adults. *Sci Rep.* 2021;11(1):4636.
4. He L, Gao Y, Gao X, Lei X. Sleep patterns and physical and mental health of residents during the COVID-19: susceptibility factors and coping strategies. *J Southwest Univ.* 2020;42(5):11-20.
5. Jahrami H, BaHammam AS, Bragazzi NL, Saif Z, Faris M, Vitiello MV. Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. *J Clin Sleep Med.* 2021;17(2):299-313.
6. Wu T, Jia X, Shi H, et al. Prevalence of mental health problems during the COVID-19 pandemic: a systematic review and meta-analysis. *J Affect Disord.* 2021;281:91-98.



7. Wang Y, Fu P, Li J, et al. Changes in psychological distress before and during the COVID-19 pandemic among older adults: the contribution of frailty transitions and multimorbidity. *Age Ageing*. 2021;50(4):1011-1018. doi:10.1093/ageing/afab061.
8. Sella E, Carbone E, Toffalini E, Borella E. Self-reported sleep quality and dysfunctional sleep-related beliefs in young and older adults: changes in times of COVID-19 lockdown. *Sleep Med*. 2021;81:127-135.
9. Gao R, Zhang B, Peng S, et al. Mental health status of the general population during the COVID-19 epidemic in Ya'an city. *Chin Ment Health J*. 2021;35(1):79-84.
10. Ji Y, Wang Z, Chen W, Li S, Xie W. Sleep quality and related factors among the general public during the COVID-19 epidemic. *Chin Ment Health J*. 2020;34(9):795-799.
11. Wong SYS, Zhang D, Sit RWS, et al. Impact of COVID-19 on loneliness, mental health, and health service utilisation: a prospective cohort study of older adults with multimorbidity in primary care. *Br J Gen Pract*. 2020;70(700):e817-e824.
12. Wang M, Liu X, Guo H, Fan H, Jiang R, Tan S. Mental health of middle-aged and elderly population during outbreak of coronavirus disease 2019. *Chin J Mult Organ Dis Elder*. 2020;19(4):241-245.
13. Parlapani E, Holeva V, Nikopoulou VA, et al. Intolerance of uncertainty and loneliness in older adults during the COVID-19 pandemic. *Front Psychiatr*. 2020;11:842.
14. Blanken TF, Benjamins JS, Borsboom D, et al. Insomnia disorder subtypes derived from life history and traits of affect and personality. *Lancet Psychiatr*. 2019;6(2):151-163.
15. Voitsidis P, Gliatas I, Bairachtari V, et al. Insomnia during the COVID-19 pandemic in a Greek population. *Psychiatr Res*. 2020;289:113076.
16. Handley TE, Kay-Lambkin FJ, Baker AL, et al. Investigation of a suicide ideation risk profile in people with co-occurring depression and substance use disorder. *J Nerv Ment Dis*. 2016;204(11):820-826.
17. Rohde P, Stice E, Gau JM. Effects of three depression prevention interventions on risk for depressive disorder onset in the context of depression risk factors. *Prev Sci*. 2012;13(6):584-593.
18. Zhong BL, Zhou DY, He MF, et al. Mental health problems, needs, and service use among people living within and outside Wuhan during the COVID-19 epidemic in China. *Ann Transl Med*. 2020;8(21):1392.
19. Zhong BL, Luo W, Li HM, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci*. 2020;16(10):1745-1752.
20. Bao L, Li WT, Zhong BL. Feelings of loneliness and mental health needs and services utilization among Chinese residents during the COVID-19 epidemic. *Glob Health*. 2021;17(1):51.
21. Zhao J, Liu M, Ungvari GS, et al. Prevalence and clinical correlates of insomnia symptoms and their association with quality of life in Chinese patients with HBV-related liver disease. *PeerJ*. 2021;9:e10956.
22. Zheng W, Luo XN, Li HY, et al. Prevalence of insomnia symptoms and their associated factors in patients treated in outpatient clinics of four general hospitals in Guangzhou, China. *BMC Psychiatr*. 2018;18(1):232.
23. Song YY, Lu Y. Decision tree methods: applications for classification and prediction. *Shanghai Arch Psychiatr*. 2015;27(2):130-135.
24. Camp NJ, Slattery ML. Classification tree analysis: a statistical tool to investigate risk factor interactions with an example for colon cancer (United States). *Cancer Causes Control*. 2002;13(9):813-823.
25. Xiang YT, Ma X, Cai ZJ, et al. The prevalence of insomnia, its sociodemographic and clinical correlates, and treatment in rural and urban regions of Beijing, China: a general population-based survey. *Sleep*. 2008;31(12):1655-1662.
26. Chiu HF, Xiang YT, Dai J, et al. The prevalence of sleep problems and their socio-demographic and clinical correlates in young Chinese rural residents. *Psychiatr Res*. 2012;200(2-3):789-794.
27. Liu X, Zhou H. Sleep duration, insomnia and behavioral problems among Chinese adolescents. *Psychiatr Res*. 2002;111(1):75-85.
28. Roberge EM, Bryan CJ. An integrated model of chronic trauma-induced insomnia. *Clin Psychol Psychother*. 2021;28(1):79-92.
29. Ellis JG, Perlis ML, Espie CA, et al. The natural history of insomnia: predisposing, precipitating, coping, and perpetuating factors over the early developmental course of insomnia. *Sleep*. 2021;44(9):zsab095. doi:10.1093/sleep/zsab095.
30. Steiger A. Sleep and the hypothalamo-pituitary-adrenocortical system. *Sleep Med Rev*. 2002;6(2):125-138.
31. Phillips B, Mannino D. Correlates of sleep complaints in adults: the ARIC study. *J Clin Sleep Med*. 2005;1(3):277-283.