



## Original Article

## Prevalence of and factors associated with nightmares in the elderly in a population based cohort study

Dasom Park <sup>a</sup>, Soriul Kim <sup>b</sup>, Chol Shin <sup>b, c, \*\*, 1</sup>, Sooyeon Suh <sup>a, \*, 1</sup><sup>a</sup> Department of Psychology, Sungshin Women's University, Seoul, Republic of Korea<sup>b</sup> Institute for Human Genomic Study, College of Medicine, Korea University, Seoul, Republic of Korea<sup>c</sup> Division of Pulmonary Sleep and Critical Care Medicine, Department of Internal Medicine, Korea University Ansan Hospital, Ansan, Republic of Korea

## ARTICLE INFO

## Article history:

Received 19 July 2020

Received in revised form

23 November 2020

Accepted 29 November 2020

Available online 4 December 2020

## Keywords:

Elderly

Epidemiology

Dreaming

Nightmare

Risk factor

Suicidal ideation

## ABSTRACT

**Objectives:** Nightmares are extremely unpleasant and vivid recurring dreams that are accompanied with awakening during sleep. However, earlier studies were mostly conducted with children and adults, with very few studies on nightmares in older adults. This population-based study aims to investigate the prevalence of nightmares and its associated factors in the elderly.

**Methods:** This study utilized a subsample from the Korean Genome and Epidemiology Study (KoGES). Participants (n = 2940; mean age 63.71 ± 6.73) completed the questionnaires on nightmares (Disturbing Dream and Nightmare Severity Index; DDNSI), depression, suicidal ideation, sleep quality and stress.

**Results:** Among the sample, 2.7% (n = 79) were classified into the nightmare group (NG), which was classified with DDNSI scores. In the age group over 70, prevalence of nightmares was 6.3% (n = 37), which was significantly higher than other age groups. Marital status, employment status and family income were associated with nightmares. Additionally, NG reported significantly more sleep problems, higher suicidal ideation, depression and stress compared to the non-nightmare group (N-NG). Logistic regression analyses results indicated that the NG was 4.35 times at higher risk for depression, and 3.16 higher risks for stress, and 3.45 higher risks for suicidal ideation compared to the N-NG after controlling for covariates.

**Conclusions:** Our results indicate that psychological and demographic factors are associated with nightmares in the elderly. Furthermore, this population-based cohort study showed the prevalence of nightmares increased after age 70, which suggests the need for further studies of nightmares in older populations.

© 2020 Elsevier B.V. All rights reserved.

**Abbreviations:** KoGES, Korean Genome and Epidemiology Study; NG, Nightmare group; N-NG, Non-Nightmare group; DDNSI, Disturbing Dream and Nightmare Severity Index; DSI-SS, Depressive Symptom Inventory-Suicidality Subscale; BDI, Beck Depression Inventory; PSS, Perceived Stress Scale; PSQI, Pittsburgh Sleep Quality Index; adj.p, adjusted p-value.

\*\* Corresponding author. Division of Respiratory and Critical Care, Department of Internal Medicine, Korea University Ansan Hospital, #123, Jeokgeum-ro, Danwon-gu, Ansan, 15355, Republic of Korea. Fax: +82 31 412 5604.

\* Corresponding author. Department of Psychology, Sungshin Women's University, 2 Bomun-ro 34dagil, Seongbuk-gu, Seoul, 02844, Republic of Korea. Fax: +82 2 920 2040.

E-mail addresses: [chol-shin@korea.ac.kr](mailto:chol-shin@korea.ac.kr) (C. Shin), [alysuh@sungshin.ac.kr](mailto:alysuh@sungshin.ac.kr) (S. Suh).

<sup>1</sup> These authors contributed equally to this study.

## 1. Introduction

Nightmares are vivid dreams that often lead to awakening during sleep with repeated occurrences of dreams, including intense and negative emotions. Nightmare Disorder, a subcategory of parasomnias, can be diagnosed when nightmares cause sleep problems and negatively affects social, occupational or other important functional areas [1].

Previous population-based studies that explored the frequency of nightmares report that 13–45% of people experience nightmares more than once a month, and 2–6% experience nightmares more than once a week [2–6]. The Diagnostic and Statistical Manual of Mental Disorders, Fifth version (DSM-5) reports 1–2% prevalence of frequent nightmares in general adults, with 6% of those individuals having nightmares at least once a month [1]. This wide range in the prevalence of nightmares stems from differences in criteria for

defining and diagnosing nightmares [7]. Most population-based studies assessed nightmares used a single question asking about frequency, with loose criteria for nightmare symptoms [3,5,6]. For example, dreams and nightmares differ by definition [8–10], but is not necessarily reflected in research. Considering that nightmares are more serious and accompanied by awakening than bad dreams [1,11], more studies that measure nightmare frequency, awakening during sleep, and nightmare severity consistent with this definition are needed.

Earlier studies have shown that nightmares are linked to various sleep problems. In patients experiencing nightmares, previous studies have reported links to difficulty initiating and maintaining sleep [12], and decline in daytime function [13]. Also, frequent nightmares are known to be related to various psychopathology. Prior studies have reported that nightmares are associated to high anxiety [7,14–16], depression [14,17,18] and suicidal ideation [12,19,20]. Although very few studies have investigated the relationship between nightmares and psychological problems for the elderly, one study reported that nightmares were associated with both depression and anxiety in elderly adults [21].

There have been a few studies attempting to identify risk factors of nightmares in the general population. One large community-based study of middle-aged individuals in Hong Kong reported that lower socioeconomic status, insomnia, impaired sleep quality and neuroticism personality trait were associated with nightmares [3]. In a large cohort study of more than 10,000 Finnish adults, depression and insomnia were the strongest predictors of nightmares, and found related factors such as psychological well-being, sociodemographic factors and low life satisfaction closely related to nightmares [22]. However, these attempts to identify nightmare risk factors through large samples are limited because they do not include a wide range of age groups [3]. In particular, there have currently been no population-based studies on nightmares investigating nightmares in the elderly.

There is ample evidence that sleep changes with age. Compared to younger adults, older adults often display an advanced circadian phase [23], more awakenings during sleep and less slow wave sleep (SWS) and sleep spindle activity [24–26]. Also, older adults complain of insomnia symptoms such as early morning awakenings, difficulty initiating or maintaining sleep and daytime sleepiness [27]. Considering the changes in sleep structure due to aging, it is plausible that nightmares in the elderly population may differ in terms of various mental and physical outcomes. Until now, nightmares have generally been regarded as a disorder caused during childhood [9,28], with its known incidence to be highest from late adolescence to early adulthood [29]. Thus, studies that explored nightmares in old age are relatively sparse. Studies that have explored the nightmare prevalence for all ages have shown that the nightmare prevalence of the elderly is lower than the younger adults [9,28,30–32]. However, a large population-based study that studied the prevalence of nightmares in 69,813 individuals in Finland showed an increased rate of nightmare prevalence in groups over 71 years of age [5]. In addition, it is known that nightmares are generally experienced more frequently in younger women compared to men [29], but a meta-analysis on gender differences in nightmares has shown these gender differences do not appear in older age groups due to increase of nightmares in elder men [33]. As such, this calls for a study to investigate nightmares in a population-based study of elder individuals.

The current study was an exploratory study investigating prevalence and factors associated with nightmares in an elderly population. We hypothesized that factors associated with nightmares would be consistent with previous studies, such as demographic (gender), psychological (depression, stress, suicidal ideation) and sleep (insomnia) factors. However, these

characteristics may be different compared to the general adult population, considering the changes in sleep accompanied by the aging process. Thus, this study had three aims: (1) To identify the prevalence of nightmares in the elderly population, including nightmare frequency, severity and awakenings due to nightmares in a large population-based sample; (2) To explore factors associated with nightmares such as demographic characteristics, psychological factors and sleep problems by comparing the differences between Nightmare (NG) and Non-Nightmare groups (N-NG) in elderly individuals; and (3) to examine whether being in the NG was associated with depression, stress and suicidal ideation, after adjusting for demographic characteristics and insomnia symptoms.

## 2. Methods

### 2.1. Participants

Data for this study utilized a subsample of the Korean Genome and Epidemiology Study (KoGES), an ongoing community-based cohort study that began in 2001. This study used data collected in 2017 and 2018. Among the total 2951 participants, 11 who did not answer the nightmare related questionnaire were excluded, and 2940 individuals were included in the final analysis. This study was approved by the institutional review board of Korea University Ansan Hospital, and all participants signed an informed consent form.

### 2.2. Measures

#### 2.2.1. Sociodemographic factors

Participants were asked to complete information about gender, age, marital status, monthly family income, employment status, alcohol consumption and smoking. Age was divided into three groups by 10 years, and family income was divided in three groups: less than \$850, \$850 to \$2550, more than \$2550 [34]. Employment status was divided into two groups: currently “employed” and “unemployed” including housework and non-economic status due to retirement. Alcohol consumption and smoking were answered with three options “past user” “current user” “never user”.

#### 2.2.2. Nightmares

The Disturbing Dream and Nightmare Severity Index (DDNSI) [35] is a five item self-report scale and is a revised version of the Nightmare Frequency Questionnaire (NFQ) [36]. The questionnaire assesses the frequency of nightmares, the number of nightmares, intensity and severity of nightmares, and the frequency of nightmare-related awakenings. The scale is scored on a 0 to 37 scale, and higher scores reflect more severe nightmare difficulties. A total score greater than 10 is considered reflective of clinical levels of nightmares [35]. The internal consistency of the DDNSI in this sample was 0.909. This questionnaire was validated for use in Korean [37].

#### 2.2.3. Psychological factors

**2.2.3.1. Suicidal ideation.** The Depressive Symptom Inventory-Suicidality Subscale (DSI-SS) [38] consists of four items, and is a subscale of the Hopelessness Depression Symptom Questionnaire. Each question is measured on a four-point Likert scale 0–3, with total scores ranging from 0 to 12. The scale assesses the frequency of suicidal ideation, specific plans for suicide, controllability of suicidal thoughts, and impulses in the past two weeks. Higher total scores indicate greater severity of suicidal ideation [39]. In this study the cut-off of this questionnaire was based on four score suggested by validated Korean version of DSI-SS [40]. The internal consistency of the DSI-SS in this sample was 0.947.

**2.2.3.2. Depression.** The Beck Depression Inventory (BDI) [41] is a 21-item self-report questionnaire, and used to evaluate the depressive symptoms within the previous two weeks. All items are measured on a four-point Likert scale from 0 to 3, with total scores ranging from 0 to 63. Higher scores reflect higher severity of depressive symptoms. The internal consistency of the BDI in this study was 0.877.

**2.2.3.3. Stress.** The Perceived Stress Scale (PSS) [42] is a 10-item self-report questionnaire that measures the degree to which situations in one's life are appraised as stressful. Participants are asked to respond to each question on a five-point Likert scale, with each question ranging from 0 to 4. A total score is calculated by summing up all items. Higher scores correspond to higher perceived stress. The internal consistency of the PSS in this study was 0.536.

#### 2.2.4. Sleep-related factors

**2.2.4.1. Sleep quality.** The Pittsburgh Sleep Quality Index (PSQI) [43] is a 19-item self-rated questionnaire that evaluates sleep quality and sleep disturbances. The seven subcomponents of the PSQI as follows: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. The sum of scores ranges from 0 to 21. Higher scores indicate more sleep difficulties. The internal consistency of the PSQI in this sample was 0.696.

**2.2.4.2. Insomnia symptoms.** Items asking about insomnia symptoms in the study were as follows: (a) "Do you experience difficulty falling asleep?" (b) "Do you have difficulty falling back asleep after waking up at night?" (c) "Do you experience early morning awakenings?", and if the participant answered "yes", they were followed up with questions regarding frequency: "sometimes (1–2 times a week), often (3–4 times a week), and almost every day (more than five times a week)". In this study, we classified people who experience one or more of the three insomnia symptoms and more than three times a week as individuals experiencing insomnia symptoms.

**2.2.4.3. Sleepiness.** The Epworth Sleepiness Scale (ESS) [44] is an eight-item self-report questionnaire that measures the tendency of sleep and sleepiness during the day in everyday situations. Participants are asked to respond to each question on a four-point likert scale, with each question ranging from 0 to 3. A total score is calculated by summing up all items. Higher scores correspond to higher extreme daytime sleepiness. The internal consistency of the ESS in this study was 0.764.

#### 2.2.5. Data analysis

SPSS Statistics Version 23 (IBM Corp., Armonk, NY, USA) was used for data analysis. For the main analysis, we classified the NG and the N-NG using the DDNSI cut-off, and we conducted Pearson chi-square ( $\chi^2$ ) test to analyze differences with categorical variables such as sociodemographic factors between NG and N-NG. The Mann–Whitney U test, a nonparametric test method, was performed to analyze the continuous variables such as the psychological and sleep-related factors differences between the two groups since the assumptions of normality were not met. Additionally, multiple logistic regressions was conducted to analyze the association between nightmares and psychological factors after adjusting for relevant sociodemographic variables such as sex, age, marital status, insomnia symptom, family income, and employment status. P-values were corrected for multiple comparisons

using the Holm–Bonferroni method [45] to prevent for possible Type I error. This method is similar to the Bonferroni method, but Holm adjustment was subsequently proposed with less conservative method. In public health research with multiple testing, Holm's procedure has been suggested as a better method than the traditional Bonferroni procedure [46]. The adjusted p-values (adj.p) were calculated using an online EXCEL calculator developed by Justin Gaetano [47], and could be compared to 0.05 to determine significance.

### 3. Results

The mean age of participants was 63.71 ( $\pm 6.73$  SD) years (age range 51–85 years). Of the total 2940 participants, 49.3% were female. General characteristics are summarized in Table 1.

#### 3.1. Prevalence of nightmares in the elderly

Among the sample, 399 participants (13.6%) reported having nightmares at least once a year. Among these respondents, 250 participants (8.5%) reported experiencing nightmares every year, 73 participants (2.5%) answered that they had nightmares every month, and 76 (2.6%) said that they experienced nightmares every week.

For this study, we used the DDNSI using the cut-off score of 10 to investigate the prevalence of clinical nightmares in our sample. Approximately 2.7% ( $n = 79$ ) of our sample reported having clinical levels of nightmare. Age was divided into three groups by decade to determine whether there was a difference in prevalence of nightmare by age categories in the elderly population.

For individuals in their 50s and 60s, 17 (1.8%) and 25 (1.8%) were classified into the NG, respectively. However, in the age group over 70, 37 (6.3%) out of 590 individuals were classified into the NG. Chi-square test results indicated that differences in the prevalence of nightmares among the three age groups were significant [ $\chi^2(2, n = 2940) = 36.27, \text{adj.p} < 0.001, \text{Fig. 1}$ ].

#### 3.2. Sociodemographic factors

##### 3.2.1. Gender

Females consisted of 64.6% ( $n = 51$ ) in the NG. Chi-square test results indicated a significant difference for gender [ $\chi^2(1, n = 2940) = 7.58, \text{adj.p} < 0.05$ ] between the NG vs. N-NG. The difference in gender difference of nightmare prevalence was significant in the overall sample, but the difference was not significant in the group over 70 years of age, suggesting that gender differences disappear in this age group (Fig. 2).

##### 3.2.2. Employment status

Among the sample, 43.7% ( $n = 1285$ ) were unemployed. Regarding employment, 43% ( $n = 1229$ ) were unemployed in the N-NG, and 70.9% ( $n = 56$ ) were unemployed in the NG. Chi-square test results indicated that employment status was associated with nightmares [ $\chi^2(1, n = 2940) = 24.37, \text{adj.p} < 0.001$ ] in the elderly.

##### 3.2.3. Income

Monthly family income was classified into three groups based on income level. Among the sample, 11.8% ( $n = 340$ ) belonged to the income group below \$850, and 31.4% ( $n = 902$ ) belonged to the group \$850 to \$2550. Regarding monthly family income, 11.5% ( $n = 322$ ) were classified into the group below \$850 in the N-NG, and 24% ( $n = 18$ ) were classified into the group below \$850 in the

**Table 1**  
Differences in sociodemographic factors in the NG vs. N-NG (n = 2940).

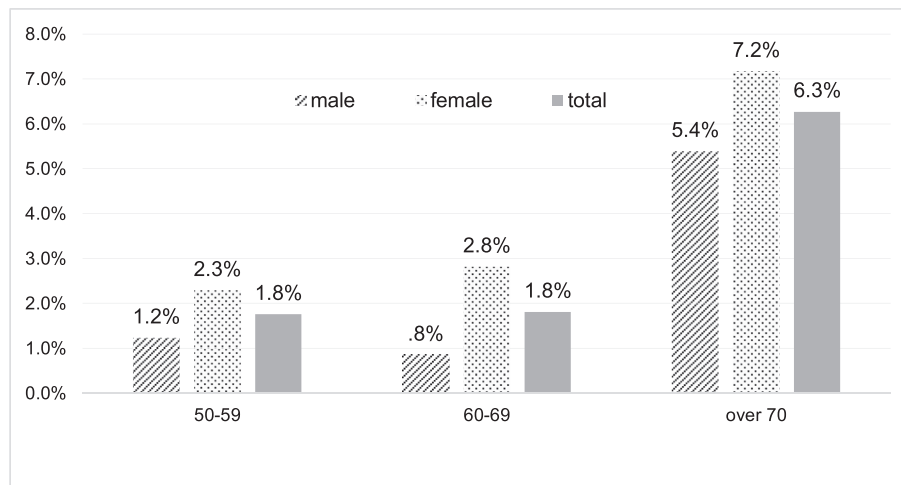
	Total sample	Nightmare Group	Non-Nightmare Group	p <sup>a</sup>	Adjusted p <sup>c</sup>
<b>All subjects, n (%)</b>	2940	79 (2.7%)	2861 (97.3%)		
<b>Gender, n (%)</b>					
Female	1449 (49.3%)	51 (64.6%)	1398 (48.9%)	<b>0.006</b>	<b>0.036</b>
Male	1491 (50.7%)	28 (35.4%)	1463 (51.1%)		
<b>Age, y (mean, SD)</b>	63.71 ± 6.73	67.48 ± 7.83	63.60 ± 6.67		
<b>Age group, n (%)</b>					
50-59	968 (32.9%)	17 (21.5%)	951 (33.2%)	<b>&lt;0.001</b>	<b>&lt;0.001</b>
60-69	1382 (47.0%)	25 (31.6%)	1357 (47.4%)		
>69	590 (20.1%)	37 (46.8%)	553 (19.3%)		
<b>Marital status</b>					
Single	13 (0.4%)	0 (0.0%)	13 (0.5%)	<b>&lt;0.001<sup>b</sup></b>	<b>&lt;0.001</b>
Married	2534 (86.2%)	57 (72.2%)	2477 (86.6%)		
Separated	18 (0.6%)	1 (1.3%)	17 (0.6%)		
Divorced	112 (3.8%)	1 (1.3%)	111 (3.9%)		
Bereavement	257 (8.7%)	19 (24.1%)	238 (8.3%)		
Cohabitation	5 (0.2%)	1 (1.3%)	4 (0.1%)		
<b>Employment status</b>					
Employed	1655 (56.3%)	23 (29.1%)	1632 (57.0%)	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Unemployed <sup>d</sup>	1285 (43.7%)	56 (70.9%)	1229 (43.0%)		
<b>Monthly Family income (\$)</b>					
850	340 (11.8%)	18 (24.0%)	322 (11.5%)	<b>0.001</b>	<b>0.007</b>
850-2550	902 (31.4%)	27 (36.0%)	875 (31.3%)		
>2550	1629 (56.7%)	30 (40.0%)	1599 (57.2%)		
missing	69	4	65		
<b>Alcohol Consumption</b>					
None	1573 (53.5%)	47 (59.5%)	1526 (53.3%)	0.542	0.852
Past	152 (5.2%)	4 (5.1%)	148 (5.2%)		
Current	1215 (41.3%)	28 (35.4%)	1187 (41.5%)		
<b>Smoking</b>					
None	1795 (61.1%)	54 (68.4%)	1741 (60.9%)	0.336	0.852
Past	850 (28.9%)	20 (25.3%)	830 (29.0%)		
Current	295 (10.0%)	5 (6.3%)	290 (10.1%)		

<sup>a</sup> Chi-square test.

<sup>b</sup> By Fisher's exact test.

<sup>c</sup> Adjusted p-values are after Holm-Bonferroni correction, and the p-values lower than significance level are indicated in bold.

<sup>d</sup> Employment Category - Unemployed: Including Household chores and retirement.



**Fig. 1.** Nightmare prevalence by age group.

NG. Chi-square test results indicated a significant difference for monthly family income [ $\chi^2(1, n = 2871) = 13.95, \text{adj.}p = 0.007$ ] between the NG vs. N-NG.

### 3.2.4. Marital status

Regarding marital status, 8.3% (n = 238) reported being bereaved in the N-NG, and 24.1% (n = 19) were bereaved in the NG. Fisher's exact test results indicated a significant difference for marital status between the NG vs. N-NG (adj.p < 0.001).

### 3.2.5. Smoking and alcohol consumption

There were no significant differences between the elderly NG and the N-NG for smoking status and alcohol consumption (Table 1).

### 3.3. Nightmares and sleep-related factors

Elderly individuals in the NG reported significantly worse sleep quality assessed by the total score of the PSQI than older adults in

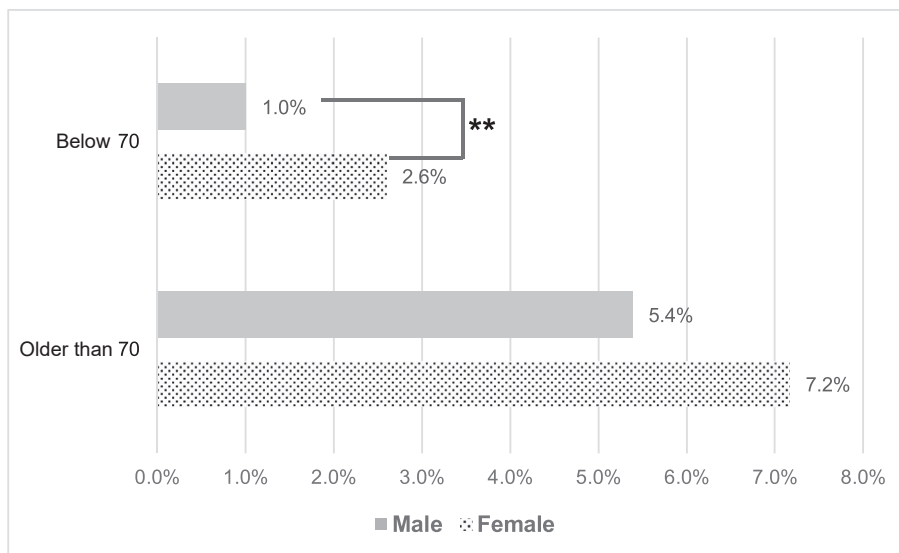


Fig. 2. Gender difference in nightmare prevalence by age group.

the N-NG (adj.p < 0.001). Among the subscales of PSQI, the NG reported longer sleep latency (adj.p < 0.001), worse habitual sleep efficiency (adj.p < 0.001), more sleep disturbance (adj.p < 0.001) and more use of sleep medication (adj.p < 0.001) compared to the N-NG.

Nightmares were also associated with insomnia symptoms. 12.4% (n = 356) of the N-NG compared to 43% (n = 34) of the NG reported having insomnia symptoms. There were no significant differences between the NG and the N-NG for sleepiness and daytime dysfunction (Table 2).

### 3.4. Nightmares as a risk for depression, stress, suicidal ideation in the elderly population

The NG reported significantly higher levels of depression (adj.p < 0.001), stress (adj.p < 0.001) and suicidal ideation (adj.p < 0.001) compared to the N-NG (Table 2).

Table 2  
Differences in psychological and sleep-related factors in the NG vs. N-NG (n = 2940).

	Total sample	Nightmare Group	Non-Nightmare Group	p <sup>b</sup>	Adjusted p <sup>†</sup>
<b>Psychological factors</b>					
Suicidal Ideation(DSI)	0.26 ± 0.97	0.81 ± 1.70	0.24 ± 0.94	<0.001	<0.001
Depression(BDI)	6.28 ± 6.29	14.06 ± 10.19	6.06 ± 6.00	<0.001	<0.001
Stress (PSS)	14.93 ± 4.26	18.41 ± 4.35	14.83 ± 4.21	<0.001	<0.001
<b>Sleep-related factors</b>					
PSQI	3.95 ± 3.11	7.62 ± 4.50	3.85 ± 3.00	<0.001	<0.001
Sleep quality	0.99 ± 0.63	1.73 ± 0.75	0.97 ± 0.61	<0.001	<0.001
Sleep latency	0.63 ± 0.89	1.50 ± 1.16	0.60 ± 0.87	<0.001	<0.001
Sleep duration	1.01 ± 0.99	1.32 ± 1.09	1.00 ± 0.99	0.011	0.055
Habitual sleep efficiency	0.42 ± 0.86	0.96 ± 1.17	0.41 ± 0.84	<0.001	<0.001
Sleep disturbance	0.35 ± 0.49	0.88 ± 0.56	0.34 ± 0.48	<0.001	<0.001
Use of sleeping medication	0.11 ± 0.52	0.70 ± 1.18	0.09 ± 0.48	<0.001	<0.001
Daytime dysfunction	0.48 ± 0.74	0.61 ± 0.85	0.48 ± 0.74	0.185	0.740
Sleepiness (ESS)	3.95 ± 3.17	4.53 ± 3.80	3.93 ± 3.15	0.284	0.852
<b>Insomnia</b>					
Normal	2550 (86.7%)	45 (57.0%)	2505 (87.6%)	<0.001 <sup>a</sup>	<0.001
Insomnia Symptoms	390 (13.3%)	34 (43.0%)	356 (12.4%)		

†Adjusted p-values are after Holm-Bonferroni correction, and the p-values lower than significance level are indicated in bold.

<sup>a</sup> Chi-square test.

<sup>b</sup> Mann–Whitney u test.



**Table 3**  
Results of multiple logistic regression with psychological factors (n = 2940).

		Depression Group			High Stress Group <sup>c</sup>			Suicidal Ideation Group		
		OR	95%CI	p <sup>a</sup>	OR	95%CI	p <sup>a</sup>	OR	95%CI	p <sup>a</sup>
Nightmare Group	Crude	5.61	(3.54 8.91)	<0.001	3.52	(2.24 5.52)	<0.001	3.66	(1.83 7.29)	<0.001
	Adjusted <sup>b</sup>	4.35	(2.64 7.17)	<0.001	3.16	(1.96 5.09)	<0.001	3.45	(1.66 7.16)	0.001

<sup>a</sup> P-value by multiple logistic regression.

<sup>b</sup> Adjusted for Sex, Age, Insomnia symptom, Marital status, Employment status, Family income.

<sup>c</sup> 75% quartile, score = 18.

factors, and sleep disturbance associated with nightmares using a standardized questionnaire in a large elderly population.

#### 4.1. Prevalence of nightmares in the elderly population

Among the total sample, 2.7% of the sample aged over 50 frequently experienced severe nightmares accompanied with awakening. Among them, the prevalence in the aged over 70 was 6.3%, showing a sharp increase of nightmares compared to other age groups (50s and 60s). These results were consistent with the results of Sandman and colleagues's study investigating prevalence of nightmares in a large population-based study [5], and we were able to confirm that the prevalence of nightmares remained stable with similar prevalence in middle adulthood until early old age, but increased after the age of 70. While mechanisms to explain the increase of nightmares in the 70s are unclear, one can speculate on a number of possible factors based on previous research.

First, it's possible that the process of physical aging has a direct effect on nightmares. Aging is associated with continuous weakening in many physiological and physical functions, and increases the risk of various diseases. Heart rate modulation is affected by age [48], and aging also has a marked effect on the heart and arterial system, leading to increased cardiovascular disease (CVD) such as hypertension, arteriosclerosis and myocardial infarction [49]. The cardiovascular system is closely related to the activity of the autonomic nervous system, and excessive sympathetic nerves are known to be related to the imbalance of the autonomic nerves and CVD, such as rising blood pressure and increased heart rate [50–53]. Nightmares are also accompanied by autonomic nervous system activation such as sweating, palpitations, and rapid breathing during sleep. While the pathophysiological mechanisms of nightmares are not clearly known, individuals reporting frequent nightmares report features of heightened nervous system activity, such as the emergence of alpha waves that reflect awakening during REM sleep experiencing nightmares, increased leg movements, and increased heart rate [54–56]. There is a possibility that there may be shared underlying pathways implicating the autonomic nervous system that is a part of the aging process and nightmares. For example, there was one study conducted on the elderly in Sweden which found that cardiac symptoms, such as irregular heartbeats and spasmodic chest pain were associated with nightmares [57].

Second, it is possible that the process of physical aging has an indirect effect on nightmares via increasing comorbid physical illnesses. Elder individuals often suffer from one or more physical diseases caused by aging. Studies that have seen associations between nightmares and physical disease are sparse, but some previous studies have shown that nightmares are related to physical health. Sandman and colleagues' studies have shown that there is a strong association between nightmare frequency and having frequent headaches in the general adult population, and nightmares are significantly associated with physical illnesses such as

angina pectoris, heart failure, asthma, diabetes, and joint disease, although the effect sizes were small [22]. Additionally, other studies have shown that patients with chronic back pain report more negatively toned dreams than healthy control group [58], and that the frequency of nightmares increased with somatic symptoms such as musculo-skeletal pain, restless legs and muscle cramps in the legs in elderly [59]. The mechanism has not been revealed in the association between nightmare and physical health, but there is the possibility that sleep problems caused by physical disease, which subsequently lead to frequent awakenings during sleep and low sleep quality can indirectly affect nightmares. While the current study mainly focused on the link between nightmares and psychopathology, physical symptoms may be considered in elderly, as a major risk factor for nightmares by extending the association between nightmares and physical diseases.

Finally, it is possible that nightmares can be caused by side effects of drugs frequently taken in old age. Nightmares have been reported to be associated with the use of medication, mainly medications that affect neurotransmitters in the central nervous system, such as antidepressants and antihypertensive drugs [60,61]. The older the individual is, the more likely the individual will be taking medication due to multiple illnesses, and there is higher likelihood that the side effects of these medications may be associated with nightmares.

#### 4.2. Sociodemographic factors associated with nightmares in the elderly population

There were significant gender differences in individuals over the age of 50 in our study. This result is consistent with studies showing that women generally experience more nightmares [1,3,29,62]. However, it is worth noting that the difference in prevalence between men and women disappeared in age groups over 70 in this study. This is a pattern consistent with previous studies that gender difference in nightmare prevalence is affected by age and differences tend to narrow as participants age [5] and disappear with old age [33]. Although it is unclear why gender differences do not appear after age 70, one hypothesis is that nightmares increase in older men. In one study, Sandman and colleagues speculated that men's decreasing androgen levels affect nightmares [5]. In addition, the elevated reporting of nightmares in elderly males may be associated with comorbid REM sleep behavioral disorder (RBD), a condition where the patient enacts dreams. RBD is another type of the parasomnia like nightmares [63], and further studies are needed to investigate the association between various parasomnias.

Nightmares were also significantly linked to low socioeconomic status, such as low income and unemployment. The association between socioeconomic factors and nightmares for the general adult population had different outcomes among studies, with some finding that situations such as low economic conditions and retirement were related to frequent nightmares [3,13,22,64], while

others did not [6]. These can be interpreted as the previous study that 'state' factors such as stress events may increase nightmares [65,66]. Long-term economic burdens on health care and living expenses, along with a reduction in economic activity due to retirement and the increase in life expectancy, may be main stressors associated with old age.

Marital status was not related to nightmares in the Schredl study, and the study by Sandman and colleagues shows that divorce and bereavement were associated with nightmares only in men [6,22]. However, in our sample, there was a difference in marital status between the NG and N-NG. Among them, the rate of bereavement was higher in the NG than N-NG. Although there are studies that have reported bereavement was associated with sleep problems such as insomnia [67] and sleep disturbances [68], this is the first study that has demonstrated the relationship with nightmares. If one possible explanation can be inferred, the death of a spouse who has lived together for a long time and shared a bed of sleep can be considered as a traumatic event qualified the A1 criteria for Posttraumatic Stress Disorder (PTSD) as explained by the DSM-5 [1], suggesting that it may be associated with nightmares and may particularly be a stress issue that is more frequently experienced in elderly. Nonetheless, further studies will be needed to explain the relationship between bereavement and nightmares, as there are many influencing factors, such as when the bereavement was experienced and whether it was a loss due to violent death and sudden loss [69].

#### 4.3. Psychological factors associated with for nightmares in the elderly population

In this study, nightmare in old age was found to be related to depression, stress, and suicidal ideation. The nightmare group had a 4.35 times higher risk of depression. 3.16 higher risk of stress and 3.45 higher risk of suicidal ideation compared to the non-nightmare group after controlling for covariates. While this has been reported in a number of previous studies in general adults, few studies have been conducted in elderly individuals in a population-based study. This study shows the results are consistent with Mallone's study that nightmares were associated with depression in the elderly population [21].

Moreover, results indicated that nightmares were associated with depression, stress, and suicide, even after controlling for insomnia symptoms and demographic variables such as age, gender and economic conditions. In a study by Nadorff and colleagues who investigated the relationship between insomnia, nightmares and suicidal ideation among elderly people over the age of 65, insomnia was reported to be associated with suicidal ideation, but nightmares were not associated with suicidal ideation [70]. In our sample, even after adjusting for insomnia symptoms and sociodemographic factors, nightmares were independently associated with suicidal ideation. The difference between the two studies may be due to the fact that insomnia symptoms were assessed using only three symptoms based on DSM-5 insomnia diagnosis criteria [1], rather than a standardized questionnaire in our study. Insomnia symptoms were assessed by the three nocturnal symptoms and frequency, and may not be sufficient to reflect the overall characteristics of insomnia, such as the diurnal impact of insomnia symptoms. Further validation will be needed in future studies using standardized and valid questionnaires that reflect the symptoms of insomnia and daytime functioning. Nevertheless, our results indicate that nightmares are associated with suicidal ideation in the elderly population. This suggests the possibility that an intervention for nightmares may be helpful in reducing suicidal ideation in this population.

#### 4.4. Limitations

Although this study has merits, one limitation was that this study utilized a cross-sectional design and thus we could not ascertain causality between nightmares and psychological factors measured in this study. Future longitudinal studies will be helpful in exploring causality of nightmares and other risk factors in the elderly population.

Nightmares were also assessed using retrospective reports from participants. Objective assessments such as polysomnography (PSG) [71,72] and functional magnetic resonance imaging (fMRI) [73,74] can reflect more different implications about sleep and nightmare patterns of old age compared to subjective reports, and would have made it possible to identify sleep features such as brain waves and brain regions of NG compared to N-NG. Future studies through various measurement methods will be needed to illuminate the underlying mechanism of nightmares in the elderly as there may be common pathways as well as confounding factors such as the effects of physical aging on sleep.

This study also did not explore the association with nightmares and other psychiatric or physical conditions. For example, it is well-known that nightmares are closely related to trauma, especially war combat. Previous studies have found that nightmares and PTSD caused by war [75–78]. In a study of the prevalence of nightmares in Finland, a study was conducted by separating the elderly population who experienced second World War [5]. South Korea experienced the second World War in the 1950s, and considering the age range of this study is between 50 and 85, it is necessary to control and examine trauma in future studies to ensure the study results are not limited to a specific age cohort. In addition, tests for cognitive styles and anxiety, such as pre-sleep arousal [7,14–16] affecting individual arousal level associated with nightmares were not reflected in this study. If this is supplemented in future research, it will have more rich implications for understanding nightmares in the elderly.

#### 5. Conclusion

Despite the limitations, this study has the meaning in that it is the first to explore the relation between nightmares and a wide range of related factors including demographic, psychological, and sleep factors in healthy elderly people from a large population-based study. In addition, nightmares were assessed utilizing a validated diagnostic tool that included both frequency, awakening during sleep, intensity and severity of nightmares rather than a single question. In this study, relatively conservative criteria were applied for the precise definition of a nightmare that was clinically meaningful, and therefore a small sample of 79 out of 2940 (2.7%) was defined as NG experiencing a clinical level of nightmare. Since the prevalence of nightmares is not high in the general population, our nightmare studies using large samples without intentional sampling may be important. Most importantly, results from this study suggest that nightmares in the elderly may be different from younger age groups and warrants further attention.

#### CRediT authorship contribution statement

**Dasom Park:** Conceptualization, Formal analysis, Investigation, Writing - original draft. **Soriul Kim:** Methodology, Data curation, Validation, Formal analysis, Investigation. **Chol Shin:** Project administration, Supervision, Methodology, Resources, Validation. **Sooyeon Suh:** Supervision, Conceptualization, Methodology, Validation, Writing - review & editing.

## Acknowledgements

This study was supported by the Korea Centers for Disease Control and Prevention (KCDC) (2017-E71001-00, 2018-E7101-00), and the Sungshin Women's University Research Grant of 2019 (2019-1-82-001).

## Conflict of interest

The authors have no conflicts of interest.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <https://doi.org/10.1016/j.sleep.2020.11.039>.

## References

- Association AP, Association AP. Diagnostic and statistical manual of mental disorders: DSM-5. Washington, DC: American psychiatric association; 2013.
- Blagrove M, Farmer L, Williams E. The relationship of nightmare frequency and nightmare distress to well-being. *J Sleep Res* 2004;13(2):129–36.
- Li SX, Zhang B, Li AM, et al. Prevalence and correlates of frequent nightmares: a community-based 2-phase study. *Sleep* 2010;33(6):774–80.
- Miró E, Martínez M. Affective and personality characteristics in function of nightmare prevalence, nightmare distress, and interference due to nightmares. *Dreaming* 2005;15(2):89.
- Sandman N, Valli K, Kronholm E, et al. Nightmares: prevalence among the Finnish general adult population and war veterans during 1972–2007. *Sleep* 2013;36(7):1041–50.
- Schredl M. Nightmare frequency and nightmare topics in a representative German sample. *Eur Arch Psychiatr Clin Neurosci* 2010;260(8):565–70.
- Spoormaker VI, Schredl M, van den Bout J. Nightmares: from anxiety symptom to sleep disorder. *Sleep Med Rev* 2006;10(1):19–31.
- Zadra A, Pilon M, Donderi DC. Variety and intensity of emotions in nightmares and bad dreams. *J Nerv Ment Dis* 2006;194(4):249–54.
- Levin R, Nielsen TA. Disturbed dreaming, posttraumatic stress disorder, and affect distress: a review and neurocognitive model. *Psychol Bull* 2007;133(3):482.
- Lee R, Suh S. Comparison of dream themes, emotions and sleep parameters between nightmares and bad dreams in nightmare sufferers. *J Sleep Med* 2016;13(2):53–9.
- American Academy of Sleep M. International classification of sleep disorders. 2014.
- Nadorff MR, Nazem S, Fiske A. Insomnia symptoms, nightmares, and suicidal ideation in a college student sample. *Sleep* 2011;34(1):93–8.
- Ohayon MM, Morselli P, Guilleminault C. Prevalence of nightmares and their relationship to psychopathology and daytime functioning in insomnia subjects. *Sleep* 1997;20(5):340–8.
- Levin R, Fireman G. Nightmare prevalence, nightmare distress, and self-reported psychological disturbance. *Sleep* 2002;25(2):205–12.
- Roberts J, Lennings C. Personality, psychopathology and nightmares in young people. *Pers Individ Differ* 2006;41(4):733–44.
- Nielsen TA, Laberge L, Paquet J, et al. Development of disturbing dreams during adolescence and their relation to anxiety symptoms. *Sleep* 2000;23(6):1–10.
- Lancee J, Spoormaker VI, Van Den Bout J. Nightmare frequency is associated with subjective sleep quality but not with psychopathology. *Sleep Biol Rhythm* 2010;8(3):187–93.
- Tanskanen A, Tuomilehto J, Viinamäki H, et al. Nightmares as predictors of suicide. *Sleep* 2001;24(7):845–8.
- Cukrowicz KC, Otamendi A, Pinto JV, et al. The impact of insomnia and sleep disturbances on depression and suicidality. *Dreaming* 2006;16(1):1.
- Lee R, Suh S. Nightmare distress as a mediator between nightmare frequency and suicidal ideation. *Dreaming* 2016;26(4):308.
- Mallon L, Broman J-E, Hetta J. Sleeping difficulties in relation to depression and anxiety in elderly adults. *Nord J Psychiatr* 2000;54(5):355–60.
- Sandman N, Valli K, Kronholm E, et al. Nightmares: risk factors among the Finnish general adult population. *Sleep* 2015;38(4):507–14.
- Schmidt C, Peigneux P, Cajochen C. Age-related changes in sleep and circadian rhythms: impact on cognitive performance and underlying neuroanatomical networks. *Front Neurol* 2012;3:118.
- Neubauer DN. Sleep problems in the elderly. *Am Fam Physician* 1999;59(9):2551.
- Nicolas A, Petit D, Rompre S, et al. Sleep spindle characteristics in healthy subjects of different age groups. *Clin Neurophysiol* 2001;112(3):521–7.
- Ohayon MM, Carskadon MA, Guilleminault C, et al. Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: developing normative sleep values across the human lifespan. *Sleep* 2004;27(7):1255–73.
- Cohen V, Arbus C, Soto M, et al. Sleep disorders and their impacts on healthy, dependent, and frail older adults. *J Nutr Health Aging* 2009;13(4):322–9.
- Salvio M-A, Wood JM, Schwartz J, et al. Nightmare prevalence in the healthy elderly. *Psychol Aging* 1992;7(2):324.
- Nielsen T, Zadra A. Idiopathic nightmares and dream disturbances associated with sleep-wake transitions. In: Principles and practice of sleep medicine. 5th ed. Philadelphia: Saunders; 2011. p. 1106–15.
- Bengtsson C, Lennartsson J, Lindquist O, et al. Sleep disturbances, nightmares and other possible central nervous disturbances in a population sample of women, with special reference to those on antihypertensive drugs. *Eur J Clin Pharmacol* 1980;17(3):173–7.
- Nielsen TA, Stenstrom P, Levin R. Nightmare frequency as a function of age, gender, and September 11, 2001: findings from an Internet questionnaire. *Dreaming* 2006;16(3):145.
- Wood JM, Bootzin RR, Quan SF, et al. Prevalence of nightmares among patients with asthma and chronic obstructive airways disease. *Dreaming* 1993;3(4):231.
- Schredl M, Reinhard I. Gender differences in nightmare frequency: a meta-analysis. *Sleep Med Rev* 2011;15(2):115–21.
- Shin C, Lee S, Lee T, et al. Prevalence of insomnia and its relationship to menopausal status in middle-aged Korean women. *Psychiatr Clin Neurosci* 2005;59(4):395–402.
- Krakow B, Schrader R, Tandberg D, et al. Nightmare frequency in sexual assault survivors with PTSD. *J Anxiety Disord* 2002;16(2):175–90.
- Krakow B, Hollifield M, Schrader R, et al. A controlled study of imagery rehearsal for chronic nightmares in sexual assault survivors with PTSD: a preliminary report. *J Trauma Stress* 2000;13(4):589–609.
- Lee R, Krakow B, Suh S. Psychometric properties of the disturbing dream and nightmare severity index-Korean version. *J Clin Sleep Med* 2020. <https://doi.org/10.5664/jcs.m.8974>. In press.
- Matslky GI, Joiner TE. The hopelessness depression symptom questionnaire. *Cognit Ther Res* 1997;21(3):359–84.
- Joiner Jr T, Pfaff JJ, Acres JG. A brief screening tool for suicidal symptoms in adolescents and young adults in general health settings: reliability and validity data from the Australian National General Practice Youth suicide prevention project. *Behav Res Ther* 2002;40(4):471–81.
- Suh S, Ryu H, Chu C, et al. Validation of the Korean depressive symptom inventory-suicidality subscale. *Psychiatr Invest* 2017;14(5):577.
- Beck AT, Steer RA, Brown GK. Beck depression inventory-II. *San Antonio* 1996;78(2):490–8.
- Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav* 1983;385–96.
- Buysse DJ, Reynolds 3rd CF, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatr Res* 1989;28(2):193–213.
- Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep* 1991;14(6):540–5.
- Holm S. A simple sequentially rejective multiple test procedure. *Scand Stat Theory Appl* 1979;6:65–70.
- Aickin M, Gensler H. Adjusting for multiple testing when reporting research results: the Bonferroni vs Holm methods. *Am J Publ Health* 1996;86:726–8.
- Gaetano J. Holm-Bonferroni sequential correction: an EXCEL calculator [Microsoft Excel workbook]. 2013.
- Antelmi I, De Paula RS, Shinzato AR, et al. Influence of age, gender, body mass index, and functional capacity on heart rate variability in a cohort of subjects without heart disease. *Am J Cardiol* 2004;93(3):381–5.
- Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part I: aging arteries: a “set up” for vascular disease. *Circulation* 2003;107(1):139–46.
- Attavar P, Silverman DI. Normal and pathological changes in cardiovascular autonomic function with age. *Autonomic nervous system in old age*, vol. 33. Karger Publishers; 2004. p. 32–44.
- De Meersman RE, Stein PK. Vagal modulation and aging. *Biol Psychol* 2007;74(2):165–73.
- Vaseghi M, Shivkumar K. The role of the autonomic nervous system in sudden cardiac death. *Prog Cardiovasc Dis* 2008;50(6):404.
- Wulsin L, Herman J, Thayer JF. Stress, autonomic imbalance, and the prediction of metabolic risk: a model and a proposal for research. *Neurosci Biobehav Rev* 2018;86:12–20.
- Nielsen T, Paquette T, Solomonova E, et al. Changes in cardiac variability after REM sleep deprivation in recurrent nightmares. *Sleep* 2010;33(1):113–22.
- Simor P, Bódizs R, Horváth K, et al. Disturbed dreaming and the instability of sleep: altered nonrapid eye movement sleep microstructure in individuals with frequent nightmares as revealed by the cyclic alternating pattern. *Sleep* 2013;36(3):413–9.
- Simor P, Horváth K, Gombos F, et al. Disturbed dreaming and sleep quality: altered sleep architecture in subjects with frequent nightmares. *Eur Arch Psychiatr Clin Neurosci* 2012;262(8):687–96.
- Asplund R. Nightmares, sleep and cardiac symptoms in the elderly. *Neth J Med* 2003;61(7):257–61.
- Schredl M, Kälberer A, Zacharowski K, et al. Pain dreams and dream emotions in patients with chronic back pain and healthy controls. *Open Pain J* 2017;10(1).
- Asplund R. Nightmares in relation to health, sleep and somatic symptoms in the elderly. *Sleep Hypn* 2003;5:175–81.



- [60] Pagel J. Nightmares and disorders of dreaming. *Am Fam Physician* 2000;61(7):2037.
- [61] Pagel J, Helfter P. Drug induced nightmares—an etiology based review. *Hum Psychopharmacol* 2003;18(1):59–67.
- [62] Schredl M, Reinhard I. Gender differences in dream recall: a meta-analysis. *J Sleep Res* 2008;17(2):125–31.
- [63] Postuma R, Gagnon J, Vendette M, et al. Quantifying the risk of neurodegenerative disease in idiopathic REM sleep behavior disorder. *Neurology* 2009;72(15):1296–300.
- [64] Kroth J, Thompson L, Jackson J, et al. Dream characteristics of stock brokers after a major market downturn. *Psychol Rep* 2002;90(3\_part\_2):1097–100.
- [65] Loveland Cook CA, Caplan RD, Wolowitz H. Nonwaking responses to waking stressors: dreams and nightmares 1. *J Appl Soc Psychol* 1990;20(3):199–226.
- [66] Schredl M. Effects of state and trait factors on nightmare frequency. *Eur Arch Psychiatr Clin Neurosci* 2003;253(5):241–7.
- [67] Hardison HG, Neimeyer RA, Lichstein KL. Insomnia and complicated grief symptoms in bereaved college students. *Behav Sleep Med* 2005;3(2):99–111.
- [68] Byrne GJ, Raphael B. The psychological symptoms of conjugal bereavement in elderly men over the first 13 months. *Int J Geriatr Psychiatr* 1997;12(2):241–51.
- [69] Kaltman S, Bonanno GA. Trauma and bereavement: examining the impact of sudden and violent deaths. *J Anxiety Disord* 2003;17(2):131–47.
- [70] Nadorff MR, Fiske A, Sperry JA, et al. Insomnia symptoms, nightmares, and suicidal ideation in older adults. *J Gerontol B Psychol Sci Soc Sci* 2013;68(2):145–52.
- [71] Phelps AJ, Kanaan RA, Worsnop C, et al. An ambulatory polysomnography study of the post-traumatic nightmares of post-traumatic stress disorder. *Sleep* 2018;41:zsx188.
- [72] Simor P, Körmendi J, Horváth K, et al. Electroencephalographic and autonomic alterations in subjects with frequent nightmares during pre-and post-REM periods. *Brain Cognit* 2014;91:62–70.
- [73] Shen C, Wang J, Ma G, et al. Waking-hour cerebral activations in nightmare disorder: a resting-state functional magnetic resonance imaging study. *Psychiatr Clin Neurosci* 2016;70:573–81.
- [74] Marquis L-P, Julien S-H, Baril A-A, et al. Nightmare severity is inversely related to frontal brain activity during waking state picture viewing. *J Clin Sleep Med* 2019;15:253–64.
- [75] Kaup BA, Ruskin PE, Nyman G. Significant life events and PTSD in elderly World War II veterans. *Am J Geriatr Psychiatr* 1994;2(3):239–43.
- [76] Neylan TC, Marmar CR, Metzler TJ, et al. Sleep disturbances in the Vietnam generation: findings from a nationally representative sample of male Vietnam veterans. *Am J Psychiatr* 1998;155(7):929–33.
- [77] Schredl M, Piel E. War-related dream themes in Germany from 1956 to 2000. *Polit Psychol* 2006;27(2):299–307.
- [78] Schreuder BJ, Kleijn WC, Rooijmans HG. Nocturnal re-experiencing more than forty years after war trauma. *J Trauma Stress* 2000;13(3):453–63.