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Original Article

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The role of sleep hygiene in the risk of Shift Work Disorder in nurses

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Abstract

A high proportion (20%–30%) of shift workers experience Shift Work Disorder (SWD), characterized by chronic sleepiness and/or insomnia associated with work schedules. The reasons for individual variation in shift work tolerance are not well understood, however. The aim of this study was to identify individual factors that contribute to the risk of SWD. Nurses (n = 202) were categorized as low or high risk of SWD based on the Shift Work Disorder Questionnaire. Participants provided demographic and lifestyle information and completed the Sleep Hygiene Index (SHI) and Morningness–Eveningness Questionnaire (MEQ). High risk of SWD was associated with poorer sleep hygiene (SHI, 35.41 ± 6.19 vs. 31.49 ± 7.08, p < .0001) and greater eveningness (MEQ, 34.73 ± 6.13 vs. 37.49 ± 6.45, p = .005) compared to low risk. No other factors, including body mass index, marital status, having children, or caffeine or alcohol intake were significant. Logistic regression showed that SHI was the most significant contributing factor to SWD risk (odds ratio [OR] = 1.09, 95% confidence interval [CI] = 1.04 to 1.14). Standardized odds ratio further revealed that with every unit increase on the SHI score, the odds of being at high risk of SWD increased by 80% (OR = 1.84). Most individuals at high risk of SWD reported "always" or "frequently" going to bed at different times (79%) and waking at different times (83%; compared to 58%, p = .017, and 61%, p = .002, respectively for the low-risk group), as well as going to bed stressed/angry (67% vs. 41%, p < .0001) and/or planning/worrying in bed (54% vs. 22%, p < .0001). Interventions aimed at improving sleep hygiene practices and psychological health of shift workers may help reduce the risk of SWD.

Statement of Significance

This study contributes to the limited knowledge of the underlying basis of Shift Work Disorder (SWD). It is one of the few studies to have used a validated screening tool to identify the risk of SWD and to examine the role of a combination of demographic and lifestyle factors on the disorder. It highlights that sleep hygiene is a major contributor to SWD risk, in particular, variability in sleep timing and emotional state before bedtime. The study provides novel targets for interventions to help manage SWD; increased education of the benefits of good sleep hygiene practices might help reduce the risk of SWD in health care shift workers. Further research on the effectiveness of interventions based on sleep hygiene are needed.

Key words: shift work; sleep; hygiene; health care; circadian rhythm; sleepiness; insomnia; nurses

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Introduction

Shift work is often associated with a conflict between an individual's circadian pacemaker and sleep/wake timings imposed by shift work schedules [1, 2], resulting in sleep impairment [3]. There can be considerable interindividual differences in the tolerance of shift work, even under similar work schedules; shift work can result in more severe sleep impairment, insomnia, and sleepiness for certain individuals, suggesting that individual characteristics and lifestyle circumstances also need to be considered [2, 4–6]. For the majority of shift workers, insomnia and/or sleepiness symptoms are temporary and often recover after returning to a normal sleep–wake schedule [2]. For some, however, shift work results in chronic impairment resulting in Shift Work Disorder (SWD) [7, 8]. SWD is a circadian rhythm sleep disorder characterized by the presence of insomnia symptoms and/or sleepiness associated with shift work schedules [9]. Approximately 20%–30% of the shift worker population is considered to be affected [10–12].

Prior research on SWD risk has measured a variety of sleep parameters to diagnose SWD, including sleep duration, sleep quality, insomnia symptoms, or daytime sleepiness [13]. These measures, however, do not take into consideration shift work and its relationship with poor sleep outcomes and, due to the inconsistencies in measurement tools, findings are conflicting. Also, none have used a validated SWD screening tool to screen for the disorder [13].

The underlying basis of individual variability in response to shift work is not well understood and a better understanding of why some people cope better than others would help to inform interventions. The role of individual factors on SWD in the health care industry has not been examined in detail; few studies have applied International Classification of Sleep Disorders, Third Edition (ICSD-3) SWD criteria or used a validated SWD measurement tool to define vulnerability to shift work [13].

The bulk of SWD research has focused on male-dominated roles, such as fire fighters, pilots, truck drivers, fly-in-fly-out workers, police officers, or blue-collar workers [14]. Health care is a female-dominated industry and may be associated with different individual risk factors compared to other male-dominant industries [10, 15–18]. In addition, health care can be a highly stressful work environment, which can exacerbate sleep-related impairments [16, 19] and may lead to higher rates of SWD within this population.

While studies have shown that certain biological, demographic, social, and lifestyle risk factors might have an influence on an individual's response to the challenges of shift work [13, 20, 21], older shift workers, for example, seem to be more vulnerable to irregular shift work schedules than younger workers [5, 22, 23]. In addition, changes in circadian rhythm timing in older individuals can result in more morning-type diurnal preferences [24–27]. Morning types have been shown to be a predictor of sleep-related impairment due to shift work [13]. Other factors have also been shown to be associated with poor sleep quality in shift workers, such as an increase in body mass index (BMI) [19, 28, 29] and insomnia severity has been associated with an increase in caffeine or alcohol intake and smoking in shift workers [30–32]. There is, however, no study that has concurrently measured the influence of a wide range of demographic, lifestyle, and work-related factors, along with sleep hygiene behavior, using a validated SWD screening tool.

Understanding potential risk factors is important to help identify shift workers at higher risk of SWD and provide targets for interventions. These workers are at greater risk of workplace injuries, motor vehicle accidents, increased sick leave, and absenteeism than daytime workers [33–35]. The aim of this study is to identify the demographic and lifestyle factors that contribute to the risk of SWD, using a validated SWD screening tool. It was hypothesized that shift workers at high risk of SWD will be older and have a more morning-type preference.

Methodology

Participants

Nurses from 16 wards at the Austin Hospital in Melbourne, Australia, were invited to participate. They were recruited via flyers posted on wards, promotion during scheduled education sessions and staff hand-over meetings, and via walk-arounds on the ward with a nurse educator. Out of a total of 475 staff who were approached, 224 consented to participate and 202 (97% female) completed the required protocol (42.5% response rate). Eligible participants were aged at least 18 years, were employed on regular rotating or permanent night shift schedules, worked a minimum of 15 h per week and had not received or is not currently receiving treatment for a sleep disorder including obstructive sleep apnea or insomnia. Participation was voluntary and participants provided written informed consent prior to participation. The study protocol was approved by the Austin Health and Monash University Human Research Ethics Committees and conformed to the standards set by the latest revision of the Declaration of Helsinki.

Procedures

The study formed part of a larger randomized controlled trial (RCT), which aimed to evaluate the effectiveness of an individualized intervention program for individuals at high risk of SWD compared to a control group (ACTRN 12616000369426). This paper presents the cross-sectional baseline data. Data were collected between January 2015 and December 2017.

Materials

Following consent, participants were provided with a link to an online questionnaire, which encompassed a range of surveys. The online questionnaire was developed by members of the Cooperative Research Centre for Alertness, Safety and Productivity, with the support of the Australasian Sleep Trials Network (ASTN). Data collected comprised of general demographic, social, and lifestyle questions along with the following validated surveys: the Shift Work Disorder Questionnaire (SWDQ), Sleep Hygiene Index (SHI), the Horne–Östberg Morningness–Eveningness Questionnaire (MEQ), Insomnia Severity Index (ISI), and Epworth Sleepiness Scale (ESS). Questions related to demographics and lifestyle included age, sex, BMI, number of children, smoking status, number of caffeinated and alcoholic drinks consumed on work and nonwork days, and timing of caffeine before bedtime. Work-related questions included the number and type (day/evening/night) of shifts worked in the prior month, number of hours worked over a typical week and month, and years of shift work experience. The SWDQ comprises four items that are used to assess an individual's risk of SWD based on the ICSD diagnostic criteria [8, 9].The four questions are: (Q1) problems with waking up too early and not being able to get back to sleep; (Q2) sense of well-being during the time you were awake; (Q3) doze off at work; and (Q4) doze off while driving after at least 2 days off from work. Each item is scored on a scale between 1 and 4 and scoring of the questionnaire characterizes an individual as either high or low risk of SWD. Initially, the SWDQ consisted of 37 items regarding insomnia and excessive sleepiness comprised from focus groups and previous studies and then reduced to 26 items after factor analysis. Final discriminant function analyses found that the final four items were the strongest predictors of SWD diagnosis. The first three questions assess symptoms of (1) insomnia, (2) excessive daytime sleepiness, and (3) well-being as associated with a shift working schedule. The last item assesses sleepiness during days off work to identify whether poor sleep symptoms are due to the shift work. The SWDQ has 89% positive predictive value and 62% negative predictive value (sensitivity = .74; specificity = .82) [8]. The SHI was used to examine differences in sleep hygiene behavior amongst participants [36]. The SHI assesses environmental and behavioral variables that could promote poor sleep before bedtime, such as inconsistency in bed timing, feelings of stress, anger or worry, watching television or other activities in bed, drinking caffeine, or exercising before bedtime, as well as the bedroom environment and the comfort of the bed. Total scores range on a continuous scale from 13 to 65, with higher scores indicative of poorer sleep hygiene. The MEQ measures diurnal preference [37] on a continuous scale from 16 to 86, with lower scores indicating greater eveningness. The ISI was used to examine the severity of insomnia symptoms [38]. With scores ranging from 0 to 28, higher scores represent more severe insomnia symptoms. Self-reported sleepiness was measured by the ESS [39]. Scores range from 0 to 24, and an ESS score >10 is considered to be suggestive of significant daytime sleepiness. Due to the overarching RCT's protocol, participants in the control group had ESS data collected only at follow-up (n = 70), meaning that a mixture of ESS scores from baseline and follow-up questionnaire was used for that analysis. This group did not undergo an intervention (treatment) program prior to completing the ESS.

Statistical analysis

Participants were categorized into low or high risk of SWD according to the SWDQ. Demographic variables (age, sex, BMI, and number of children), lifestyle variables (pregnancy, menopause, and caffeine and alcohol intake), work-related variables (shift number, shift type, and years of shift work experience), and results from the validated sleep-related surveys (SHI, ESS, ISI, and MEQ) were compared between SWD risk groups (high vs. low risk). Univariate analysis (independent t-tests for continuous variables and Pearson's χ^2 for categorical variables) were used to compare the two groups. Results are presented as mean ± *SD* (continuous variables) or as a percentage (categorical variables). Significance levels were set at $p < .05$. MEQ scores were further categorized into morning (59–86), intermediate (42–58), and evening (16–41) types and the SHI scores into good (≤26), average (27–39), and poor (40+). Variables that significantly differed between SWD groups based on univariate analyses were included in a logistic regression model to further assess the relationship with SWD. Variables were entered separately (crude analysis) to measure the effects each predictor variable had on the independent variable and then subsequent adjusted analysis was undertaken, controlling for age. Where the 95% confidence interval (CI) did not include 1.00, the odds ratios (ORs) were considered statistically significant. To make variables more directly comparable, standardized odds ratios (SOR) were calculated by taking into consideration 1 *SD* change in each variable. The role of different sleep hygiene practices in determining SWD risk was examined by assessing specific items on the SHI. Logistical regression analysis was performed to compare each SHI item and SWD risk (low vs. high), with a significance level of $p < .05$. SPSS Statistics version 25 (SPSS Inc., Chicago, IL) was used for all statistical analyses.

Results

A total of 202 participants (n = 192 female) from 16 wards completed the protocol. Participants had a mean age of 35.3 ± 12.0 years (range 21–65 years) and had an average of 10.2 ± 8.4 years (range 0–45 years) shift work experience. Descriptive statistics for the whole sample of shift workers are outlined in Table 1. Almost one-third (29%; n = 59) of the participants were identified as being at high risk of SWD based on the SWDQ. Univariate analyses comparing participants at low and high risk of SWD are outlined in Table 1. SWD risk groups did not differ for demographic factors (age, sex, BMI, number of children, current status of pregnancy or menopause, or the amount of caffeine and alcohol consumed) or for work-related factors (the number of day/evening/night shifts, number of hours worked per week/month, or years of shift work experience; Table 1). Participants at high risk of SWD had significantly lower scores on the MEQ (34.86 ± 6.26) compared to those at low risk (37.49 ± 6.45; p = .005), indicating more evening-type preference. Of those at high risk, 86.4% (n = 51) were categorized as evening type and 13.6% as intermediate compared to those at low risk of SWD (n = 101, 70.6% and 29.4% respectively, x^2 = 5.61, p = .018). No participants were categorized as morning type. Individuals at high risk of SWD had higher scores on the SHI (35.41 ± 6.19) compared to those at low risk (31.49 ± 7.08; $p < .0001$). Participants at high risk of SWD had poorer sleep hygiene than low-risk participants, with 27.1% categorized as having poor sleep hygiene compared to 15.4% of the low-risk group, and 10.2% were categorized as having good sleep hygiene compared to 25.2% of the low-risk group (x^2 = 7.65, p = .022).

As insomnia and sleepiness are components of SWD criteria, the ISI and ESS were analyzed separately. Both components correlated with SWD risk, with those at high risk of SWD also having higher mean ISI scores (13.39 ± 4.98) compared to those at low risk (6.83 ± 4.65; $p < .0001$) and higher ESS scores (7.56 ± 3.76 vs. 5.72 ± 3.30; p = .003). In addition, the ISI was significantly related to the SHI ($p < .0001$) and MEQ ($p < .001$), and the ESS was significantly related to the SHI ($p < .001$) and MEQ ($p < .0001$). No other factors were significant.

Crude unadjusted ORs showed that both SHI (OR = 1.09, 95% CI = 1.04 to 1.14) and MEQ (OR = 0.93, 95% CI = 0.89 to 0.98) significantly increased the likelihood of being identified as high risk of SWD, with higher SHI and lower MEQ increasing the likelihood that an individual was at risk of SWD. A backward stepwise

Table 1. Individual and work-related characteristics of the sample population and comparison between participants at low and high risk of SWD

	n	Whole sample	Low SWD risk (*n* = 143)	High SWD risk (*n* = 59)	Sig.
Age (years)	202	35.28 ± 12.00	34.58 ± 12.02	36.98 ± 11.92	.197
Sex: % female (*n*)	202	96 (192)	95.1 (136)	94.9 (56)	.995*
BMI	202	26.07 ± 6.34	25.81 ± 6.66	26.7 ± 5.48	.370
SHI	202	32.63 ± 7.05	**31.49 ± 7.08**	**35.41 ± 6.19**	**<.0001**
MEQ	202	36.68 ± 6.46	**37.49 ± 6.45**	**34.73 ± 6.13**	**.005**
ISI	202	8.74 ± 5.60	**6.83 ± 4.65**	**13.39 ± 4.98**	**<.0001**
ESS†	164	6.23 ± 3.52	**5.72 ± 3.30**	**7.56 ± 3.76**	**.003**
ESS‡	94	5.97 ± 3.26	**5.61 ± 3.10**	**6.92 ± 3.52**	**<.0001**
Typical no. caffeinated drinks on work days	147	1.29 ± .79	1.31 ± .81	1.21 ± .74	.500
Typical no. caffeinated drinks on nonwork days	146	1.10 ± .76	1.12 ± .73	1.05 ± .84	.638
Usual hours between last caffeinated drink and bed on work days (h)	147	4.38 ± 3.72	4.2 ± 3.6	4.91 ± 4.06	.316
Usual hours between last caffeinated drink and bed on nonwork days (h)	147	4.11 ± 3.61	4.06 ± 3.49	4.25 ± 3.99	.786
Currently pregnant: % yes (*n*)	190	7.6 (15)	8.1 (11)	7.3 (4)	.551*
Currently menopausal: % yes (*n*)	186	11.3 (21)	10.7 (14)	12.7 (7)	.800*
Typical no. alcoholic drinks per week	167	1.36 ± 1.42	1.25 ± 1.35	1.63 ± 1.61	.174
Typical no. alcoholic drinks per day (work days)	103	0.53 ± .6	0.52 ± .58	0.57 ± 6.79	.728
Typical no. alcoholic drinks per day (nonwork days)	101	1.66 ± .91	1.66 ± .81	1.67 ± 1.12	.984
No. children	202	0.8 ± 1.19	0.76 ± 1.12	0.92 ± 1.36	.387
Years of shift work experience	179	10.2 ± 8.43	9.7 ± 8.14	11.42 ± 9.07	.187
No. day shifts (past month)	202	8.69 ± 6.21	8.98 ± 6.77	7.96 ± 4.43	.309
No. evening shifts (past month)	202	7.48 ± 4.58	7.77 ± 5.07	6.74 ± 2.86	.163
No. night shifts (past month)	202	5.97 ± 3.61	5.74 ± 3.39	6.39 ± 3.99	.422
No. of different shift types worked (past month)	202	2.80 ± 1.00	2.78 ± 1.02	2.86 ± 0.97	.573
Total number of shifts worked (past month)	202	17.91 ± 8.52	17.90 ± 8.39	17.89 ± 8.91	.993
Work hours in a typical week	196	35.57 ± 8.82	35.53 ± 9.02	35.67 ± 8.42	.921
Work hours in a typical month	195	132.38 ± 34.57	134.67 ± 34.72	127.12 ± 33.92	.162

Bold indicates significant differences between groups ($p < .05$). Comparison conducted using independent *t*-tests unless otherwise stated.
*Pearson χ^2 test.
†ESS data includes follow-up from $n = 70$.
‡ESS data excludes the 70 follow-up participants.

Table 2. Crude logistic regression results for age, SHI, and MEQ between low and high SWD risk groups

	Unadjusted		Unadjusted SOR		Adjusted		Adjusted SOR	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.02	0.99 to 1.04	1.14	0.94 to 1.29	**1.04***	**1.01 to 1.06**	**1.29***	**1.07 to 1.46**
SHI	**1.09***	**1.04 to 1.14**	**1.84***	**1.32 to 2.52**	**1.09***	**1.03 to 1.15**	**1.84***	**1.23 to 2.68**
MEQ	**0.93***	**0.89 to 0.98**	**0.64***	**0.47 to 0.89**	0.96	0.91 to 1.02	0.77	0.54 to 1.14

Bold*=significance $p<0.05$ level (two-tailed)
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logistic regression was performed to examine the combined effect of SHI and MEQ on the likelihood that participants had high risk of SWD. As the relationship between SWD risk and age was almost significant and age has been shown to influence the ability to adjust to shift work schedules [23, 40], age was controlled for in the model. ISI and ESS were excluded as they were considered confounding variables to SWD risk, given sleepiness and insomnia are the primary symptoms of SWD. Once all three variables (SHI, MEQ, and age) were combined, age became a significant factor ($p = .02$) with SHI ($p < .0001$), while MEQ ($p = .16$) was excluded from the model. The model including SHI and age explained 12.6% (Nagelkerke R^2) of the variance between SWD groups, correctly classifying 71.8% of cases. The SOR further revealed that with every *SD* increase on the SHI score, the odds of being at high risk of SWD increased by 80% (OR = 1.84; Table 2).

Independent samples *t*-tests between SWD risk groups and individual items on the SHI revealed that 7 of the 13 items were significantly different between groups (Table 3). Of those at high risk of SWD, nearly 80% (79.3%) reported that they 'always' or "frequently" went to bed at different times compared to 58.1% of those at low risk ($x^2 = .017$). Over 80% (82.8%) of the high SWD risk group got out of bed at different times from day to day compared to 60.9% of the low-risk group ($x^2 = .002$). Additionally, 67.2% went to bed stressed/angry and 53.5% planned/worried in bed (vs. 41.3%, $p < .0001$, and 22.4%, $p < .0001$). Logistical regression analysis revealed that all the questions accounted for 22.2% ($R^2 = 22.2$) of the variance between SWD risk groups, with "going to bed at different times," "doing important work before bedtime," and "planning/worrying when in bed" being the most significant questions, accounting for 18.5% ($R^2 = 18.3$) of the total variance.

Table 3. Comparison of individual items on the SHI between high SWD risk and low SWD risk groups

	Low risk (n = 143)		High risk (n = 59)			
	Mean ± *SD*	%	Mean ± *SD*	%	*t*	Sig.
1. I take daytime naps lasting two or more hours.	1.80 ± 0.77	18.2	2.05 ± 0.99	31.0	−1.95	.053
2. I go to bed at different times from day to day.	3.62 ± 0.99	58.1	3.97 ± 0.67	79.3	−2.42	**.017***
3. I get out of bed at different times from day to day.	3.61 ± 0.99	60.9	4.07 ± 0.75	82.8	−3.20	**.002***
4. I exercise to the point of sweating within 1 h of going to bed.	1.52 ± 0.70	9.1	1.59 ± 0.77	13.8	−0.55	.583
5. I stay in bed longer than I should two or three times a week.	2.41 ± 1.12	18.9	3.02 ± 1.21	36.2	−3.40	**.001***
6. I use alcohol, tobacco, or caffeine within 4 h of going to bed or after going to bed.	2.26 ± 1.20	15.4	2.45 ± 1.29	24.1	−0.995	.321
7. I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).	3.06 ± 1.22	42	3.26 ± 1.02	36.8	−1.12	.266
8. I go to bed feeling stressed, angry, upset, or nervous.	2.36 ± 0.77	41.3	2.84 ± 0.88	67.2	−3.90	**<.0001***
9. I use my bed for things other than sleeping or sex (for example: watch TV, read, eat, or study).	2.75 ± 1.23	28.7	3.12 ± 1.20	41.4	−1.97	.051
10. I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets).	1.41 ± 0.70	1.4	1.67 ± 0.98	5.1	−2.12	**.035***
11. I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy).	1.48 ± 0.75	2.1	1.79 ± 0.85	3.4	−2.61	**.010***
12. I do important work before bedtime (for example: pay bills, schedule, or study).	2.36 ± 0.91	9.1	2.26 ± 0.97	10.3	0.68	.496
13. I think, plan, or worry when I am in bed.	2.83 ± 0.93	22.4	3.43 ± 0.84	53.5	−4.24	**<.0001***

SHI scoring: always = 5, frequently = 4, sometimes = 3, rarely = 2, never = 1.
*bold = p < .05 significant two tailed.
% = the percentage of participants who reported "always" or "frequently."

Discussion

This study aimed to explore what individual factors may contribute to high risk of SWD in nurses, using a validated screening tool, the SWDQ. From an extensive range of work-related, demographic, and lifestyle factors examined, SHI and MEQ scores were the factors most strongly predictive of SWD risk amongst this sample of health care workers; however, backward logistical regression modeling combining SHI and MEQ, controlling for age, found that SHI was the most significant factor influencing risk of SWD. Individual SHI questions showed that approximately 80% of the high SWD risk group got up at different times from day to day, 68% went to bed stressed/angry, and 54% planned/worried in bed (vs. 61%, 41.3%, and 22.4%, respectively).

The prevalence rate of high risk of SWD based on the SWDQ in this study (29%) is similar to other studies, confirming that the rate of SWD amongst health care workers is similar to that of other shift work industries [10, 12, 22]. High SWD risk was associated with more insomnia and excessive sleepiness symptoms (components of SWD), which is consistent with the SWD definition [9] and the specific items on the SWDQ [8]. These findings are not surprising given that sleep problems are a common symptom in shift workers [34, 35]. On their own, these measurements do not take into consideration sleep complaints related to shift work schedules and so further interpretation is difficult. However, those at high risk for SWD scored in the subclinical range on the ISI (mean = 13.39 vs. 6.83), but the difference between ESS scores was not as great. This could be due to the incomplete sample of ESS data. Furthermore, insomnia and sleepiness were found to have the same significant relationship with the SHI and MEQ and supports the idea that both insomnia and sleepiness should be a focus for treatment of SWD via targeted sleep hygiene

Sleep hygiene was the predominant factor associated with SWD risk in this study, suggesting that sleep-related problems experienced by shift workers could be exacerbated by poor sleep hygiene behaviors. The higher the score on the SHI, the poorer the sleep hygiene behavior; however, no suggested cutoff is recommended for what is considered poor sleep hygiene for the SHI [36]. In this study, those at high risk for SWD scored significantly higher on the SHI, suggesting poor sleep hygiene. Furthermore, the majority of these participants scored "always" or "frequently" for each item, which is classified by a past study as being poor sleep hygiene behavior [41]. This study demonstrated that for every 1 *SD* increase in SHI (7.05), the odds of being at high risk of SWD increased by 80%. Previous studies have shown that poor sleep hygiene was significantly related to poor sleep quality and insomnia [32, 36, 41]. Furthermore, research has shown that good sleep hygiene behavior can combat poor sleep, with improved knowledge of good sleep hygiene behavior shown to improve sleep quality in working women [42], and that sleep hygiene education improved sleep quality compared to a control group in day workers [43]. In clinical practice, good sleep hygiene is commonly recommended and has been seen as an integral part of managing and treating SWD [44–46]; however, as highlighted by a recent systematic review, research is limited in shift workers, with only two studies that looked at the impact poor sleep hygiene had on sleep impairment in shift workers [13, 30, 47].

In this study, variability in sleep schedules (going to bed and getting up at similar times, as well as not staying in bed) from the SHI was a significant factor in SWD risk. This is consistent with past research showing that inconsistent sleep schedules are a significant risk factor for impaired sleep in other populations [32, 47, 48]; however, this is often not possible for shift workers with variable work schedules. Consistency in prebed routines (i.e., limited screen time, on the internet, and playing games) and improved comfort of the bedroom and bedding were also associated with lower risk of SWD in this study, which could be instigated. Finally, reducing stress, worry, or anger before bed could be another strategy that could benefit those at high risk of SWD as this was another difference between those at low versus high risk. Difficulties switching-off from a high stressful occupation and/or going to bed angry or worried has been shown to have an impact on sleep impairment in other studies also. Research shows that high anxiety can lead to insomnia [5, 49, 50] and a concept called sleep reactivity, which looks at how sleep is affected by an individual's ability to cope with stress and shows that individuals who cope better with stress are less likely to have impaired sleep as a result of the stress [49]. Strategies aimed at improving these behaviors might be feasible tools for managing SWD and the dissemination of sleep hygiene principles might be the key to help mitigate the risks of SWD. The benefits of this approach are evidenced in a recent publication that found poor knowledge of good sleep hygiene behavior, general sleep knowledge, and attitudes toward sleep were independent predictors of poor sleep quality in nurses [51] and in a recent report highlighting that greater awareness and education is needed around the importance of good sleep hygiene for shift work management in the future [52]. It is possible, however, that poor sleep hygiene is a compensatory response to sleep problems, that is, an individual may self-medicate with alcohol or caffeine or watch television because they are having trouble getting to sleep or staying asleep rather than the other way around [53]. Future longitudinal intervention programs are needed to analyze the direction of this relationship and whether the modification of sleep hygiene behavior improves SWD risk.

Diurnal preference has also been shown to be a significant risk factor in SWD. This study found a statistically significant relationship between diurnal preference and SWD, with an increase in eveningness being associated with SWD risk. This is in contrast with other prior studies that found morning types at greater risk [5, 13, 22]. A variation in shift work schedules between studies could account for differences between studies, with past studies finding that morning types have less sleep impairment on morning shifts but more sleep disruptions on night and evening shifts [25, 26, 54, 55] and that evening types are better suited to night and evening shifts [56]. This suggests that when shift work schedules are not suitable to an individual's diurnal preference, it might make them more susceptible to impaired sleep. Although this study found a difference, the effect size was small and significance was lost after controlling for age. Diurnal preference has been known to change with age, with an increase in morning type with increased age [24, 57, 58]. This study also did not have any participants classified as morning types; therefore, caution should be taken in the interpretation of this relationship between diurnal preference and SWD risk.

No other factors, including marital status, number of children at home, or caffeine intake, were significantly related to SWD risk, which is not consistent with the majority of other studies [5, 22, 23, 49]. Direct comparisons are difficult to perform, however, due to the large variety of sleep measurement tools used in other studies. We found no significant differences in work-related factors between those at low versus high risk of SWD, including the number of day, evening, and night shifts worked, the number of different shift types worked or the total number of shifts worked in the past month. In addition, the total number of hours worked (in the past week and month) or years of shift work experience were not different. The number of consecutive night shifts or frequency of quick returns (day shift immediately followed by evening shift) could not be addressed in the current study. Furthermore, the role of psychosocial work factors on response to shift work could be examined, including high work demands and job strain that have been shown to contribute to insomnia or sleepiness in shift workers [4, 22, 59]. The impact of these factors on risk of SWD was minimized in the current study due to the recruitment of nurses from the same hospital and similar wards, thus reducing the variability of these factors given that participants were working under similar work conditions, scheduling policies, and work environments.

Some limitations of this study should be acknowledged. The cross-sectional design makes it difficult to make definitive conclusions on any causal relationship between SWD risk and poor sleep hygiene. Consequently, it is unclear whether SWD is a consequence of poor sleep hygiene or whether SWD results in poor sleep behaviors. The strong association between SWD and sleep hygiene, however, indicates that sleep hygiene is an important factor that could be targeted for future SWD treatment programs. Future studies examining sleep hygiene behavior in more detail, including the use of sleep logs and actigraphy to measure sleep variability, would be beneficial, as well as longitudinal studies to understand whether there is a causal effect between poor sleep hygiene and developing SWD. Although the current study provides important understanding of SWD within the unique population of health care workers (i.e., predominantly female and specific work stressors), future work could be conducted across multiple hospitals and various industries to expand the generalizability of the findings. Due to the restrictions placed by the overarching RCT protocol, ESS data were not collected in half of the participants. Also, caution needs to be taken in the interpretation of the MEQ results of this study as no morning types were identified and a small effect size was found, which disappeared once age was controlled for. These results, however, help inform future research by bringing focus and awareness to the importance of sleep hygiene for individuals who undertake shift work and that these findings could be applied to other shift work populations.

Conclusions

Several demographic, lifestyle, and work-related factors were explored for their impact on SWD risk in this study, with poor sleep hygiene being the strongest contributing factor to high SWD risk. This suggests that there are potential benefits in raising awareness and education on good sleep hygiene practices to help curb the risk of sleep-related impaired due to shift work. This is the first and the largest study to use a validated SWD risk tool and measure a range of work, demographic, and lifestyle factors concurrently within the health care sector. Future research should explore the effectiveness of improving sleep hygiene behavior on SWD risk in health care and other organizational settings.

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