

✧ ORIGINAL ARTICLE ✧

The mediating and moderating effects of sleep hygiene practice on anxiety and insomnia in hospital nurses

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The mediating and moderating effects of sleep hygiene practice on anxiety and insomnia in hospital nurses

This study aimed to test the mediating and moderating effects of sleep hygiene practice on the relationship between anxiety and insomnia severity in hospital nurses. A cross-sectional survey was employed, and a convenience sample was recruited from one regional hospital in Taiwan. Participants completed the following self-report questionnaires over a 3-month period in 2009: the Insomnia Severity Index, the Beck Anxiety Inventory, and Sleep Hygiene Awareness and Practice Scale. The results indicated that nurses with more anxiety tended to have higher insomnia severity. Further, nurses with poor sleep hygiene practice had more insomnia. Sleep hygiene practice partially mediated the effects of anxiety on insomnia severity. Also, sleep hygiene practice was a moderator in the relationship between anxiety and insomnia severity with age and work units as covariates. Sleep hygiene practice mediated and moderated the relationship between anxiety and insomnia severity after controlling the variables of age and work units. Continuing to learn and train sleep hygiene practice might promote nurses' sleep hygiene, and thereby ameliorate anxiety and reduce the risk of insomnia.

Key words: anxiety, insomnia, nurses, sleep hygiene.

INTRODUCTION

Insomnia is defined as difficulty initiating or maintaining sleep, early awakening, and interrupted or non-restorative

sleep.¹ The multidimensional model of insomnia proposed by Spielman focuses on predisposing factors (e.g. age, gender and socioeconomics),^{2,3} precipitating factors (e.g. psychiatric illness, psychological, social or occupational stress such as work units, shift schedule)³ and perpetuating factors (e.g. maladaptive sleep hygiene awareness or sleep hygiene practices).^{3,4} The precipitating and perpetuating factors such as anxiety and sleep hygiene practice can cause clinical sleep disturbances and strengthen insomnia

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Conflict of interest

No conflict of interest has been declared by the authors.

severity. To efficiently reduce the degree of insomnia, the influence factors of insomnia deserve further exploration.

Nurses are assigned to shift work in order to provide continuous care for patients, but shift work often leads to sleep disturbances such as insomnia or daytime sleepiness.⁵ Irregular work schedules often result in sleepiness when wakefulness is required and insomnia during the main sleep episode. The rate of sleep problems was found higher in shift workers than the general population.⁶ A commonly used intervention to improve insomnia is education about sleep hygiene, which refers to behaviours that lead to good sleep quality.⁷ These include avoiding late-afternoon naps; avoiding caffeine, alcohol and tobacco as well as cognitively or emotionally demanding activities before bedtime; sleeping in a quiet and comfortable environment; and maintaining the same sleep schedule.⁷ Previous studies have examined the relationship between sleep hygiene and sleep quality in adolescents,⁸ university students^{9,10} and medical students.¹¹ Consequently, poor sleep hygiene is considered to be one of the major etiological factors of psychophysiological insomnia.⁴

The clinical setting is a significantly challenging environment for nurses to take care of patients. However, the challenging environments might cause nurses to experience stress and anxiety. As acute aspects of the occupational stress evolve, people can become increasingly anxious and frustrated about their inability to sleep.¹² Many studies related to sleep quality in nurses have also been carried out regarding fatigue,^{13,14} quality of life^{15,16} and hospital shifts.^{17–21} Furthermore, insomnia has been associated with depression,²² anxiety,^{23,24} perceived stress^{25,26} and sleep hygiene^{27–29} in patients and residents. However, the relationship between anxiety and insomnia severity has yet to be investigated in hospital nurses who are vulnerable to sleep disorders due to their work schedules.

Based on above literature, the variables of anxiety and sleep hygiene practice have been found important factors in determining insomnia severity. Few studies focused on examining the effects of psychosocial factors and sleep hygiene in determining insomnia severity on clinical shift nurses. Therefore, this study aimed to explore the relationships among anxiety, sleep hygiene practice and insomnia severity and tested whether sleep hygiene practice mediates and/or moderates the effects of anxiety on insomnia severity. We hypothesized that the effect of anxiety on insomnia severity was manifested through

sleep hygiene practice. Also, we hypothesized that for nurses with higher anxiety, poor sleep hygiene practice was significantly associated with insomnia severity.

METHODS

Subjects and setting

This correlational and cross-sectional study assessed the relationships between demographic factors, sleep hygiene practice, anxiety and insomnia severity. A convenience sample of nurses was recruited from one urban regional hospital in Taiwan. The inclusion criteria were: (i) registered female nurse; (ii) working full-time for at least 3 months; and (iii) no personal history of psychiatric or neurological disorders. The exclusion criteria were pregnant nurses during the study. A power analysis determined that a minimum 138 participants were needed to obtain statistically significant results. The estimated statistical power was computed based on the requirement for a regression analysis with four predictors, where the alpha level was set at 0.05, a moderate effect size at 0.15 and the level of power at 0.95.³⁰ In this study, a total of 188 registered nurses received a self-administered questionnaire and had 2 months (from September to November 2009) to complete it. In total, 163 nurses returned the questionnaire, which corresponds to a response rate of 86.70%. Data from three respondents were excluded from the analysis due to missing data. The analysis included 160 female nurses aged 21–61, and their mean age was 35.83 years (standard deviation (SD) = 10.11). The sample had mean work experience of 13.4 years in nursing (SD = 10.0). Half the participants were currently unmarried. About one-third of clinical nurses were from the medical–surgical ward (35.5%). Most participants were on a fixed shift schedule (61.3%), and more than half took exercise regularly (60%). The fixed schedule means that nurses worked on fixed shifts (only night, evening or day shifts). However, the shifting schedule means that nurses had varied shifts. The demographic data were found to have no significant difference between nurses who worked fixed shifts and those whose shifts varied.

Measures

Insomnia Severity Index

Insomnia severity was measured with the Insomnia Severity Index (ISI). The ISI is a seven-item questionnaire that measures the severity of insomnia problems over the last 2 weeks, such as the severity of sleep onset (initial), sleep maintenance (middle), early morning awakening

(terminal) problems, satisfaction with current sleep pattern, interference with daily functioning, noticeability of impairment attributed to the sleep problem and the level of distress caused by the sleep problem. The score for each item ranges 0–4 (0 = not at all; 4 = extremely), and the sum score ranges 0–28. Higher scores indicate more severe insomnia within four categories: (i) no clinically significant insomnia (0–7); (ii) mild (8–14); (iii) moderate (15–21); and (iv) severe insomnia (22–28).³¹ The ISI has a reported Cronbach's reliability coefficient of 0.84 in primary care patients.³² The concurrent validity was assessed with Pearson's coefficients 0.5–0.91 between ISI insomnia subtypes and the corresponding sleep diary variables.³³ This study showed Cronbach's $\alpha = 0.91$ for the ISI.

Beck Anxiety Inventory

The 21-item Beck Anxiety Inventory (BAI) questionnaire was used to evaluate the degree of severity of anxiety symptoms experienced. The BAI's general utility in clinical^{34,35} and non-clinical population^{36–38} is also well established. Each item is rated on a 5-point Likert scale with 0 indicating 'not at all' and 3 indicating 'severely'. The scores range 0–63, with higher scores representing greater severity.³⁹ The BAI demonstrated a high level of internal consistency of 0.91 and had better discrimination from symptoms of depression in the normal populations.³⁶ Furthermore, the BAI had excellent convergent validity to be regarded as one of the exceptional measurement for the assessment of anxiety.³⁹ In this study, the Cronbach's $\alpha = 0.91$ for the BAI was also excellent.

Sleep hygiene practice

Sleep Hygiene Awareness and Practice Scale (SHAPS) was developed by Lacks & Rotert (1986).⁴⁰ The sleep hygiene practice section of the SHAPS contains 19 self-report items inquiring how many nights each week the participants engaged in the same items of behaviour. These items included napping, regular use of sleep medications, waking up at the same time every day, drinking alcohol in the evening and smoking. Responses are scored on a 7-point Likert scale ranging from 1 (very beneficial) to 7 (very disruptive). The sum scores range 0–133, with higher scores indicating poorer sleep hygiene practice.⁴⁰ In the previous study, the SHAPS was found to have a fair internal consistency.⁴¹ In this study, the SHAPS was found to have fairly adequate consistency with Cronbach's $\alpha = 0.72$.

Procedure

After the approval of the study by the Institutional Review Board, the investigator contacted the head nurse in each ward to explain the purpose of the study to potential participants at the staff meeting. The participants read and signed an informed consent that provided an information sheet outlining the study aims and how confidentiality would be protected. After obtaining informed consent, the investigator sent these participants anonymous, self-administered questionnaires and a returned envelope. All questionnaires were returned in sealed envelopes. Before the analysis, the returned envelopes were assigned an id number.

Data analysis

This study used descriptive statistics to describe the demographic characteristics. Bivariate analysis was performed first to determine associations between individual variables and insomnia severity. Insomnia groups were defined by being higher than the score of ISI (8).³¹ Due to the presence of non-normally distributed data, socio-demographic characteristics, nursing work features (working years, shift schedule), anxiety score and sleep hygiene practice were statistically examined by using Mann–Whitney *U*-test for continuous variables and chi-squared test for categorical variables. The variable of age was highly correlated with working years ($r = 0.93$). Then, the potential confounders such as age and work unit were determined relevant covariates to include in the mediating and moderating analyses. The associations between psychosocial variables and insomnia severity were examined using Spearman's rank correlation for continuous data. The SPSS 20.0 (SPSS Inc., Chicago, IL, USA) for Windows was used to perform all statistical analyses, and the significance level (*P*-value) was set at 0.05.

Statistical tests for the mediator effect

This study presents that anxiety was regarded as the independent variable, sleep hygiene practice was the mediator, insomnia severity was the dependent variable with age and working units regarded as covariates. The requirement of the mediation fulfilled the following guidelines recommended by the Preacher and Hayes (2008). We used SPSS macro to test bootstrap method to create with new data sets by using random sampling with replacement.⁴² Bootstrapping is a non-parametric

Table 1 Basic characteristics and comparison of the groups with insomnia or without insomnia (non-insomnia) ($n = 160$)

Variable	All participants	Insomnia (ISI ≥ 8) ($n = 82$)	Non-insomnia (ISI < 8) ($n = 78$)	<i>P</i> -value [†]
Age (Mean \pm SD) years	35.83 \pm 10.11	33.64 \pm 9.12	38.08 \pm 10.63	< 0.05
Working years (Mean \pm SD)	13.43 \pm 10.00	11.73 \pm 9.08	15.22 \pm 10.65	< 0.05
Marital status				0.114
Single	80 (50.0%)	46 (56.1%)	34 (43.6%)	
Married	80 (50.0%)	36 (43.9%)	44 (56.4%)	
Work unit				< 0.05
Medical–surgical wards	56 (35.0%)	36 (43.9%)	20 (25.6%)	
ICU	40 (25.0%)	20 (24.4%)	20 (25.6%)	
Other	64 (40.0%)	26 (31.7%)	38 (48.7%)	
Shift Schedule				0.090
Fixed	98 (61.3%)	45 (54.9%)	53 (67.9%)	
Shifting	62 (38.8%)	37 (45.1%)	25 (32.1%)	
Exercise				0.698
No	64 (40.0%)	34 (41.5%)	30 (38.5%)	
Yes	96 (60.0%)	48 (58.5%)	48 (61.5%)	

[†] Mann–Whitney *U*-test for continuous variables and chi-squared tests for categorical variables. ISI, Insomnia Severity Index; SD, standard deviation; ICU, intensive care unit.

resampling procedure. Also, it had higher statistical power when controlling for type I errors.⁴³ Therefore, bootstrapping is recommended over the traditional Sobel test to examine indirect effects with or without the inclusion of covariates in the complex mediation model.⁴⁴ The statistically significant level was set at the 0.05 and 95% confidence interval (CI) to test the indirect effect. If 95% CI does not contain zero, the results indicated the significant level.

Statistical tests for the moderator effect

This study used a two-step hierarchical multiple regression to test moderating effects. The predictor (anxiety) and the moderator (sleep hygiene practice) were entered simultaneously, and then the interaction terms (anxiety \times sleep hygiene practice) were computed to predict the insomnia severity, separately. To exclude multicollinearity, the mean-centering-before-multiplication method was used including the following: (i) the dependent variable was transformed using log 10 method; (ii) all continuous variables were mean centred; (iii) a multiplicative term was computed; and (iv) the main and interaction effects of the

model were examined. Lack of collinearity was further confirmed by examining the variance inflation factor (VIF) in the regression model.⁴⁵ Multicollinearity of the independent variables was unlikely with the general rule that the VIF value should not exceed 10.²⁷

RESULTS

The study included 160 female nurses whose demographic characteristics were summarized in Table 1. The mean (\pm SD) age was 35.83 (\pm 10.11) years old, and working years were 13.43 (\pm 10.00) years. Only 35.0% subjects worked in the medical–surgical wards, and over half of the subjects (61.30%) worked in fixed schedule. The majority of the subjects (60.0%) had regular exercise. The relationship between demographic variables for nurses and insomnia severity was shown to present relevant covariates. The results indicated that younger nurses and nurses who had fewer working years reported significantly more insomnia severity. Participants who worked in the medical–surgical wards had significantly higher insomnia severity compared with the non-insomnia group.

Table 2 Intercorrelations among the study variables

Variables	Anxiety	Sleep hygiene practice score	Insomnia severity	Mean (SD)
Anxiety	1.00	—	—	10.34 (7.99)
Sleep hygiene practice score	0.37**	1.00	—	28.00 (11.93)
Insomnia severity	0.56**	0.49**	1.00	7.83 (5.17)

** $P < 0.001$. SD, standard deviation.

Table 3 Mediating model when controlling for age, work unit (step 1: without transformation)

Model	Predictor	Dependent variable	Step 1			Step 2			Value
			B	SE	β	B	SE	β	
1	Anxiety	Insomnia severity	0.364	0.043	0.563**	0.022	0.003	0.489**	
2	Anxiety	Sleep hygiene practice	0.549	0.110	0.368**	0.512	0.109	0.368**	
3	Sleep hygiene practice	Insomnia severity	0.210	0.030	0.484**	0.008	0.002	0.443**	
4	Anxiety	Insomnia severity	0.283	0.043	0.437**	0.018	0.003	0.362**	
	Sleep hygiene practice		0.116	0.030	0.268**	0.008	0.002	0.245**	
	Covariates								
	Age		−0.071	0.035	−0.137*	−0.007	0.003	−0.187*	
	Work unit								
	Medical–surgical wards		—	—	—	—	—	—	
	ICU		−0.412	0.826	−0.035	−0.018	0.066	−0.020	
	Others		−0.860	0.807	−0.082	−0.050	0.065	−0.063	
	Indirect effect								0.004
	Bootstrap with bias-corrected 95% CI								0.002–0.007
	Mediation (%)								34.05

* $P < 0.05$ ** $P < 0.001$. SE, standard error; ICU, intensive care unit; CI, confidence interval.

As shown in Table 2, significant correlations were found among the three major variables. The anxiety was positively related to the scores of sleep hygiene practice ($r_s = 0.37$, $P < 0.001$) and insomnia severity ($r_s = 0.56$, $P < 0.001$). The scores of sleep hygiene practice were also positively correlated with insomnia severity ($r_s = 0.49$, $P < 0.001$). The results indicated that nurses with more anxiety tended to have higher insomnia severity. However, nurses with higher levels of anxiety had poor sleep hygiene practice.

Sleep hygiene practice as a mediator

Table 3 presents the results of the mediating model for a multilevel model. There are four requirements met by the

following results. Anxiety significantly predicted the insomnia severity ($\beta = 0.563$, $P < 0.001$). Anxiety significantly predicted the scores of sleep hygiene practice ($\beta = 0.368$, $P < 0.001$). Sleep hygiene practice significantly predicted the insomnia severity ($\beta = 0.484$, $P < 0.001$). When sleep hygiene practice was controlled in the regression equation of anxiety and insomnia severity, the relationship had a significant reduction in Figure 1 ($\beta = 0.362$, $P < 0.001$) with age and work units as covariates. The covariates of working years were not included in the model because of collinearity. The 95% CI was 0.002 and 0.007 in the bootstrapping analysis estimating the indirect effect between anxiety and insomnia severity. This CI did not include zero; the indirect effect

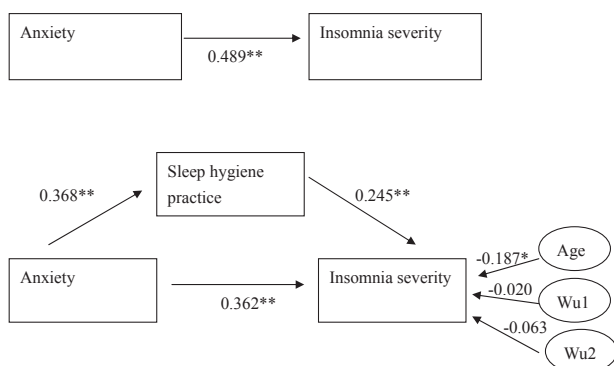


Figure 1. Mediation models of the sleep hygiene practice on the relationship between anxiety and insomnia severity in hospital nurses ($n = 160$). Wu1, Wu2, the dummy variable of work unit.

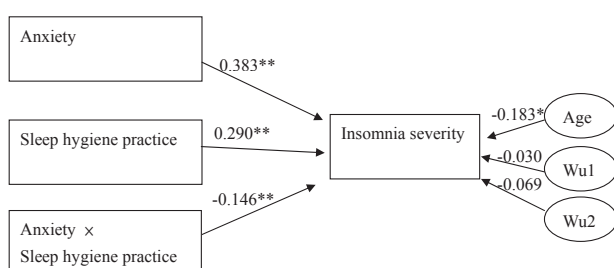


Figure 2. Moderation models of the sleep hygiene practice on the relationship between anxiety and insomnia severity in hospital nurses ($n = 160$). Wu1, Wu2, the dummy variable of work unit.

had significant level. The results indicated that sleep hygiene practice partially mediated the effects of anxiety on insomnia severity. Among the covariates, only age significantly influenced insomnia severity, with older nurses showing higher insomnia severity.

In step 2, data were transformed with log 10 to perform the meditational analysis. Consequently, this model was not significantly different from the results without transformation. Overall, these results showed that sleep hygiene practice was a mediator after controlling the potential problem of non-normality of data.

Sleep hygiene practice as a moderator

Hierarchical regression analysis was shown the effects of the main and interaction terms on insomnia severity in Table 4. The main effects of anxiety and sleep hygiene practice were significant ($P < 0.001$) in step 1 and step 2. Also, only age was significantly associated with insomnia severity among the covariates. Specific to moderation, the interaction terms were shown significant effect on the

insomnia severity in Figure 2. The data transformed into log 10 with the results in step 2 were similar to those in step 1. All results supported that sleep hygiene practice was a moderator in the model.

DISCUSSION

Anxiety and sleep hygiene have been found to be significant predictors of insomnia severity in population. Therefore, these two predictors were selected for analysis in the dependent variable of insomnia severity. This study demonstrated that anxiety, sleep hygiene practice and insomnia severity were interrelated in nurses and that sleep hygiene practice both mediated and moderated the relationship between anxiety and insomnia severity.

The finding of this study was the positive relationship between anxiety and insomnia severity among shift-work nurses. Nurses suffered from more insomnia if they had more anxiety. This result is consistent with previous studies, which indicated that anxiety was significantly associated with sleep difficulties in a number of population studies.^{46–48} Many psychological assessments show higher levels of anxiety in non-psychiatric patients with insomnia.^{49,50} The available evidence suggests that psychological health problems, such as anxiety and depression, are a primary characteristic that can have a role in the development of insomnia.¹² Our data provided that nurses with insomnia usually feel more anxiety compared with nurses with non-insomnia. Therefore, this study suggests that we could develop effective strategies such as relaxation intervention to reduce nurses' insomnia.

This study also found a significant relationship between insomnia severity and sleep hygiene practices. Nurses who had poor sleep hygiene practices had higher insomnia severity. This is consistent with results from previous studies, which found poor sleep hygiene practices to be significantly associated with poor sleep quality in adolescents,⁸ university students⁹ and medical students.¹¹ It is known that poor sleep-related habits are considered to be one of the major etiological factors of psychophysiological insomnia.⁴ It would be easy to assume that nurses try to adjust their sleep habits to adapt to shift works; however, nurses did not actually implement proper sleep hygiene. Our data suggest that sleep hygiene is one of the important determinants of insomnia severity for female shift-working nurses. Especially, nurses with poor sleep hygiene reflected negative extremes on the irregularity of sleep hours, which might result in the irregular sleep habits.

Table 4 The moderating model of insomnia severity when controlling for age, work unit (step 1: without transformation)

Dependent variable	Predictor	Step 1			Step 2			Value
		B	SE	β	B	SE	β	
Insomnia severity	Intercept							
	Anxiety	0.283	0.043	0.437**	0.019	0.003	0.383**	
	Sleep hygiene practice	0.116	0.030	0.268**	0.010	0.002	0.290**	
	Anxiety \times Sleep hygiene practice	—	—	—	−0.001	0.002	−0.146**	
	Covariates							
	Age	−0.071	0.035	−0.137*	−0.007	0.003	−0.183*	
	Work unit							
	Medical–surgical wards	—	—	—	—	—	—	
	ICU	−0.412	0.826	−0.035	−0.027	0.066	−0.030	
	Others	−0.860	0.807	−0.082	−0.054	0.064	−0.069	
	R^2							0.325
	R^2 increase due to interaction							0.02

* $P < 0.05$ ** $P < 0.001$. SE, standard error; ICU, intensive care unit.

As predicted, sleep hygiene practice significantly mediated the relationships between anxiety and insomnia severity. When sleep hygiene practice was found to be a mediator, the correlation between anxiety and sleep hygiene practice significantly decreased, indicating that the effect of anxiety on insomnia severity was partially through sleep hygiene practice. The findings were similar to the study of Brown *et al.*,⁹ which states that sleep hygiene practice partially mediated the relationship between sleep hygiene awareness and sleep quality. Our study further indicated that poor sleep hygiene practice was positively related to anxiety and insomnia severity. As acute aspects of the occupational stress evolve, people can become increasingly anxious and frustrated about their inability to sleep, thus practicing poor sleep hygiene.¹² Furthermore, the mediation accounted for 34.05% of the variance in the relationship between anxiety and insomnia severity. This may be attributed to the effect of anxiety individually accounting for 23.9% of the variance of insomnia severity; however, this study points out that sleep hygiene practice is an important issue for improving sleep quality even though nurses usually work in high anxious environment. Future interventions should focus on practicing proper sleep hygiene to assist nurses in coping with anxiety to decrease insomnia severity.

The sleep hygiene practice significantly moderated the relationship between anxiety and insomnia severity after controlling the age and work units. Nurses with low levels of anxiety but poor sleep hygiene practice showed higher levels of insomnia severity. Nurses usually work under greater anxiety to provide continuous care for patients, which can increase nurses' insomnia severity. However, nurses might be less anxious to sleep at bedtime which can affect the timing of wake up. Thus, they might not force themselves to stay on the bed in order to fall asleep. Furthermore, sleep habit which would affect the sleeping time might increase the insomnia severity. Sleep hygiene practice including environmental factors (such as lighting, noise and temperature) can also affect insomnia severity. Nurses live with other partners who work on different shift schedule. When they came back to rest after they finished their work, the room might have the light or noise. Therefore, for nurses with low levels of anxiety on sleep habits, nurse should avoid poor sleep hygiene practice related to risk for insomnia.

This study also found age and years employed in nursing had a significantly negative correlation with insomnia severity. This result is not consistent with that older age was associated with less time asleep or more awakenings during sleep.⁵¹ However, this study is consistent with increasing age or longer year employed in

nursing associated with less risk for worse sleep quality.⁵² This study also implies that more experienced nurses could have greater tolerance to shift work, which allows them to adjust their irregular sleep habits.

Several possible limitations need to be considered when evaluating these results. First, although the study examined the insomnia severity of hospital nurses who perceive their workplace to be stressful or anxious, it might have overlooked a number of other variables, such as daytime fatigue and interpersonal difficulties. Second, all claims to insomnia severity need to be taken with caution because this study did not use further investigations such as sleep diaries, interviews, actigraphy and sleep studies to exclude other sleep disorders. We used the ISI measurement to determine insomnia severity or insomnia-like conditions at one fixed point. All claims based on a single ISI measurement might have a major oversight and not be prudent. Third, the major limitation was no men or part-time nurses were included in this study, which might not align with international characteristics of nursing populations. Fourth, the majority of our sample was fixed-shift schedule workers, which again does not account for the large number of rotating shift workers worldwide. The generalizability of the results is limited by use of convenience sampling for collection of data. Finally, the cross-sectional research design used cannot test adequately the relationship between these variables; therefore, a longitudinal assessment of predictor and outcome variables would be an efficient way to propose solutions.

CONCLUSIONS

This is the first study to investigate the mediating and/or moderating roles of sleep hygiene practice underlying the relationships between anxiety and insomnia severity. This study indicated that anxiety, sleep hygiene practice and insomnia severity were interrelated in hospital nurses and that sleep hygiene practice was mediator and moderator of the relationship between anxiety and insomnia severity. The current findings implied that good sleep hygiene practice might help shift workers dealing with anxiety to reduce the risk of insomnia severity. Especially, nurse with higher levels of anxiety should avoid poor sleep hygiene practice to improve sleep quality.

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