



Nightmare frequency and psychopathological problems in a large sample of Chinese adolescents

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Abstract

Purpose Nightmares are common, especially in pediatric populations and psychiatric patients. Nightmares are associated with daytime distress and negative health outcomes. The data on the prevalence and psychopathological profiles of nightmares in Chinese adolescents are limited. This study examined age and gender differences in nightmare frequency and associated psychopathological problems in a large sample of Chinese adolescents.

Methods A total of 11,831 adolescent students (mean age = 14.9, 12–18 years) participated in the baseline survey of Shandong Adolescent Behavior and Health Cohort. Participants completed a self-administered questionnaire to report their nightmare frequency, trait anger, hopelessness, and multiple domains of behavioral/emotional problems. Univariate and multivariate analyses were performed to examine psychopathological problems in relation to nightmare frequency.

Results Of the sample, 45.2% reported having nightmares at least once in the past month and 7.9% at least once/week. Girls reported more frequent nightmares than boys. Nightmare frequency significantly declined with age for both boys and girls. Mean scores on trait anger, hopelessness, attention, internalizing problems, and externalizing problems significantly increased with nightmare frequency. Frequent nightmares (at least once/week) were significantly associated with 2–4-fold increased likelihood of behavioral/emotional problems after adjusting for adolescent and family covariates.

Conclusion Nightmares are prevalent in Chinese adolescents. Frequent nightmares are associated with multiple domains of psychopathological problems. Assessment and intervention of frequent nightmares should be incorporated into routine clinical practice and mental health services in adolescents.

Keywords Nightmares · Prevalence · Behavioral/emotional problems · Adolescents

Introduction

Nightmares are vivid, disturbing, or frightening dreams that result in a startled awakening and usually occur during rapid eye movement (REM) [1–3]. Nightmares are prevalent and are associated with negative health outcomes, including but not limited to sleep disturbance, daytime distress, emotional/behavioral problems, psychosocial functioning impairment, post-traumatic stress disorder, anxiety, depression, psychotic

symptoms, suicidal thought, and self-harm in clinical and general populations [3–11].

Epidemiological studies demonstrate that nightmares are prevalent, with 2–10% of the population reporting having nightmares at least once per week [3, 10, 12]. Nightmares occur more frequently in pediatric populations and psychiatric patients [3, 5, 10]. Nightmares are also very common following stressful life events [3]. Nightmares are more prevalent in early childhood and decline with age [13]. Gender differences in nightmares between adolescents and younger adults are substantial with females reporting nightmares more often than males [1, 14, 15]. However, there are no gender differences in young children and elderly populations in the previous studies [1, 16, 17]. The variation of prevalence rates in the previous studies may be mainly due to different study populations (e.g., pediatric vs. adult populations, general populations vs. psychiatric patients), different definitions (e.g., with or without the awakening criterion),

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or measures (e.g., a single question vs. dream log/diary), different informants (parent vs. self-report), and different timeframes (e.g., last week, last month, last year, or lifetime) used to assess nightmares [1, 15, 18–20].

A number of epidemiological studies of nightmare frequency and psychopathology in relation to nightmares have been conducted in Western pediatric populations [1, 8, 14, 21]. However, the findings observed in Western pediatric populations may not be generalized to Chinese peers due to cultural and psychosocial differences in sleep patterns/problems [22, 23] and mental health problems [24, 25]. Epidemiological data on nightmares among Chinese pediatric populations are limited. To our knowledge, there are three large epidemiological studies of nightmares in Chinese pediatric populations: one study of children in Hongkong [17] and two studies of school adolescents in Mainland China [26–28].

In a cross-sectional survey of 6,359 children aged 5–15 years (mean age = 9.1) in Hongkong [17], Li et al. reported that the prevalence of frequent nightmares (at least once per week) as reported by parents was 5.2% and did not significantly differ by age or gender. Furthermore, the authors found that frequent nightmares were significantly associated with hyperactivity, frequent temper outbursts/mood disturbance, poor academic performance, insomnia symptoms, and parasomnia symptoms. In a cross-sectional survey of 19,299 high school students aged 10–20 years (median age = 14) in Fuzhou, Mainland China [26], Lin et al. used the question “How often did you have nightmares in the previous month?” to ask about nightmares. The prevalence of recurrent nightmares defined as having nightmares “often” or “always” was 7.1%. The authors did not report epidemiological characteristics of nightmares (e.g., age and gender differences) and psychopathology associated with nightmares. One of the major limitations of the 2 studies mentioned above is that nightmares were participants’ own definition/perception of nightmares without an awakening criterion or clear recall of disturbing mentation [10]. Nightmares (with awakening) and bad dreams (without awakening) are differentiated by the awakening criterion. The nightmares reported by the 2 studies may include bad dreams rather than nightmares alone, which may overestimate the prevalence rates of nightmares [1].

Shandong Adolescent Behavior and Health Cohort (SABHC) is a longitudinal study of 11,831 school adolescents aged 12–18 years in Shandong, Mainland China [27–29]. In the study, Liu and colleagues defined nightmares as emotionally intense, frightening, and vivid dreams that awaken the participant from sleep [5, 28]. Approximately 8% of the participants reported having frequent nightmares (at least once/week) in the last month [27]. The authors have demonstrated that frequent nightmares were significantly associated with increased risk of self-harm [5, 28, 30].

In the current analysis of the SABHC baseline data, we aimed to describe age and gender differences in nightmare frequency and associated psychopathology in a large sample of Chinese adolescents. Psychopathology included multiple domains of emotional/behavioral problems, attention problems, trait anger, and hopelessness as assessed by established rating scales. Based on the literature [1, 3, 11, 14, 15, 17, 30, 31], we will test the following hypotheses. First, female adolescents report having nightmares more frequently than male peers. Second, nightmare frequency decreases with advancing age during adolescence. Third, following Levin and Nielsen’s etiological model of nightmares [3, 10], we hypothesized that frequent nightmares are associated with elevated levels of trait anger (a general tendency to react angrily to perceived situations) and multiple dimensions of behavioral and emotional problems, such as anxiety and depressive symptoms, somatic complaints, aggressive behavior, attention problems, and thought problems.

Methods

Participants and procedure

In November–December 2015, the SABHC baseline survey was conducted in 3 counties of Shandong Province, China. Shandong is located in the east coast of China and the lower reaches of the Yellow River. Shandong has a total population of 97.89 million, with 54.62 million being rural residents in 2014 [32]. Detailed sampling and data collection have been reported in our previous publications [29, 33, 34]. Briefly, 3 counties were first selected, and 5 middle schools and 3 high schools were then selected from the 3 target counties, based on geographic location, representativeness of adolescent students in the region, prior study collaboration, convenience for follow-up, and budget to conduct the study. With the permission from the 8 target schools’ principals, all 7th graders and 10th graders in the target schools were requested to participate in the study, and half of the 8th graders, 9th graders, and 11th graders with classes as the primary sampling units were randomly selected for the study.

A self-administered paper-and-pencil questionnaire including standardized rating scales and questions about nightmares, demographics, and family environment was used to collect data [35, 36]. After getting permission from the class teachers of the sampled classes, trained master-level public health workers administered the questionnaire to the students in their classrooms during regular school hours. Before filling out the questionnaire, participants were instructed to read the instructions carefully and informed that the survey was anonymous, and their participation was voluntary without any penalties for nonparticipation. About 45 min were required to complete the questionnaire. The

study was approved by the research ethics committee of Shandong University School of Public Health and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Measures

Nightmare frequency

Two questions were used to assess nightmare frequency experienced during the past year and during the past month, respectively [5, 15, 37]. “In the past year, how often did you have nightmares (emotionally intense, frightening, and vivid dreams that awoken you from sleep)? The response was on a -7-point frequency scale (1 = never, 2 = about once a year, 3 = several times a year, 4 = a few times a month, 5 = once a week, 6 = a few times a week, 7 = almost every night). “During the past month, how many times did you have nightmares?” The participant was asked to enter number of nights with nightmares. The nightmare frequency during the past month was used for the current analysis because the responses to the 2 questions were significantly and positively correlated ($r=0.514$, $p<0.0001$) and the recall of nightmares in the past month may be more reliable than in the past year. Frequent nightmares were defined as having nightmares at least once/week in the past month [3, 17].

Measures of psychopathology

Based on the literature review [3, 15, 27, 28, 38, 39], the following measures were selected to assess psychopathology that might be associated with frequent nightmares.

The Youth Self-Report (YSR) of Child Behavior Checklist was used to measure adolescent behavioral/emotional problems [40, 41]. The YSR comprises 103 problem items to which the respondent can answer “0” if the problem is not true of him or herself, “1” if the item is somewhat or sometimes true, and “2” if it is very true or often true. Example items are “I feel lonely” and “I am unhappy, sad, or depressed”. The participant was asked to score each item that describes him or her now or within the past six months. By summing 1s and 2s on all problem items, eight syndromes (anxious/depressed, withdrawn, somatic complaints, delinquent behavior, aggressive behavior, attention problems, social problems, and thought problems) and two second-order factors (internalizing and externalizing) can be assessed. The externalizing factor is made up of the aggressive behavior and delinquent behavior; the internalizing factor is made up of the anxious/depressed, withdrawn, and somatic complaints. The Chinese YSR has satisfactory psychometric properties and has been used in multiple studies

[41–43]. The Cronbach α was 0.93 for internalizing problems and 0.91 for externalizing problems with the current sample.

The Beck Hopelessness Scale (BHS) is a 20-item, true-or-false, self-report scale designed to assess negative expectancies about the future [44]. Example items are “I look forward to the future with hope and enthusiasm” and “My future seems dark to me”. The BHS is scored by summing the keyed responses of pessimism for each of the 20 items. The total score of the scale ranges from 0 to 20, with a higher score indicating more hopelessness. The BHS has been used extensively with adolescents [43, 45]. The Chinese version has shown satisfactory psychometric properties [46]. The Cronbach α was 0.74 with the current sample.

The trait subscale of the Spielberger State-Trait Anger scale (STAS) was used to assess the intensity of anger as an emotional state at a particular time, and to measure individual differences in anger proneness as a personality trait [47]. The subscale includes 10 items with a response format from “1 = never or rarely”, “2 = sometimes”, “3 = often”, to “4 = always.” Example items are “I have a fiery temper” and “I get angry when I’m slowed down by others’ mistakes”. The Cronbach alpha was 0.92 with the current sample.

Demographics and family environmental factors. Adolescent factors included gender (male = 1, female = 2), age (years), chronic disease (yes = 1, no = 0), ever cigarette smoking (yes = 1, no = 0), ever alcohol use (yes = 1, no = 0), and schools that participants were attending (7 dummy variables for 8 schools). Family environmental factors included father’s education (primary school = 1, middle school = 2, high school = 3, college or above = 4), perceived family economic status (good = 1, fair = 2, poor = 3) as compared with other families in the community, and interparental relationship (excellent = 1, good = 2, fair = 3, poor = 4, separated, divorced, or widowed = 5).

Statistical analysis

Chi-square tests for categorical variables and analysis of variance for continuous variables were used to examine differences in demographical characteristics and family environmental factors across nightmare frequencies. Logistic regression analysis was performed to examine the associations of demographical characteristics and family factors with nightmares at least once in the past month.

As the norms of the scales used in the study have not been well established in Chinese adolescents, raw scores on each scale were standardized by T score transformation ($50 + 10(x-\text{mean})/\text{SD}$) for comparison [43] and 90th percentile on each scale was used as the cutoff for potentially clinically relevant psychopathology [48, 49]. Analyses of variance (ANOVA) and covariance (ANCOVA) were conducted to compare mean T scores across nightmare

frequencies. Multivariate analysis of variance (MANOVA) was not performed because the p for Box's Test of Equality of Covariance Matrices was <0.001 , indicating violating the assumption of homogeneity of covariance. A series of univariate and multivariate logistic regression models were performed to examine the likelihood of clinically relevant psychopathology (i.e., >90 th percentile) associated with nightmare frequency in the past month. In the multivariate analyses, demographics and family variables in Table 1 were included to adjust for their potential confounding effects because these variables might be associated with nightmare frequency and psychopathology [1, 3, 11, 17, 26, 50]. Correlation coefficients were computed between psychopathological variables and nightmare frequency. Stepwise linear regression analysis was then performed to examine which psychopathological variables were independently associated with nightmare frequency while controlling for demographics, family variables, and attending schools. A p value less than 0.05 was considered statistically significant.

All statistical analyses were performed by IBM SPSS 25.0 (Armonk, NY: IBM Corp).

Results

A total of 12,301 students were sampled to participate in the survey and 11,831 (96.2%) returned usable questionnaires. Of the 11,831 participants, 11,399 (96.3%) answered the question about nightmare frequency in the past month. The mean age of the sample was 14.9 ± 1.5 years, and 49% were girls.

Age and gender differences in the prevalence of nightmares

Of the sample, 45.2% reported having experienced nightmares at least once, 24.6% twice or more, and 7.9% at least 4 times during the past month. As shown in Table 1, there

Table 1 Adolescent and family factors associated with nightmare frequency

Characteristics	Nightmare frequency in last month								Statistical test	
	None		1 time		2–3 times		≥ 4 times		χ^2	p
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%		
<i>Sex</i>									39.76	<.0001
Male	3328	57.2	1079	18.6	947	16.3	461	7.9		
Female	2913	52.2	1272	22.8	965	17.3	434	7.8		
<i>Chronic disease</i>									15.51	.001
No	6014	55.0	2259	20.6	1830	16.7	838	7.7		
Yes	227	49.7	92	20.1	81	17.7	57	12.5		
<i>Ever cigarette smoking</i>									1.95	.400
No	4910	55.1	1840	20.6	1486	16.7	683	7.7		
Yes	1331	53.7	511	20.6	426	17.2	212	8.5		
<i>Ever alcohol use</i>									9.93	.019
No	3858	54.1	1529	21.5	1200	16.8	538	7.6		
Yes	2383	55.8	822	19.2	713	16.7	357	8.4		
<i>Family economic status</i>									37.94	<.0001
Good	1190	53.3	454	20.3	377	16.9	212	9.5		
Fair	4294	55.8	1611	20.9	1267	16.5	528	6.9		
Poor	711	51.7	271	19.7	246	17.9	146	10.6		
<i>Father education</i>									35.99	<.0001
Primary school	778	51.4	329	21.7	284	18.8	122	8.1		
Middle school	3295	54.3	1290	21.3	1015	16.7	465	7.7		
High school	1131	54.4	427	20.5	361	17.4	159	7.7		
College or above	982	60.2	281	17.2	229	14.0	138	8.5		
<i>Interparental relationship</i>									45.77	<.0001
Excellent	2662	56.9	964	20.6	724	15.5	329	7.0		
Good	1689	55.6	631	20.8	501	16.5	216	7.1		
Fair	1434	51.1	573	20.4	536	19.1	265	9.4		
Poor/separated/divorced	395	51.8	165	21.6	128	16.8	75	9.8		

n Number of participants in each category of nightmare frequency

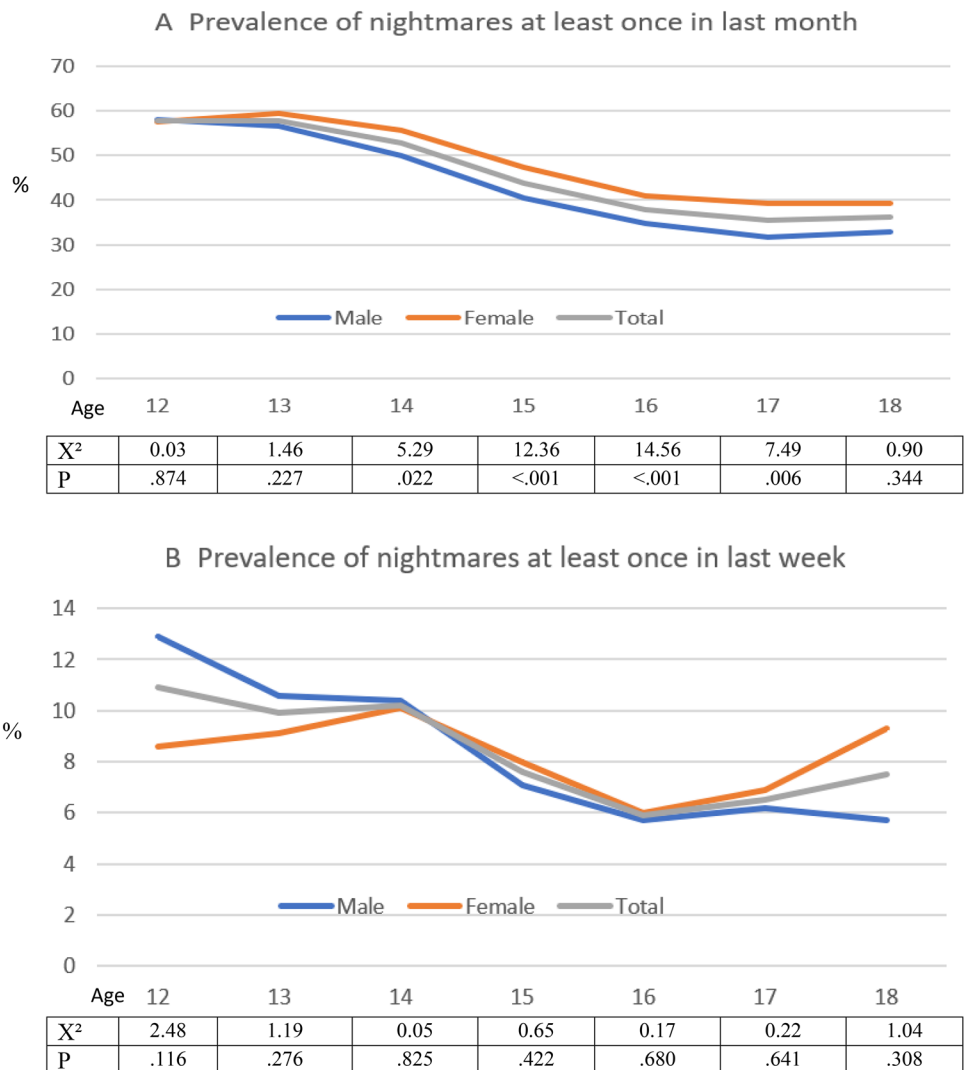
were significant gender differences in nightmare frequency ($\chi^2=39.76, p<0.0001$). Female adolescents reported nightmares more frequently than males for at least once in the past month (47.8% vs. 42.8%; $\chi^2=29.49, p<0.0001$). The mean age tended to decline with nightmare frequency in the past month (15.17 ± 1.40 years for nightmare frequency = 0, 14.74 ± 1.46 for nightmare frequency = once, 14.65 ± 1.47 for nightmare frequency = 2–3 times, and 14.66 ± 1.49 for nightmare frequency ≥ 4 times; $F=104.73, p<0.0001$).

Logistic regression analyses demonstrated significant interactions of gender by age on nightmares at least once in the past month (Wald test = 4.20, $p=0.040$) and frequent nightmares (i.e., at least once per week) (Wald test = 4.34, $p=0.037$). Figure 1A shows that the prevalence rates of nightmares at least once in the past month significantly declined with advancing age for both males ($\chi^2=207.65, p<0.001$) and females ($\chi^2=126.45, p<0.0001$). The

prevalence rates of frequent nightmares also significantly declined with advancing age for males ($\chi^2=42.06, p<0.001$) and females ($\chi^2=16.31, p=0.012$) (Fig. 1B).

Separate analyses by age demonstrated that the prevalence rates of nightmares at least once in the past month were significantly higher in females than in males across ages 14–17 years (all $p<0.05$) (Fig. 1A). However, gender differences were not obvious in younger adolescents (12–13 years). Regarding frequent nightmares, younger male adolescents (12–13 years) tended to report more often than their female peers, older female adolescents (17–18 years) tended to report more often than their male peers, and there were no obvious gender differences in adolescents aged 14–16 years (Fig. 1B). However, there were no statistically significant differences between males and females across age groups (all $p>0.05$).

Fig. 1 Prevalence rates (%) of nightmares by age and gender in Chinese adolescents



X² tests between males and females for each age group

Demographical and family factors associated with nightmare frequency

In addition to age and gender differences in nightmare frequency as described above, there were significant group differences in chronic diseases, ever alcohol use, family economic status, interparental relationship, and paternal education by nightmare frequency (all $p < 0.05$). See Table 1 for detailed distributions of these variables by nightmare frequency in the past month.

Logistic regression analyses showed that chronic diseases (OR = 1.23, 95%CI = 1.03–1.49, $p = 0.026$) and poor interparental relationship (OR = 1.10, 95%CI = 1.06–1.14, $p < 0.001$) were significantly associated with increased occurrence of nightmares at least once in the past month while father's education level was significantly associated with decreased occurrence of nightmares (OR = 0.90, 95%CI = 0.87–0.94, $p < 0.001$). Ever cigarette smoking (OR = 1.06, 95%CI = 0.97–1.16, $p = 0.221$), ever alcohol use (OR = 0.94, 95%CI = 0.87–1.01, $p = 0.095$), and family economic status (OR = 1.01, 95%CI = 0.95–1.08, $p = 0.078$) were not significantly associated with nightmares at least once in the past month.

Nightmare frequency and psychopathology

As shown in Fig. 2, the prevalence rates of all psychopathological problems tended to increase with nightmare frequency. The prevalence rates increased by 2–3 times in adolescents who reported nightmares at least once a week. Univariate logistic regression analyses showed that nightmare frequency was significantly associated with increased likelihood of all psychopathological problems. The associations remained significant after adjusting for adolescent demographics and family covariates in Table 1 and attending school (Fig. 2). For example, the likelihood of anxious/depressive symptoms increased from 1.32 (95%CI = 1.08–1.61) in adolescents who reported nightmares once in the past month to 3.99 (95%CI = 3.22–4.95) in adolescents who reported at least once a week.

Nightmare frequency and severity of psychopathology

Table 2 presents mean T scores (SD) of psychopathological variables by nightmare frequency before and after adjusting for adolescent and family covariates. All mean T scores significantly increased with nightmare frequency regardless of covariate adjustment (all $p < 0.0001$). For example, mean hopelessness T scores increased from 48.82 in adolescents who reported having no nightmares in the past month, 50.18 in those peers who reported nightmares once in the past month, to 53.81 in those who reported at least once a

week ($F = 88.51$, $p < 0.001$). The adjusted mean T scores had almost no changes and remained significant ($F = 68.11$, $p < 0.0001$).

Stepwise regression analysis

As presented in Table 3, the correlation coefficients between psychopathological variables ranged from 0.16 between trait anger and hopelessness to 0.75 between anxious/depressed and withdrawn. Nightmare frequency was positively correlated with all psychopathological variables. All correlation coefficients were significant at $p < 0.001$. Stepwise regression analysis was performed to determine psychopathological variables that were independently associated with nightmare frequency. Table 4 presents the psychopathological variables and their regression coefficients in the final stepwise regression model (all $p < 0.001$). According to standardized regression coefficients, somatic complaints (STD $\beta = 0.081$) demonstrated the strongest effects on nightmare frequency, followed by hopelessness (STD $\beta = 0.069$), trait anger (STD $\beta = 0.064$), thought problems (STD $\beta = 0.057$), and anxious/depressed (STD $\beta = 0.045$). Other psychopathological variables were excluded by stepwise regression.

Discussion

To our knowledge, this study represents the first to report age and gender differences and psychopathological profiles of nightmares in a large sample of Chinese adolescents ($n = 11,831$). Our major findings are summarized and discussed as follows.

First, nightmares are prevalent in Chinese adolescents. In the current study, we found that 45.2% reported having nightmares at least once in the past month and 7.9% at least once/week. The prevalence of frequent nightmares or clinically relevant nightmares (i.e., at least once/week) is lower than those reported in several studies of Western college students (11–14%) [7, 51] and adolescents (19.5%) [8]. The prevalence is comparable to one study in Chinese adolescents (7.1% having nightmares “often” or “always”) [26]. However, the prevalence is higher than the rate of 5.1% as reported by parents in a large sample of Hongkong children and adolescents (5–15 years old) [17]. The rate is much higher than a study of German children aged 10 years (i.e., nightmares occurred often in 2.5% by parent report and 3.5% by self-report in the past 3 months) [14]. The variation of prevalence reported in previous studies may be mainly due to differences in the measures and criteria used to define nightmares and informants. For example, there is evidence that nightmares in pediatric populations is underreported by parents compared with self-report [20]. Including the criteria

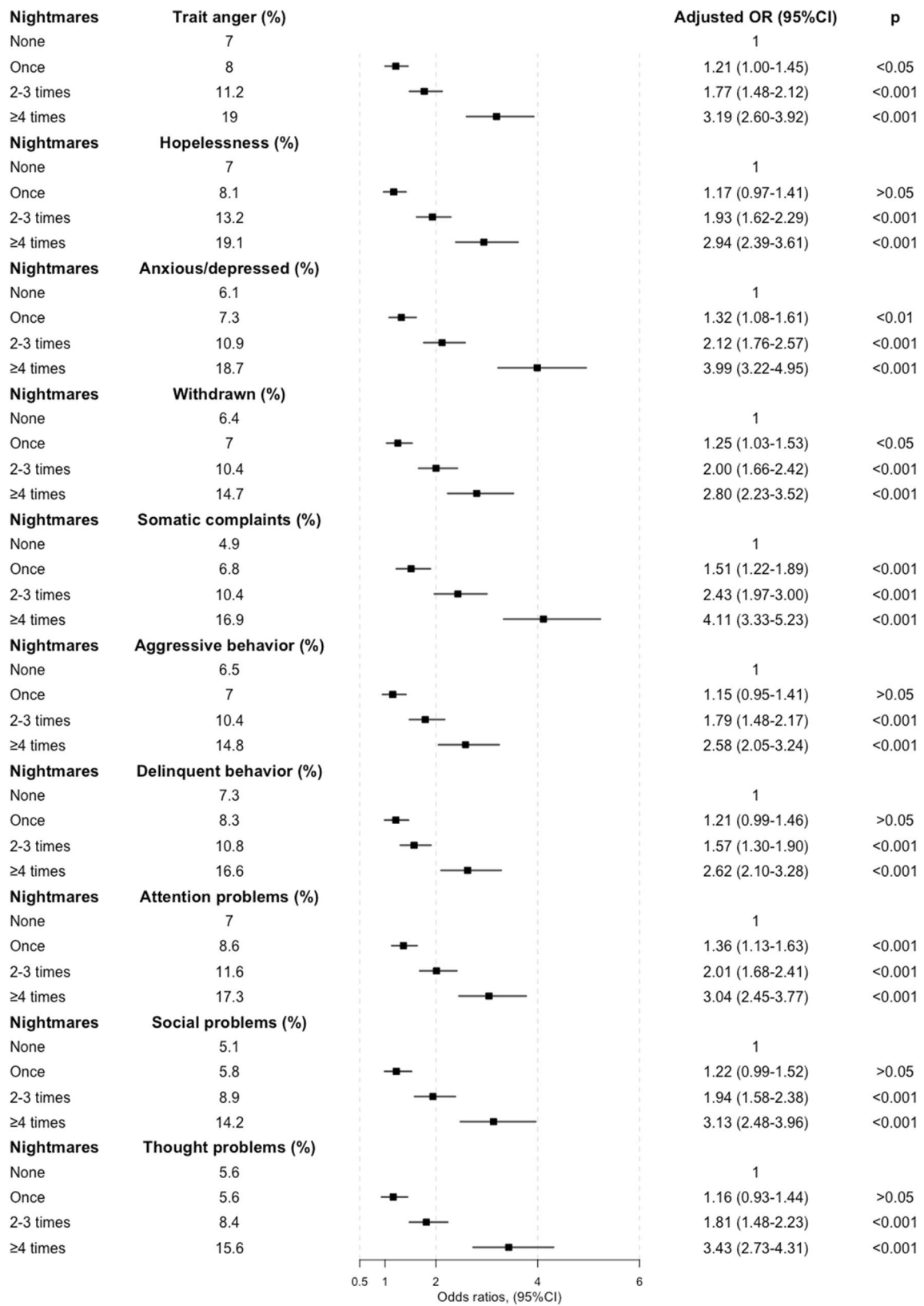


Fig. 2 Prevalence rates (%) and adjusted odds ratios of psychopathology (> 90th percentile as cutoff) by nightmare frequency

Table 2 Mean T scores of psychopathological scales by nightmare frequency

	Nightmare frequency in last month					F	p
	Total	None	Once	2–3 times	≥ 4 times		
<i>Trait anger</i>							
N	11,209	6145	2321	1870	873		
Mean (SD)	49.98(9.95)	49.04(9.38)	49.74(9.52)	51.53(10.51)	53.90(12.13)	80.58	<.0001
AdjMean (SE)		48.87(0.13)	49.81(0.20)	51.58(0.23)	53.69(0.32)	89.06	<.0001
<i>Hopelessness</i>							
N	10,965	6035	2248	1824	858		
Mean (SD)	49.97(9.99)	48.82(9.32)	50.18(9.65)	51.67(10.76)	53.81(12.07)	88.51	<.0001
AdjMean (SE)		49.05(0.15)	50.16(0.21)	51.43(0.23)	53.48(0.34)	68.11	<.0001
<i>Anxious/depressed</i>							
N	11,090	6104	2284	1842	860		
Mean (SD)	49.98(9.97)	48.75(9.32)	49.87(9.44)	51.83(10.47)	55.09(12.27)	131.85	<.0001
AdjMean (SE)		48.40(0.14)	49.85(0.20)	51.76(0.22)	54.78(0.32)	151.67	<.0001
<i>Withdrawn</i>							
N	11,220	6163	2314	1872	871		
Mean (SD)	50.00(9.95)	49.21(9.60)	49.64(9.46)	51.44(10.44)	53.44(11.40)	62.92	<.0001
AdjMean (SE)		48.64(0.14)	49.59(0.20)	51.34(0.22)	53.15(0.32)	83.22	<.0001
<i>Somatic complaints</i>							
N	9835	5403	2050	1632	750		
Mean (SD)	49.97(9.93)	48.61(9.05)	50.16(9.58)	52.17(10.63)	54.48(12.71)	115.97	<.0001
AdjMean (SE)		48.87(0.15)	50.52(0.22)	52.39(0.24)	54.43(0.35)	113.12	<.0001
<i>Aggressive behavior</i>							
N	11,111	6109	2299	1841	862		
Mean (SD)	49.98(9.95)	49.06(9.42)	49.70(9.51)	51.50(10.66)	53.91(11.66)	78.82	<.0001
AdjMean (SE)		49.04(0.14)	49.98(0.20)	51.62(0.22)	53.64(0.32)	83.87	<.0001
<i>Delinquent behavior</i>							
N	11,180	6139	2306	1869	866		
Mean (SD)	49.98(9.88)	49.23(9.21)	49.74(9.39)	51.07(10.48)	53.58(12.97)	59.12	<.0001
AdjMean (SE)		49.40(0.13)	50.15(0.20)	51.24(0.22)	53.46(0.31)	60.89	<.0001
<i>Attention problems</i>							
N	11,166	6134	2304	1868	860		
Mean (SD)	49.98(9.94)	49.01(9.64)	49.94(9.67)	51.50(10.03)	53.73(11.23)	76.23	<.0001
AdjMean (SE)		48.57(0.14)	49.98(0.20)	51.59(0.22)	53.49(0.32)	104.49	<.0001
<i>Social problems</i>							
N	11,141	6132	2295	1854	860		
Mean (SD)	49.98(9.96)	49.14(9.49)	49.80(9.50)	51.31(10.47)	53.54(120.06)	63.61	<.0001
AdjMean (SE)		48.85(0.14)	49.80(0.21)	51.17(0.23)	53.17(0.33)	66.52	<.0001
<i>Thought problems</i>							
N	11,171	6141	2303	1862	865		
Mean (SD)	49.98(9.95)	49.16(9.41)	49.49(9.60)	51.32(10.47)	54.17(11.96)	79.99	<.0001
AdjMean (SE)		48.59(0.14)	49.53(0.20)	51.33(0.22)	53.77(0.32)	100.43	<.0001

AdjMean Mean adjusted for adolescents and family variables in Table 1 and attending schools

N Number of participants in each category of nightmare frequency, SD Standard deviation; SE Standard error; T score $50 + 10(X-m)/SD$

of awakening, recall of vivid disturbing dreams, and severity/frequency of nightmares or not may be another major factor to yield different prevalence rates of nightmares [10]. For the purpose of accurate estimation and comparison of nightmare frequency across different studies, standardized

criteria and measures of nightmares should be developed for children and adolescent populations.

Second, the overall prevalence of nightmares (i.e., at least once in the past month) was significantly higher in adolescent girls than in boys. Higher prevalence of nightmares in

Table 3 Spearman’s rho correlation coefficients^a between psychopathological variables

	1	2	3	4	5	6	7	8	9	10
Trait anger	1.00									
Hopelessness	.16	1.00								
Anxious/Depressed	.53	.30	1.00							
Withdrawn	.41	.27	.75	1.00						
Somatic complaints	.37	.20	.58	.52	1.00					
Aggressive behavior	.65	.22	.70	.57	.49	1.00				
Delinquent behavior	.46	.24	.54	.46	.38	.68	1.00			
Attention problems	.53	.29	.71	.62	.49	.70	.54	1.00		
Social problems	.42	.25	.66	.61	.43	.60	.50	.72	1.00	
Thought problems	.45	.19	.68	.62	.47	.65	.52	.65	.57	1.00
Nightmare frequency	.12	.13	.17	.11	.17	.12	.10	.12	.11	.11

^aAll coefficients were significant at $p < .001$

Table 4 Psychopathological variables independently associated with nightmare frequency: stepwise linear regression*

	β	SE	STD β	t	p
Trait anger	0.271	0.046	0.064	5.94	<.001
Hopelessness	0.285	0.045	0.069	6.33	<.001
Anxious/depressed	0.198	0.054	0.045	3.70	<.001
Withdrawn	–	–	–	–	–
Somatic complaints	0.375	0.052	0.081	7.26	<.001
Aggressive behavior	–	–	–	–	–
Delinquent behavior	–	–	–	–	–
Attention problems	–	–	–	–	–
Social problems	–	–	–	–	–
Thought problems	0.271	0.054	0.057	5.04	<.001

*Adjusting for demographics and attending schools

– Not in the final model

β Regression coefficient, SE standard error, STD β standardized regression coefficient

females than in males is consistent with most studies in adolescents and young adult populations [10, 11, 14, 19, 21]. However, gender difference started from 14 years of age and became prominent with advancing age during adolescence (Fig. 1A), consistent with previous studies [3, 21]. Gender differences in frequent nightmares (i.e., at least once/week) demonstrated different patterns by age (Fig. 1B). Although there were no statistically significant gender differences in the prevalence rates of frequent nightmares across age groups, younger adolescent boys (12–13 years) tended to report more frequent nightmares, older adolescent girls (17–18 years) tended to report more frequent nightmares than boys. Further research is needed to better understand gender differences in nightmares during adolescence by age and frequency/severity of nightmares.

Third, overall prevalence of nightmares significantly declined with age for both boys and girls (Fig. 1A). This

tendency supports previous evidence that nightmare frequency is peaked between 6 and 10 years of age and then decreases with age [1]. However, few studies have specifically examined the age difference during adolescence [14, 21]. In a 2-year follow-up study of 851 10-year-old children, Schredl et al. found that nightmares as reported by both parent and self-reports significantly declined over the 2 years of follow-up [14]. In another study of 610 boys and girls surveyed at 13 years and 16 years, Nielsen et al. found decreases in disturbing dream recall for boys but increases for girls [21]. In the current study, while nightmares continued to decline with age in adolescent boys (Fig. 1A and B), frequent nightmares in females demonstrated an inverse s-shaped curve—slightly increasingly higher between ages 12 and 13 years --> quickly declining between 14 and 16 years --> increasing between 17 and 18 years (Fig. 1B).

Increase in frequent nightmares in 17–18-year-old girls could be explained within the context of psychosocial and neuroendocrine developmental changes and increased life stress during middle adolescence [3, 11, 52–55]. For example, girls during middle adolescence have typically completed full physical development and become more interested in romantic and sexual relationships—which may be stressful if they are not allowed by their families and schools. At this stage, girls may face more academic pressures to enter colleges and may have more arguments with their parents as they struggle for more independence. These may be particularly true in China because of a sexually conservative/suppressive culture, the preference of sons, and patriarchy in the social system under the prolonged influence of Confucianism [56]. Furthermore, gender differences in dream recall (i.e., females tend to recall their dreams more often than males) [1, 19], sleep disturbance, anxiety, depression, and PTSD (i.e., females are more likely to have insomnia, anxiety, depressive symptoms, and PTSD) [1, 21, 52, 57, 58] may also play a role. All of these developmental and psychosocial factors may be associated with heightened affect load

and/or affect distress (i.e., a dispositional or trait like factor consisting of a long-standing tendency to experience heightened distress and negative affect in response to emotional stimuli), which in turn lead to frequent nightmares in girls during middle adolescence [3, 10]. However, further longitudinal analyses are warranted to confirm the developmental trajectory of nightmares by gender and nightmare frequency during adolescence observed in the cross-sectional survey and understand underlying psychosocial and neurobiological mechanisms.

Fourth, mean scores on trait anger, hopelessness, attention, and internalizing and externalizing problems significantly increased with nightmare frequency. Furthermore, frequent nightmares were significantly associated with 2–4-fold likelihood of behavior/emotional problems after adjusting for adolescent and family covariates. The associations of frequent nightmares with multiple behavioral/emotional problems in adolescents are consistent with the findings of multiple studies in Western children and adolescents [8, 14, 21] and a study of children and adolescents in Hongkong [17]. Taken together, these findings support Levin and Nielsen's conclusion that nightmares do not appear to predict specific psychopathology subtypes; rather, they seem to be associated with poor psychological well-being more generally [3].

Fifth, stepwise linear regression analysis revealed that somatic complaints, trait anger, hopelessness, anxious/depressed, and thought problems were independently associated with nightmare frequency. As expected, anxious/depressed symptoms and hopelessness were associated with nightmare frequency [3, 28]. Thought problems (e.g., auditory and visual hallucinations and strange ideas and behavior) were independently associated with nightmare frequency, consistent with a recent study of the relationship between nightmares and psychotic experiences in young adults [11]. It should be noted that somatic complaints were the most prominent psychopathological variable associated with nightmare frequency. This finding supports a prospective investigation of colleague students demonstrating that somatic distress (i.e., heightened attention to, amplification of and misinterpretation of both benign and functional somatic symptoms) was associated with nightmares [38]. According to Levin et al., nightmare distress was as equally related to somatic distress as nightmare frequency [38]. Somatic distress may play a mediating role at least in part between frequent nightmares and waking psychopathology, such as anxiety/depressive symptoms. Together with the independent association of trait anger with nightmare frequency, our findings provide evidence in support of the neurocognitive model of nightmares proposed by Levin and Nielsen [3, 10]. This model fits within a diathesis–stress framework and posits that individuals with high trait affect distress are at increased risk of waking stress and developing

distressful nightmares in response [3, 10, 59]. However, mediation analysis with longitudinal data is warranted to further test the model in adolescents.

The relationship between nightmares and multiple dimensions of psychopathology may be complex: bidirectional or coexisting because of sharing similar biological and genetic mechanisms. For example, frequent nightmares may be a symptom of PTSD. Frequent nightmares may lead to multiple dimensions of psychopathology via sleep disturbance, daytime distress, and mood dysregulation, which can cause depression, anxiety, externalizing problems, thought problems, and attention problems [10, 27, 60, 61]. Large-scale longitudinal studies are needed to examine the causal relationship and underlying psychological and neurobiological mechanisms between nightmares and psychopathology in adolescence.

The findings from the current study should be interpreted with considering the following limitations. First, all the measures including nightmares and psychopathology in the study are based on the self-report; the prevalence rates of nightmares and the associations between nightmares and psychopathology may be underestimated or overestimated due to recall bias. Second, nightmares were defined as intense, frightening, and vivid dreams that awaken respondents and mental health problems were assessed by screening measures. It is unknown to what extent nightmares and psychological problems reported here are clinically meaningful and are consistent with DSM-V diagnostic criteria. Clinical interviews and assessments are needed to determine the clinical implications of findings based on the self-report. Third, this is a cross-sectional survey; no causal relationships and temporal pathways between these psychopathological variables and their associations with nightmare frequency could be made. Furthermore, although the sample size is large, it is unknown if the findings from this sample of adolescent students in Shandong, Mainland China could be generalized to adolescents in other regions.

In summary, this is one of the largest community studies of Chinese adolescents to describe age and gender differences and psychopathology of nightmares. Our findings suggest that nightmares are prevalent and more frequent in adolescent girls than in boys. Although overall nightmares declined with age, frequent nightmares demonstrated different tendencies with age by gender. Furthermore, nightmares were associated with multiple dimensions of behavioral and emotional problems and these problems significantly increased with nightmare frequency. As nightmares have been under-reported, under-diagnosed, and untreated [18, 51], these findings underscore the need to assess and treat frequent nightmares and distress associated with nightmares in routine clinical practice and mental health services for adolescents. Effective nonpharmacological therapies, such as cognitive behavior therapy (CBT) [62], imagery rescripting

(IR) and imaginal exposure (IE) [63], should be incorporated into clinical practice for adolescents with frequent nightmares to reduce nightmare frequency and distress. School-based intervention programs targeting nightmare frequency and distress may have important implications for mental health among adolescents at risk. Longitudinal research that monitors waking and sleep behaviors over time is needed to better understand the developmental trajectory of nightmares and their associations with multiple domains of psychopathology during adolescence.

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Author contributions Dr. Xiachen Liu conceptualized the study, performed data analysis, and drafted the manuscript. Drs. Zhen-Zhen Liu and Bao-Peng Liu collected data, managed data, and reviewed and revised the manuscript. Dr. Cun-Xian Jia contributed to the study design, supervised data collection and data management, and reviewed and revised the manuscript.

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Availability of data and material Data available upon request.

Declarations

Conflict of interest All authors have no conflicts of interest/competing interests to declare.

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