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Excessive daytime sleepiness in general hospital nurses: prevalence, correlates, and its association with adverse events

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Abstract

Objective To investigate the prevalence and correlates of excessive daytime sleepiness (EDS) in a population of hospital nurses in South China as well as the influence of EDS on the occurrence of adverse events.

Methods A total of 1102 nurses working in a large medical center were invited to participate in this cross-sectional study (96.9% females, mean age 29.6 years). They all completed a self-reported questionnaire consisting of items on demographic variables, lifestyle factors, insomnia, anxiety, depression, and both work-related and sleep-related characteristics.

Results A total of 1048 nurses gave a valid response (response rate 95.1%). Among them, 169 (16.1%) reported EDS as defined as an Epworth Sleepiness Scale ≥ 14. Depression (adjusted odds ratio = 2.24, 95% confidence interval 1.51–3.31), anxiety (1.65; 1.02–2.67), insomnia (2.29; 1.56–3.36), rotating shift work (1.98; 1.03–3.83), and low interest in work (1.74; 1.01–2.99) were all independent risk factors of the occurrence of EDS. EDS is associated with the occurrence of adverse events after controlling for confounding factors (adjusted OR 1.83, CI 1.26 to 2.67).

Conclusions EDS was common among this relatively young and healthy nurse population in south China. There were clear associations between EDS and depression, anxiety, insomnia, rotating shift work, and low work-related interest. Furthermore, EDS was an independent risk factor in the occurrence of adverse events (AEs) in our subjects.

Keywords Excessive daytime sleepiness · Nurses · Depression · Anxiety · Rotating shift work · Adverse events

Introduction

Excessive daytime sleepiness (EDS), which affects an estimated 20% of the adults, has become a significant public health concern [1]. It not only is an accessory symptom or risk factor for various physical and mental disorders but also associates with low productivity, various life-threatening traffic accidents, and occupational injuries related to human errors [2–4]. Identifying the factors that associate with EDS is therefore of great importance for improving the occupational health.

A large number of epidemiological studies have reported the prevalence and correlates of EDS in general populations [5–8]. Previous studies have shown that age [9], shift work [10, 11], work-related stress [12], the severity of mood symptoms [1, 13], body mass index (BMI), and personal chronotype [14] are associated with EDS. Recently, several studies had also reported the associations between shift work and daytime sleepiness among nurses and other medical professionals, but the results were contradictory [15–19].

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Therefore, the information on the prevalence and determinants of EDS in the population of nurses still needs to be explored yet.

On the other hand, EDS is an important occupational health issue in hospital nurses, which is relevant to the patients' safety directly. However, the influence of EDS on the occurrence of adverse events (AEs) in hospital nurses of China is still unknown. Moreover, most of the previous studies on this issue did not fully control the personal factors of their subjects, such as alcohol consumption [15], other sleep problems and mental health [16], and all of these might result in the divergent findings between different studies. The aims of our study were to determine the prevalence and correlates of EDS in hospital nurses. Furthermore, we also estimated the impact of EDS on the occurrence of AEs.

Methods

Study design and participant recruitment

The current study was based on an epidemiologic study, which aimed to explore the prevalence of various sleep and mental problems, their correlated factors, and consequences. Our participants were nurses who worked either rotating or day shifts in a large medical center of Guangzhou, Guangdong Province, China. This study was approved by the Hospital's Ethics Committee, and all participants provided written consents. Questionnaires were distributed and collected by the research staff in the current study. In total, 1102 nurses were recruited in the survey. Among them, 1048 participants with valid responses were included into the final analyses.

Measurements

The structured questionnaires developed for the study were consisted of several categories: socio-demographic, work-related characteristics, and lifestyle and sleep-related factors (Table 1). Frequency of moderate-to-intensive physical activity for more than 30 min was defined by a single 2-point scale question (1: < 3 days per week; 2: ≥ 3 days per week). Height and weight were self-reported and converted into body mass index (BMI). Based on the criteria for Asian adults developed by the World Health Organization (WHO), participants with a BMI > 25 were categorized as obese [17].

Work-related characteristics

The work-related characteristics of participants included department, position, average number of rotating shifts work per month, the length of work experience, interest in work, and work-related stress. In our study, both interest in work and work-related stress were surveyed using a single 2-point scale question (1: high interest 2: general interest or even low interest; 1: high level of stress 2: general or even low level of stress).

Sleep-related characteristics

EDS Daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS), a brief questionnaire which has been widely validated. The ESS questionnaire captures an individual's propensity to fall asleep during commonly encountered situations on a scale from 0 to 3 (range 0 to 24). We used a validated Chinese translation of this questionnaire [18], and the total score equal to or greater than 14 indicates EDS [19].

Insomnia symptoms and short sleep duration in weekdays The Insomnia Severity Index (ISI) was used to measure the symptoms and consequences of insomnia (Morin CM1993) during the past 2 weeks. The ISI consists of seven questions with a 5-point scale (0: not at all-4: very serious). Participants who scored 14 points or higher are classified into having insomnia symptoms [20]. Moreover, we also asked the nurses whether their sleep duration in weekdays were less than 6 h per day in the past month.

Depression and anxiety symptoms The Beck Depression Inventory (BDI) and Self-Rating Anxiety Scale (SAS) were employed to access the depression and anxiety severity of our subjects during the last week, respectively. The BDI is a well-established 21-item self-reported inventory for the assessment of the severity of depressive symptoms in adults. BDI score of at least 11is indicative of depression [21]. The Zung Self-Rating Anxiety Scale (SAS) is a self-reported scale with 20 items, which is able to distinguish normal from anxious individuals and quantifies a patient's level of anxiety [22, 23]. Participants with global scores that exceed 50 are classified considered as having anxiety symptoms.

Morningness-Eveningness Questionnaire We employed a reduced version of the Chinese Morningness-Eveningness Questionnaire (rMEQ). The total score of rMEQ of 4–11, 12–17, and 18–25 indicates eveningness, intermediate, and morningness chronotype, respectively [24].

Definition of AEs

An adverse event is an injury related to medical management [25]. It was conducted by an error known as preventable such as drug administration errors, incorrect operation of medical equipment, needle stick injuries, and patient falls. The nurses

Table 1 Results of the structured questionnaires that consisted of several categories: socio-demographic, work-related characteristics, and lifestyle and sleep-related factors

	EDS		
	No ($n = 879$)	Yes ($n = 169$)	p
Socio-demographics			
Age, years, mean (SD)	31.6 (9.7)	27.3 (5.9)	< 0.001***
Sex, female, *n* (%)	854 (97.2)	162 (95.9)	0.369
Education (bachelor), *n* (%)	524 (59.8)	107 (63.3)	0.395
Marital status (single), *n* (%)	470 (53.6)	107 (63.3)	< 0.05*
Work-related characteristics			
Monthly income (> 5000 yuan[#]), *n* (%)	435 (49.5)	77 (45.6)	0.350
Rotating shift work, *n* (%)	685 (77.9)	157 (92.9)	< 0.001***
Position (junior title), *n* (%)	707 (80.4)	158 (93.5)	< 0.001***
Work-related stress, *n* (%)	449 (51.1)	116 (68.6)	< 0.001***
Low interest in work, *n* (%)	659 (75.0)	151 (89.3)	< 0.001***
Work years, mean (SD)	9.64 (9.25)	7.01 (6.42)	< 0.001***
Lifestyle and sleep-related characteristics			
BMI > 25 (kg/m^2), *n* (%)	33 (3.8)	10 (5.9)	0.194
Alcohol drinking often, *n* (%)	7 (0.8)	2 (1.2)	0.110
Exercise often, *n* (%)	125 (14.2)	16 (9.5)	0.102
Habitual napping, *n* (%)	664 (75.6)	124 (73.4)	0.534
Snoring, *n* (%)	32 (3.6)	6 (3.6)	0.954
Time on TV or the internet (≥ 3 h/day), *n* (%)	265 (30.2)	60 (35.5)	0.171
Short sleep duration in weekdays (< 6 h/day), *n* (%)	15 (1.7)	7 (4.2)	< 0.05*
Depression, *n* (%)	337 (42.9)	123 (72.8)	< 0.001***
Anxiety, *n* (%)	73 (8.3)	39 (23.1)	< 0.001***
Insomnia, *n* (%)	164 (18.7)	79 (46.7)	< 0.001***
Chronotype			0.229
Eveningness chronotype, *n* (%)	160 (18.3)	40 (23.7)	
Intermediate chronotype, *n* (%)	535 (61.3)	100 (52.9)	
Morningness chronotype, *n* (%)	178 (20.4)	29 (17.2)	

SD Standard deviation, *NA* not available

* $P < 0.05$,** $P < 0.01$, *** $P < 0.001$

[#] One yuan equals 0.15 US dollar

were asked to report whether they had caused or been responsible for an "adverse event" including "accident" or "incident" in the past 12 months, regardless of severity of the event. Therein, an accident included medical behaviors that harmed a patient, while an incident include the action that was not taken yet but would have harmed a patient if committed or action was already taken but did not harm the patient or require follow-up observation [26].

Data analysis

The socio-demographic, work-related characteristics, lifestyle, and sleep-related factors of the participants were evaluated using descriptive statistics. The t test and χ^2 test were conducted to compare the nurses' characteristics according to the occurrence of EDS and AEs. First of all, univariate analyses and multiple logistic regression analyses were performed to examine the associations of EDS with demographic data and other confounding factors. In addition, "with AEs" and "without AEs" were taken as the dependent variables to analyze whether EDS associated with the occurrence of AEs. While with/without EDS, demographic data and work-related characteristics were considered as independent variables in model 1. Other potential confounding factors were further included into model 2. We presented odds ratios with 95% confidence intervals (CI), and a p value of < 0.05 was considered to indicate statistical significance. All tests were two-tailed. A Statistical Package for the Social Sciences (SPSS) 20.0 for windows (SPSS Inc., Chicago, IL) was used for all statistical tests.

Results

Characteristics of subjects and prevalence of excessive daytime sleepiness

The demographic, lifestyle, work-related, and sleep-related characteristics of the study subjects are presented in Table 1. In the present study, almost 16.1% of the subjects experienced EDS as defined as having ESS ≥ 14. No smoker was found in the current study. Subjects with EDS were more likely to be younger and single. We also found that rotating shift work, a lower position, high work-related stress, low interest in work, anxiety, depression, insomnia, and short sleep duration in weekdays (< 6 h/day) were associated with incident EDS. However, educational level, chronotype, BMI, habitual napping, snoring, or exercises did not show a significant association with EDS (Table 1).

The correlates of excessive daytime sleepiness

Table 2 presents the results of logistic regression, which shows that rotating shift work, low work-related interest, insomnia, as well as anxiety and depression symptoms were prominent predictors of the prevalence of EDS after controlling for age, sex, marital status, education, position, monthly income, work-related stress, and short sleep duration in weekdays.

The influence of EDS on the occurrence of AEs

There were 45.9% of the nurses who reported that they experienced AEs in the past 12 months. Those nurses with EDS had a higher prevalence of AEs than those nurses without EDS (Fig. 1). Table 3 shows the results in logistic regression models. After controlling for demographic factors and work-related characteristics in model 1, subjects with EDS were significantly associated with a higher rate of AEs (OR 1.92, CI 1.33 to 2.77). In the final model with full adjustment (model 2), EDS remained as an independent risk factor in the occurrence of AEs.

Discussion

The current study showed 16.1% of the nurse reported EDS. Rotating shift work, low work-related interest, insomnia, as well as anxiety and depression symptoms were prominent correlates of the prevalence of EDS, whereas no significant relationships were seen between educational level, chronotype, BMI, habitual napping, snoring, or exercises and EDS. In addition, EDS was an independent risk factor of AEs, a common medical problem in general hospital nurses.

Compared to the previously published results in the nursing populations in Taiwan (35%) and Japan (26%), the prevalence

Table 2 Results of logistic regression

Correlates	Crude OR (95% CI)	Logistic regression model OR (95% CI)
Age, years	NA	0.96 (0.93–1.00)
Sex, female	0.68 (0.29–1.59)	0.61 (0.24–1.53)
Marital status (single)	0.67 (0.48–0.94)*	1.00 (0.60–1.67)
Education (≥ bachelor)	1.16 (0.83–1.63)	1.32 (0.88–1.98)
Work-related stress	2.10 (1.48–2.98)***	NA
Low interest in work	2.80 (1.68–4.67)***	1.74 (1.01–2.99)*
Nightshift (Inpatient)	3.71 (2.02–6.81)***	1.98 (1.03–3.83)*
Position (junior title)	0.29 (0.15–0.54)	NA
Income (> 5000 yuan[#]/month), *n* (%)	0.85 (0.61–1.19)	NA
Depression	3.56 (2.47–5.12)***	2.24 (1.51–3.31)***
Anxiety	3.31 (2.15–5.10)***	1.65 (1.02–2.67)*
Insomnia	3.83 (2.71–5.41)***	2.29 (1.56–3.36)***
Short sleep duration in weekdays (< 6 h/day)	2.50 (1.00–6.22)*	NA

Adjusted for age, sex, married status, education, position, monthly income, rotating shift work, work-related stress, low interest in work, insomnia, sleep duration in weekdays, depression and anxiety in this logistic regression model

NA not applicable, *CI* confidence interval, *OR* odds ratio

* *p* - values <0.05, ** *p*-values <0.01, *** *p*-values <0. 001

[#] One yuan equals 0.15 US dollar

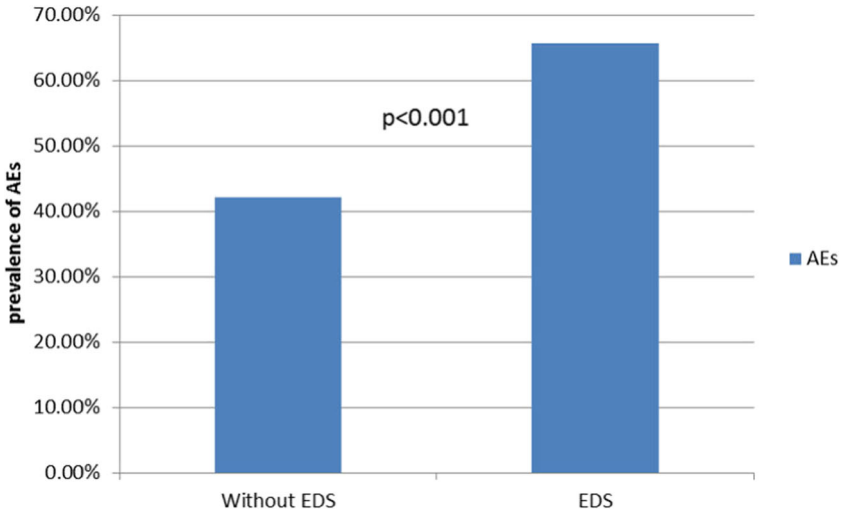

Fig. 1 Bar graph of the prevalence of AEs according to the two group subjects: without EDS vs. with EDS

of EDS in the current survey was relatively low (16%) [7, 16]. Several factors may account for the relatively low prevalence of EDS as found in our study. First, we employed a more stringent criterion to define EDS (ESS scores of ≥ 14) than the study in Taiwanese nurses (ESS scores of > 10) or the study in Japanese nurses to define EDS. Second, the subjects in the Taiwan study were much younger than that in our study. Indeed, it has been found that neurobehavioral deficits due to sleep loss are greater in younger population [27]. Our data and other studies [9, 28, 29] also revealed that younger age is a risk factor of EDS.

A number of studies have concluded that shift workers had a higher prevalence of EDS in general population [10, 11, 30, 31]. However, there were only few reports on the association between shift work and EDS on nurses or other medical staff [29, 32–34], in which findings were not consistent. Some studies found significant association between EDS and shift work in nurse population [32, 33, 35, 36], while other did not [29, 34, 37]. We speculated that a lower response rate [29], small sample size [34], differences in populations and the patterns of the night shifts might contribute to this inconsistency. Moreover, the finding that low interest in work remained an important risk factor for EDS in our study was also in keeping with previously published results [38, 39].

When it comes to mood symptoms, EDS is closely associated with depression, and depression has been shown to be a risk factor of incident and persistent EDS in general adult population [9, 40–42]. However, only a few studies had investigated the association between EDS and mood symptoms among nurses or other medical staff [29, 32, 34]. Matias et al. (2016) failed to find a significant positive association between EDS and high scores of anxiety symptoms among psychiatry residents [34]. Nevertheless, both depression and anxiety symptoms were independent significant risk factors of the prevalence of EDS in the current study. Our results were compatible with previous literature suggesting that subjects who reported depression and anxiety symptoms tended to exhibit a high degree of EDS in the general population [9, 43–45].

The relationship between insomnia and EDS has been well established in studies of working-age adults [13, 45–47]. Similar to several Taiwanese population surveys [47, 48], we found that insomnia status independently predicted the incidence of EDS with a high OR and a narrow confidence interval even after controlling for all the confounding factors. This finding confirmed the significant impact of insomnia on EDS.

We did have discordant findings; the hypothesis that BMI has positively associated with EDS and morningness trait nurses would have more sleepiness than their evening counterparts was not supported by our study [49, 50]. Though similar results have been reported elsewhere [35, 51], these differences could be interpreted that those subjects with higher BMI had an increasing risk of pathophysiological obstructive sleep apnea [52–54]. Regarding the chronotype, we explained

Table 3 Excessive daytime sleepiness in relation to adverse events

Correlates	Crude OR (95% CI)	Logistic regression model1 OR (95% CI)	Logistic regression model 2 OR (95% CI)
EDS	2.63 (1.87–3.72)***	1.92 (1.33–2.77)**	1.83 (1.26–2.67)**

* $P < 0.05$. ** $P < 0.01$. *** $P < 0.001$

the results with a high level of circadian sleep pressure during rotating shift work in all chronotypes.

Finally, our data showed 45.9% of nurses reporting AEs in the past 12 months, which was comparable with the prevalence rate reported by another study conducted in China (42.2%) [55]. As mentioned above, EDS is common in nurse population. Nevertheless, there had so far been only several reports that aimed to explore the associations between EDS and AEs [16, 56, 57].These studies, in general, reported a significant association between EDS and AEs. However, one study found that the association between EDS and AEs did not maintain statistical significance after controlling for shift work and poor mental health [57]. In current study, there was a significant association between AEs and EDS even after controlling demographics, lifestyle, work-related, and sleep-related characteristics. In this regard, further studies are warranted to explore the association between EDS and AEs taking other potential confounding factors into consideration.

Implications

Our findings suggested that EDS was prevalent in Chinese nurses and was associated with various mental distresses. We also identified several risk factors that were associated with EDS in this population, which may help to develop preventive strategies for EDS. On the other hand, AEs are very common in clinical settings, which are harmful to both patients and medical professionals. The independent association of EDS with AEs may also help to develop preventive strategies for the occurrence of AEs.

Limitations

There are also several limitations in the current study when interpreting the results. First, considering that EDS is a multifactorial construct, the unique use of the self-report ESS measurement, assessing subjective daytime sleepiness in daily life, represents a major limitation of the study. However, ESS has been previously shown to have good test–retest reliability to assess daytime sleepiness in adults [58] and has moderate association with objective daytime sleepiness measured through multiple sleep latency test [59, 60]. Recently, Johns proposed the Epworth Sleepiness Scale for Children and Adolescents (ESS-CHAD) as the official modified version of the ESS for adolescents and proved its reliability and validity in their research [61]. Similarly, it should be mentioned that the method of self-reported adverse events is also a limitation here. Sleepier nurses might remember the adverse events more frequently. Second, our study based on a cross-sectional design was insufficient to determine a causal relationship. A well-designed longitudinal study will be needed to identify the relevant factors for EDS in this cohort in the future. Third, we did not examine caffeine consumption, which was included in previous studies, for adjustment of life habits. Fourth, 96.9% of nurses in our study were females and no smokers were found in our study. However, this result was consistent with some other investigations of Chinese doctors [62, 63] and Chinese medical students [64, 65] who have reported having no female smokers at all. This phenomenon may reflect (1) a cultural reluctance for professional women to smoke in certain parts of the world, such as China, or (2) unwillingness to report smoking behaviors as measured by self-reported questionnaires. Lastly, though our subjects came from three to four different subsidiary hospitals and different departments in a large medical center, the present study was still not a multiple-center survey; thus, these results cannot represent the situation in Chinese general hospital nurses.

Conclusions

To summarize, the current study suggests that rotating shift work, depression, anxiety, insomnia, and low work interest were independent high-risk factors for EDS. On the other hand, EDS was one of the most important independent risk factor associated with the incidence of AEs, which emphasizes the need for giving more attentions to the EDS in Chinese hospital nurses.

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Compliance with ethical standards

This study was approved by the Hospital's Ethics Committee, and all participants provided written consents.

Conflict of interest The authors declare that they have no conflict of interest.

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