



## Early morning awakening and nonrestorative sleep are associated with increased minor non-fatal accidents during work and leisure time



Hsiao-Yean Chiu<sup>a</sup>, Mei-Yeh Wang<sup>b</sup>, Cheng-Kuei Chang<sup>c</sup>, Ching-Min Chen<sup>d</sup>,  
Kuei-Ru Chou<sup>a</sup>, Jen-Chen Tsai<sup>e</sup>, Pei-Shan Tsai<sup>a,f,g,\*</sup>

<sup>a</sup> Graduate Institute of Nursing, College of Nursing, Taipei Medical University, Taipei, Taiwan

<sup>b</sup> Department of Nursing, Cardinal Tien College of Healthcare and Management, New Taipei City, Taiwan

<sup>c</sup> Graduate Institute of Injury Prevention and Control, Taipei Medical University, Taipei, Taiwan

<sup>d</sup> Department of Nursing/Institute of Gerontology, National Cheng Kung University, Tainan, Taiwan

<sup>e</sup> Department and Institute of Nursing, School of Nursing, National Yang-Ming University, Taipei, Taiwan

<sup>f</sup> Department of Nursing, Wan Fang Hospital, Taipei Medical University, Taipei, Taiwan

<sup>g</sup> Sleep Science Center, Taipei Medical University Hospital, Taipei, Taiwan

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### ABSTRACT

**Background:** The relationship between a composite measure of insomnia and occupational or fatal accidents has been investigated previously; however, little is known regarding the effect of various insomnia symptoms on minor non-fatal accidents during work and leisure time.

**Objective:** We investigated the predicting role of insomnia symptoms on minor non-fatal accidents during work and leisure time.

**Methods:** Data from the 2005 Taiwan Social Development Trend Survey of 36,473 Taiwanese aged  $\geq 18$  years were analyzed in 2013. Insomnia symptoms, including difficulty in initiating sleep (DIS), difficulty in maintaining sleep (DMS), early morning awakening (EMA), and nonrestorative sleep (NRS) were investigated. A minor non-fatal accident was defined as any mishap such as forgetting to turn off the gas or faucets, accidental falls, and abrasions or cuts occurring during work and leisure time in the past month that do not require immediate medical attention. Multivariable logistic regression was performed to assess the odds ratios (ORs) and associated 95% confidence interval (CI) of minor non-fatal accidents (as a binary variable) for each insomnia symptom compared with those of people presenting no symptoms, while controlling for possible confounders.

**Results:** EMA and NRS increased the odds of minor non-fatal accidents occurring during work and leisure time (adjusted OR = 1.19, 95% CI = 1.08–1.32 and adjusted OR = 1.27, 95% CI = 1.17–1.37, respectively).

**Conclusion:** EMA and NRS are two symptoms that are significantly associated with an increased likelihood of minor non-fatal accidents during work and leisure time after adjusting for a range of covariates.

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### 1. Introduction

Sleep disturbances such as insomnia and sleepiness are highly prevalent (20–30%) in contemporary society (Morin et al., 2006; Kao et al., 2008) and affect individuals' health and daily lives. An increasing amount of evidence indicates that daytime sleepiness is

a crucial factor for the occurrence of accidents (Lavie et al., 1982; Melamed and Oksenberg, 2002; Perez-Chada et al., 2005). Undoubtedly, insomnia directly induce daytime sleepiness (Kao et al., 2008), which can result in daytime dysfunction and consequently increase the likelihood of accidents (Akerstedt et al., 2002; Leger et al., 2006; Chen and Wu, 2010). Therefore, increased attention has been focused on exploring this relationship in recent years.

Common symptoms of insomnia include difficulty in initiating sleep (DIS), difficulty in maintaining sleep (DMS), and early morning awakening (EMA) (Kryger et al., 2011). Previous studies investigating the relationship between insomnia and accidents have focused on the effect of a composite measure of insomnia

\* Corresponding author at: Corresponding author at: Taipei Medical University, Graduate Institute of Nursing, College of Nursing, 250 Wu Hsing St., Taipei 110, Taiwan. Tel.: +886 2 27338813; fax: +886 2 23772842.  
E-mail address: [ptsai@tmu.edu.tw](mailto:ptsai@tmu.edu.tw) (P.-S. Tsai).

on accidents (Leger et al., 2006; Shahly et al., 2012). Several studies analyzing the effect of various insomnia symptoms on the risk of accidents have produced mixed results. Certain studies have indicated that DIS is more strongly associated with occupational accidents than are DMS and EMA (Nakata et al., 2005; Sagberg, 2006; Salminen et al., 2010) and other studies have supported that DMS is more strongly correlated with occupational accidents than is DIS in industry workers (Lavie et al., 1982). Although these studies represent crucial advances in the understanding of the relationship between insomnia symptoms and accidents, most of these studies have focused on fatal or occupational accidents. Minor non-fatal accidents which do not require immediate medical attention are often associated with reduced sense of well-being and overall quality of life (Cubi-Molla and Herrero, 2012); therefore, increased attention must be focused on the association between specific insomnia symptoms and non-fatal accidents. Moreover, most of the relevant published reports have focused on selected work types or workplaces and have involved the use of a relatively small sample size; therefore, conducting a study by using a nationally representative sample to examine the differential impact of each insomnia symptom on minor non-fatal accidents is of importance.

Nonrestorative sleep (NRS) has been recognized as a distinct component of insomnia (American Psychiatric Association, 1994; Roth et al., 2010); however, little is known about the effect of NRS on the occurrence of accidents. Investigating the effect of each insomnia symptom on the risk of non-fatal accidents during work and leisure time can assist health care providers in developing strategies for preventing insomnia-related non-fatal accidents.

The purpose of this study was to investigate the predicting roles of DIS, DMS, EMA, and NRS, on minor non-fatal accidents during work and leisure time by analyzing data derived from a large-scale nationwide health survey.

## 2. Methods

### 2.1. Study population

We examined data from the Taiwan Social Development Trend Survey conducted in 2005, which was a face-to-face survey of representative Taiwanese residents who were 15 years of age or older. The survey was conducted by the Directorate-General of Budget, Accounting, and Statistics, Executive Yuan, Taiwan (Accounting and Statistics, 2006). A stratified two-stage clustered sampling scheme was used, which involved the proportional random selection of primary and secondary sampling units (neighborhood and household, respectively). Details of the survey methodology are described elsewhere (Accounting and Statistics, 2006). No data were missing. The final sample size for analyses was 36,473 (18,081 men, 18,392 women).

### 2.2. Measurements

#### 2.2.1. Insomnia symptoms

Insomnia symptoms were assessed using the Insomnia Self-Assessment Inventory, a 12-item questionnaire developed for the Taiwanese 2001 Social Trend Survey. Two items assessed DIS; 2 items assessed DMS; 1 item measured EMA; 4 items assessed NRS; and 1 item assessed daytime fatigue. Regarding the DIS items, one of which asked the participant to report whether they experience difficulty in falling asleep and the other item asked the participant to indicate the occurrence of taking more than 1 h to fall asleep at night. One of the DMS items asked the participant to indicate the occurrence of difficulty in falling back to sleep once awake and the other item asked the participant to indicate the occurrence of waking up more than three times during the night. The EMA item

inquired whether the respondent wakes up too early in the morning. The 4 NRS items asked the respondent to indicate the likelihood of experiencing difficulty in getting started in the morning, feeling tired upon awakening, feeling that sleep is not refreshing, or feeling unrested despite enough time in bed. Daytime fatigue was assessed by an item designed to investigate the extent to which poor sleep results in fatigue during waking hours. The answers to the questionnaire were measured based on a 5-point Likert-type scale, with 1 reflecting *never*, 2 reflecting *seldom*, 3 reflecting *sometimes*, 4 reflecting *usually*, and 5 reflecting *all the time*. In this study, a score of 4 or 5 signified the occurrence of a specific symptom. Participants exhibiting DIS or DMS were defined as those who scored 4 or above on either one of the 2 DIS or DMS questions. Respondents who scored 4 or above on either one of the 4 NRS items were referred to as participants with NRS. Respondents exhibiting EMA and daytime fatigue were those who scored 4 or above on the respective items (Kao et al., 2008). Participants could exhibit one or more insomnia symptoms. The scale demonstrated satisfactory internal consistency reliability (Cronbach's = 0.92). The validity of the Insomnia Self-Assessment Inventory was evidenced by its association with self-assessed health and a factor analysis that indicated two factor loadings (i.e., night time sleep disturbance and daytime sequelae of poor sleep) (Chen et al., 2005) which are consistent with the diagnostic criteria of insomnia established by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychiatric Association, 1994).

#### 2.2.2. Minor non-fatal accidents during work and leisure time

The occurrence of a minor non-fatal accident during work and leisure time was assessed using 1 item: "Have any mishaps occurred while you were out and about, at work, or performing household chores in the past month (e.g., forgetting to turn off the gas or faucets, accidental falls, and abrasions or cuts that do not require immediate medical attention)?" The response was rated on a 4-point Likert-type scale, with 1 reflecting *never*, 2 reflecting *occasionally*, 3 reflecting *sometimes*, and 4 reflecting *all the time*. In this study, participants who experienced minor non-fatal accidents were those who produced a score of 2 or above for this item.

#### 2.2.3. Daytime sleepiness

Daytime sleepiness was measured using the 8-item Daytime Sleepiness Self-Assessment Inventory. The scale assesses the likelihood of falling asleep in various situations. A total score between 11 and 14 indicated moderate daytime sleepiness, and a score higher than 15 suggested excessive daytime sleepiness (Chen et al., 2005). The scale demonstrated satisfactory internal consistency and few redundancies among items. The reliability coefficient was 0.86. The item-total score correlation coefficients ranged from 0.55 to 0.81 and the item-item correlation coefficients ranged from 0.28 to 0.7, which were within acceptable ranges (Chen et al., 2005; Kao et al., 2008).

#### 2.2.4. Bio-socio-demographic factors

The bio-socio-demographic factors investigated in this study comprised age, gender, marital status, education level, shift work, body mass index (BMI), sleep duration, daytime sleepiness, perceived health status (level of independence in daily living), and psychological well-being. BMI was calculated based on body height and weight. Sleep duration was assessed using the item, "How many hours do you typically sleep in a 24-h period, including daytime naps?" Sleep duration was classified into three categories: <7 h, 7–8 h and >8 h. The medium group served as the reference group (Maia et al., 2013). Psychological well-being was measured using 5 items and a high score indicates a low level of psychological well-being (Kao et al., 2008). Perceived health status was assessed using 1 item. The response was rated on a scale of 1–3,

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