Factors Associated With Circadian Rhythm, Job Burnout, And Perceived Stress Among Nurses In Chinese Tertiary Hospitals: A cross-Sectional Study

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Abstract

Background: Shift work is a common work pattern for nurses worldwide. Circadian rhythm dysregulation affects the quality of nurses' work and their physical and psychological health. Eveningness and occupational stress might be associated with burnout syndrome.

Methods: A Cross-sectional study design. Between July and September 2020, 23 tertiary hospitals were randomly selected from among 113 tertiary hospitals in Hunan Province for participation in this study. At least 25% of the nurses working in each hospital were targeted. Nurses' circadian rhythm, job burnout, and perceived stress were evaluated. This paper complies with the STROBE reporting guideline for cross-sectional studies.

Results: A total of 28.1% and 17.6% of nurses reported eveningness type and morningness type, respectively. The scores for emotional exhaustion, depersonalization, and perceived stress of eveningness nurses were higher than those of their morningness counterparts. Eveningness nurses also reported a lower sense of personal accomplishment ($P<.05$). Predictors of MEQ score included age 36-40 years, widowed or divorced, BMI ≥ 25 kg/m^2, history of chronic disease, working for 11-20 years or 21 years and above, emotional exhaustion, personal accomplishment, perceived stress.

Conclusions: A large proportion of nurses experience circadian rhythm dysregulation. It is necessary to understand the predictors and influencing factors of circadian rhythm dysregulation in nurses to relieve their job burnout and reduce perceived stress.

Introdution

Nursing shortages are a global challenge in healthcare, especially in developing countries (World Health Organization, 2010). The global nursing deficit is predicted to reach 12.9 million by 2035 ((World Health Organzition, 2015). Although there are 4.45 million registered nurses in China (Statista, 2020), this number is still insufficient when compared with the 17.5 and 11.0 registered nurses per thousand people in Norway and Japan, respectively. The ratio of nurses to 1,000 people in China is only 3.0 (China, 2019; Drennan & Ross, 2019). A previous study showed that 74% of nurses reported acute and chronic stress as a contributing factor to nurse burnout. This also affects nursing quality and contributes to turnover intention (Thomas et al., 2019).

Circadian rhythm is a type of endogenous biological clock that arose in most organisms when they evolved. It rhythmically regulates behavior and physiology and is controlled by the suprachiasmatic nucleus (SCN), located in the ventral hypothalamus (Bollinger & Schibler, 2014; Fu & Lee, 2003; Shostak, 2017). The two-process sleep model states that the interplay of homeostatic processes in the body depends on circadian pacemaker–controlled sleep and wake processes, which determines important aspects of normal sleep regulation. Humans can force desynchronization protocols, a forced sleep-wake cycle, beyond the circadian pacemaker, causing sleep to occur at different circadian rhythms (Borbély et al., 2016). Circadian rhythms can be disrupted when exogenous rhythms are out of sync with the endogenous biological clock, such as when operating across different time zones or when performing shift work (Videnovic et al., 2014). Shift work is a common work pattern for nurses worldwide (Moreno-Casbas et al., 2014). Long shifts, overtime work, and disruption of circadian rhythms are all factors that contribute to sleep deprivation among nurses (Caruso, 2014; Drake & Wright, 2011). Circadian rhythm dysregulation also affects the quality of nursing and nurses' physical and psychological health (Faseleh Jahromi et al., 2013; West et al., 2009).

Emotional exhaustion, depersonalization, and a reduced sense of personal accomplishment are the three aspects of tridimensional syndrome, which can be defined as burnout (Maslach & Jackson, 1981). Nurses are exposed to occupational burnout in the clinical environment due to shortages of medical resources and nursing manpower and increased numbers of patients (Orgambídez-Ramos et al., 2017). Burnout is more prevalent among nurses than among workers in other professions (Gómez-Urquiza, De la Fuente-Solana, et al., 2017). Guo et al., (2019) reported that 74.1% of Chinese nurses have experienced burnout. Burnout can affect professionals in many occupations associated with helping others, with nurses being the most at risk due to potential impacts on safety and quality of clinical care (Gómez-Urquiza, Vargas, et al., 2017). On the other hand, burnout is also associated with resilience and turnover intention in nurses (Guo et al., 2019; Harker et al., 2016). Burnout syndrome in the nursing profession is also considered a risk factor for turnover intention and job dissatisfaction (Jiang et al., 2017). (Hosseinabadi et al., 2019) suggested that it is necessary to reduce burnout syndrome in shift nurses and identify risk factors that influence individual differences in nurses' circadian rhythms.

"Perceived stress" is defined as a person's response to an environment that is perceived as threatening to his or her abilities and health (Richard & Susan, 1984). Perceived stress refers not only to measurable stress itself but also to how a person feels about stress. Thus, the perception of a stressful condition is more essential than the objective measurement of the stressor and can impact a person's performance (Abdollahi et al., 2014; Wang et al., 2020). Among members of medical teams, nurses experience particularly high levels of stress (Clouston, 2019). Sensitive interpersonal relationships, inadequate support and recognition from their families, heavy workloads, low income, the requirements of career development, and patient pain and death are job-related stressors for clinical nurses (Feng et al., 2018; Khamisa et al., 2017).

In this study, a model of the multidimensional association of occupational sleep loss, health conditions, and burnout factors was employed (Figure 1). According to this model, the relationship between burnout and sleep suggests the following potential etiologic mechanisms for circadian disorders: (1) activation of the hypothalamic-pituitary-renal (HPA) axis, which increases the level of physical stress; (2) chronic depletion of energy reserves; and (3) HPA axis activation and enhanced chronic stress function as mediators of burnout and sleep deprivation (Melamed et al., 2006; Stewart & Arora, 2019).

A previous study also showed that differences in circadian rhythm and occupational stress can cause burnout syndrome (Hosseinabadi et al., 2019). Although burnout and stress have been assessed separately in Chinese nurses to some extent, few studies have investigated the relationship between circadian rhythm, burnout, and perceived occupational stress in Chinese tertiary hospital nurses. The results of this study can assist nursing managers in better managing circadian rhythm dysregulation among Chinese nurses. This study could also help improve both the physical and mental health of nurses, reduce turnover intention, enhance nursing retention, and provide a basis for effective interventions. The purposes of this study were to (1) evaluate chronotype, job burnout, and perceived occupational stress among Chinese tertiary hospital nurses and (2) understand the predictors of circadian rhythm in this group of nurses.

Methods

This study is compliant with Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline for cross-sectional studies (Supplementary File 1).

Design

A cross-sectional study of multi-stratified, grounded, random sampling method was used to select the final sample of nurses.

Participants

The inclusion criteria were as follows: (1) nurses on duty; (2) registered nurses with at least 1 year of working experience; and (3) those who provided informed consent. Participants were excluded if they were (1) in an internship, undergoing advanced training and study or on vacation during the study period; or (2) had experienced a major stressful event or suffered from a serious physical or mental illness. All subjects voluntarily participated in this study.

Date Collection

Between July and September 2020, 23 tertiary hospitals were randomly selected for this study from among 113 tertiary hospitals in Hunan Province. Twenty-five percent of the nurses working in each hospital were targeted for selection. A self-administered questionnaire was developed by researches. It was sent to the participants online or offline.

Instruments

Demographic information

We collected the following demographic data from each participant: sex, age, BMI, education, marital status, number of children, comorbid chronic diseases, professional title, working year, job satisfaction, and sources of stress.

Morning and Evening Questionnaire (MEQ-19)

The MEQ-19 was used to elucidate each participant's circadian rhythm. This survey was initially developed by (Horne & Ostberg, 1976) The Chinese version of the MEQ was translated and introduced by Zhang and colleagues in 2006 (B. Zhang et al., 2006). The MEQ consists of 2 dimensions (sleep phase and time of greatest efficiency) with 19 items. Each item has a corresponding score, with a total score range of 16-86. Participants can be classified into 3 categories based on their total score: 16-49 points indicates eveningness, 50-62 points indicates intermediate, and 63-86 points indicates morningness. The validity and reliability of the Chinese version were acceptable. The Cronbach's α coefficient was .701 - .738, the Spearman-Brown split reliability was .584 -.697, and the test-retest reliability was .638 - .831 (Zhang et al., 2006).

Maslach Burnout Inventory-Human Services Survey (MBI-HSS)

The MBI-HSS has been widely applied in studies of burnout among members of healthcare groups. The MBI-HSS consists of 3 dimensions: (1) Emotional Exhaustion (EE), to evaluate the emotional reaction to work stress; (2) Depersonalization (DP), to assess work stress–induced attitudes and feelings toward patients; and (3) Personal Accomplishment (PA), to appraise the effect of work stress on the perception of one's own work (Zhang et al., 2006). EE and DP are positive scores; that is, the higher the score, the more serious the job burnout is. EE and DP scores range from 0-42 and 0-18, respectively. The PA score ranges from 0 to 42 and is reverse

scored; the lower the score, the more severe the burnout is. The Cronbach's α coefficient was .828, and the Spearman-Brown coefficient was .823 (Zhang et al., 2006).

Perceived Stress Scale (PSS)

The PSS was used to assess the level of stress perceived by the participants. It was designed by (Cohen et al., 1983) and translated into Chinese in 2003 (Yang & Huang, 2003). The PSS consists of 2 dimensions: a sense of lack of control and tension. The PSS also includes 14 items scored on a 5-point Likert scale, ranging from 0 (never) to 4 (always). The total score ranges from 0 to 56, with higher scores indicating higher perceived stress. The PSS has good reliability, with a Cronbach coefficient of .780 (Yang & Huang, 2003).

Pittsburgh Sleep Quality Index (PSQI)

The PSQI was developed to measure the quality and patterns of sleep (Buysse et al., 1989). It consists of 19 self-rated items and 5 other rated items; 18 of the self-rated items are composed of 7 dimensions: (1) sleep latency, (2) subjective sleep quality, (3) habitual sleep efficiency, (4) sleep duration, (4) hypnotic drug use, (6) sleep disturbances, and (7) daytime dysfunction. Each component is scored on a 4-Likert scale (0-3 points). The total score is 0-21 points. A higher score indicates poorer participant sleep quality. Five points is the critical value. The Chinese version of the PSQI has acceptable reliability and validity in the Chinese population (Liu et al., 1996). The Cronbach's α coefficient of the Chinese version of the scale is .734 (Zheng et al., 2016).

Ethics and Consent to Participate

This study was approved by the IRB of The Third Xiangya Hospital, Central South University and supported by the heads of the nursing departments of the various hospitals. Moreover, the participating nurses were asked to give their written consent before completing the required data collection forms. The consent forms informed all participants of the purpose, processes, benefits, and potential risks of this study. The participants had the right to decide whether to participate and could withdraw at any point in time. The privacy of the participants was rigorously protected, and no identifying information was collected.

Statistical analysis

Data from different hospitals were analyzed using SPSS 24.0 (IBM Corp., Armonk, NY, USA). Continuous variables are described by the mean and standard deviation, whereas frequency and percentage are used for categorical variables. Pearson’s correlation analysis was used to analyze the degree of association between 2 variables. The correlations between demographics, pressure sources, perceived stress, burnout, sleep quality, and circadian rhythm were assessed using the chi-square test and one-way ANOVA. Multiple linear regression analysis was employed to explore the predictions of circadian rhythm, accounting for all variables, and categorical data were transformed into continuous variables by creating dummy variables. Alpha < .05 indicated statistical significance.

Results

Demographic information

Out of 3,050 nurses from the 23 hospitals invited, 2,780 nurses completed and returned the questionnaire. As a result, the overall response rate was 91.15%. The participants were predominately female (97.7%). More than 80% of participants had a bachelor's degree, and the BMI range was 18.5-24.9 for 77.7% of the participants. Approximately 70% of nurses were married and had one or more children. Approximately one-fifth of participants had a chronic disease. Regarding job-related factors, only 7.8% had obtained a senior professional title. With regard to working experience, most of the respondents had worked for 5-10 years (33.6%) or 10-20 years (33.8%). A total of 46.2% of the participants were satisfied with their job (See Table 1).

Chronotype, burnout, perceived stress, and sleep quality of the nurses

As shown in Table 1, the eveningness type and morningness type of circadian rhythm were reported by 28.1% and 17.6% of participants, respectively. Regarding sources of stress, 82.4% of the participants expressed that late-night shift work was a source of stress. In addition, income, workload, and worktime were indicated as sources of stress by 56.2%, 53.9% and 51.8% of participants, respectively. For the emotional exhaustion and depersonalization dimensions, morningness participants scored 17.44±9.039 and 4.99±4.123, respectively. In addition, the personal accomplishment score was 21.79±8.166. The average PSS score was at a normal level (27.12±8.166), although the perceived stress levels were higher for eveningness (28.56±8.15) than morningness (25.43±8.45), which had an ordinary level. For the seven dimensions of sleep quality, participants belonging to the eveningness type presented higher scores on the PSQI and its subscales ($P<.05$). Meanwhile, eveningness nurses showed higher PSS, EE, DP, and PSQI scores and lower PA scores than morningness nurses (Table 1).

Bivariate analysis of circadian rhythm

Except for sex and BMI and other individual characteristics, all job-related factors were significantly associated with circadian rhythm. Nurses who were younger, unmarried, without children, and did not participate in sports, had a lower level of educational background and professional title, had fewer years of service, were dissatisfied with their job, and reported their sources of stress to be from late-night shift work and their workload, work time, income, work difficulty, and marital relationship were significantly more likely to be eveningness types. Table 2 summarizes the correlations between different variables.

Multiple linear stepwise regression analysis

For nurses who were 36-40 years old, had worked for 11-20 years or 21 years or more, and who did not report parent-child relationships as sources of stress, PA scores were positive predictors of the MEQ score. In contrast, for nurses who were widowed or divorced, without children, did not participate in sports, and had a BMI ≥25 along with a chronic disease, EE scores, perceived stress, hypnotic drug use, sleep latency, and sleep duration were negative predictors of the MEQ score. A total of 19.2% of the variance in the circadian rhythm was explained by the above variables ($F=44.955$, $P<.001$, $R^2=0.196$, Adjusted $R^2=0.192$) (Table 3).

Discussion

In this study, the mean MEQ score was at the lower end of the median range (54.41±8.92). This may be related to the professional characteristic that shift work is a common pattern for nurses (Moreno-Casbas et al., 2014). The participants with an eveningness type of circadian rhythm accounted for 28.1% of the study group, which

represented a higher percentage than the morningness type (17.6%). Approximately 82.4% of the 2,780 nurses we surveyed were required to work the late-night shift. Shift work, on the other hand, tends to disrupt nurses' circadian rhythms (Niu et al., 2015). Eveningness was related to a higher score on the PSQI and its subscales, which could indicate poor sleep quality. These findings were similar to those of previous studies; for example, Zhang et al., (2018) concluded that eveningness was connected with poor sleep among nurses. Yazdi et al., (2014) also indicated that nurses with a morning sleep preference had better sleep quality.

The findings of this study also revealed that the three dimensions of job burnout were significantly correlated with chronotype. However, only EE and PA were predictors of circadian rhythm. A number of previous studies have explored the effect of circadian rhythm on burnout in nurses. Feng et al., (2021) suggested that circadian misalignment can contribute to decreased work performance and burnout. Repeated disturbance of the circadian rhythm can cause feelings of isolation, irritability, and perceived EE (Hosseinabadi et al., 2019). Healthcare professionals with more than 9 night shifts/month had a significantly higher rate of low PA than those with less than 5 night shifts/month (Alqahtani et al., 2019). In addition to disruption of circadian rhythm, nurse burnout can be caused by multiple factors; professional rank, sex, job satisfaction, core competence, professional values, and negative emotions are all predictors of job burnout (Xie et al., 2021). Some of these factors were shown to be predictors of circadian rhythm type in this study. Our study demonstrated that job burnout can also in turn affect the circadian rhythm of nurses, which is in accordance with the framework model employed in this study.

Perceived stress was inversely related to circadian rhythm among nurses who participated in this study. This is in line with the mechanism revealed by former studies. The stressor of late-night shift work was also significantly related to chronotype. Law & Clow (2020) reported that disruption of the circadian rhythm of cortisol secretion was caused by stress. Roeser et al., (2012) indicated that “night owls” have higher levels of perceived stress than “early birds” among university students. In this study, we also surveyed nurses about their sources of stress. Workload, work time, work difficulty, income, and marriage relationships were identified as stressors that were significantly associated with circadian rhythm. Robat et al., (2021) also found that some of these stressors affect hospital nurses. The stressors workload, work time, and work difficulty can cause nurses to work overtime to complete their work, which leads to delays in daily life activities.

Regarding job-related factors, professional title, working years, and job satisfaction were all significantly correlated with circadian rhythm. Our study showed that working 11-20 years as well as 21 years or more were predictors of MEQ score. In China, the working years of nurses is positively correlated with professional title; that is, the longer nurses have worked, the more senior their title is. Therefore, experience can help reduce performance degradation on night shifts as working years and work experience increase (Cappadona et al., 2020). Furthermore, disruptions of circadian rhythm in irregular shifts of nurses are prone to induce work dissatisfaction (Efinger et al., 1995). Compared to day-shift nurses, night-shift nurses had significantly lower mean job satisfaction scores (Ferri et al., 2016). In view of this, nursing management should pay attention to younger nurses’ shift adaptation.

Regarding individual characteristics, age, marital state, children, educational background, exercise intensity, and presence of a chronic disease were significantly correlated with the nurses’ circadian rhythm. Nurses younger than 25 years old who were unmarried had the highest proportion of eveningness. This may be because the nurses who engaged in rotating night shifts were significantly younger and more frequently single 8/5/2021(Ferri et al., 2016). Our study showed that those with an educational background below a bachelor's degree tend to be

more eveningness type. However, Ferri et al., (2016) reported that nurses with bachelor's and master's degrees were more engaged in rotating night shift work in Italy. One possible reason is that the situation in different countries is different. In China, there is little difference in the arrangement of new nurses with different educational backgrounds. Although parenting disrupts a person's circadian rhythm (Yamazaki et al., 2005), nurses without children were significantly more likely to be the eveningness type in this study. Perhaps nurses without children have other personal characteristics, such as being younger and unmarried, that support the above results. Griep et al., (2014) indicated that night shift exposure is a risk factor for increased BMI. Another study also suggested that among nonnappers, the number of nurses working at night and the years of exposure to night work were significantly associated with an increase in BMI (Silva-Costa et al., 2017). Eveningness type correlates with decreased physical activity (Fabbian et al., 2016). Maintaining an appropriate BMI and exercising regularly has a positive effect on nurses' circadian rhythm. Finally, chronic disease was a negative predictor of MEQ score. Eveningness type also contributes to psychological and psychopathological issues, as well as cardiovascular symptoms (Fabbian et al., 2016; Ferri et al., 2016). Therefore, circadian rhythm dysregulation should also be considered in regard to nurses' physiological health.

Shifts may be unavoidable for nurses; nevertheless, understanding the predictors and related factors of circadian rhythm dysregulation for nurses is necessary for nursing educators and managers to develop a reasonable shift system and appropriate measures to assist nurses in adjusting their circadian rhythms. Support for fragmented sleep can improve nurses' sleep and help them maintain a stable circadian rhythm

Limitations

First, data were collected at a single point in this study. Longitudinal changes in nurses' circadian rhythms could not be determined. Furthermore, this study applied a self-reporting method to collect data on variables that might be influenced by the participants' subjective emotions. Further research should include objective or physiological indicators such as cortisol, blood pressure, and brain wave measurements to deepen the scientific and innovative nature of this research area. Finally, relevant factors should be further refined and categorized to investigate the impact on nurses' circadian rhythms in future studies.

Conclusions

A large proportion of nurses experience circadian rhythm dysregulation. Predictors of the MEQ score in nurses included age 36-40 years, widowed or divorced marital status, BMI ≥25, presence of a chronic disease, working for 11-20 years or 21 or more years, EE, PA, perceived stress, hypnotic drug use, sleep latency, sleep duration, without children, and exercise. In addition, educational background, professional title, job satisfaction, DP, sleep quality, and the stressors late-night shift work, workload, work time, income, and work difficulty were significantly correlated with nurses' chronotype.

Declarations

Ethics approval and consent to participate: All procedures performed in the trial were in accordance with the ethical standards of the Third Xiangya Hospital, Central South University IRB (No. 2017-S559).

Consent for publication: Not Applicable.

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Authors' contributions: This manuscript was in collaboration between all authors. Jianfei XIE & Lijun LI conceived this study. Jie LI, Chun Zhang, Yi Zhou and Xiaofei Luo participated in sampling methods design. Min Liu & Sha WANG participated in statistical methods design. Siqing DING and Andy SK CHENG drafted the protocol. All authors read and approved the final manuscript.

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Tables

Table 1 Univariate and bivariate analysis of study variables (N=2,780)

Abbreviations: DP, Depersonalization; EE, Emotional Exhaustion; MBI-HSS, Maslach Burnout Inventory-Human Services Survey; MEQ, Morning and Evening Questionnaire; PA, Personal Accomplishment; PSQI, Pittsburgh Sleep

Variables	N (%) / Mean ± SD	MEQ / N (%)			χ^2 / *F*	P [a]
		Eveningness N=781 (28.1)	Intermediate N=1,511 (54.4)	Morningness N=488 (17.6)		
Individual characteristics						
Sex					1.250	.535
Male	63 (2.3)	21 (33.3)	30 (47.6)	12 (19.0)		
Female	2717 (97.7)	760 (28.0)	1481 (54.5)	476 (17.5)		
Age					230.735	< .001***
25 and below	408 (14.7)	183 (44.9)	196 (48.0)	29 (7.1)		
25-30	724 (26.0)	270 (37.3)	366 (50.6)	88 (12.2)		
31-35	955 (34.4)	237(24.8)	548 (57.4)	170 (17.8)		
36-40	397 (14.3)	58 (14.6)	241(60.7)	98 (24.7)		
41 and above	296 (10.6)	33 (11.1)	160 (54.1)	103 (34.8)		
Marital status Not married					173.247	< .001***
Married	2001 (72.0)	431 (21.5)	1159 (57.9)	411 (20.5)		
Widowed/divorced	112 (4.0)	40 (35.7)	50 (44.6)	22 (19.6)		
Unmarried	667 (24.0)	310 (46.5)	302 (45.3)	55 (8.2)		
Children					218.270	< .001***
0	852 (30.6)	390 (45.8)	389 (45.7)	73 (8.6)		
1	1211 (43.6)	272 (22.5)	689 (56.9)	250 (20.6)		
2 and above	717 (25.8)	119 (16.6)	433 (60.4)	165 (23.0)		
Educational background					28.906	< .001***
Below bachelor's degree	356 (12.8)	138 (38.8)	166 (46.6)	52 (14.6)		
Bachelor	2304 (82.9)	621 (27.0)	1276 (55.4)	407 (17.7)		
Master or PhD	120 (4.3)	22 (18.3)	69 (57.5)	29 (24.2)		

BMI					26.963	< .001***
< 18.5	384 (13.8)	135 (35.2)	201 (52.3)	48 (12.5)		
18.5-24.9	2159 (77.7)	561 (26.0)	1189 (55.1)	409 (18.9)		
≥25	237 (8.5)	85 (35.9)	121 (51.1)	31 (13.1)		
Exercise intensity					58.960	.000***
None	1069 (38.5)	374 (35.0)	564 (52.8)	131 (12.3)		
Mild	1265 (45.5)	298 (23.6)	704 (55.7)	263 (20.8)		
Moderate	418 (15.0)	101 (24.2)	230 (55.0)	87 (20.8)		
Severe	28 (1.0)	8 (28.6)	13 (46.4)	7 (25.0)		
Chronic disease					9.397	.009*
Yes	619 (22.3)	190 (30.7)	345 (55.7)	84 (13.6)		
No	2161 (77.7)	591 (27.3)	1166 (54.0)	404 (18.7)		
Job-related factors						
Professional title					120.469	< .001***
Junior	1315 (47.3)	480 (36.5)	666 (50.6)	169 (12.9)		
Middle	1249 (44.9)	272 (21.8)	727 (58.2)	250 (20.0)		
Senior	216 (7.8)	29 (13.4)	118 (54.6)	69 (31.9)		
Working years					217.947	< .001***
5 years and below	575 (20.7)	255 (44.3)	280 (48.7)	40 (7.0)		
5-10	934 (33.6)	299 (32.0)	482 (51.6)	153 (16.4)		
11-20	967 (33.8)	193 (20.0)	586 (60.6)	188 (19.4)		
21 years and above	304 (10.9)	34 (11.2)	163 (53.6)	107 (35.2)		
Job satisfaction					52.652	< .001***
Dissatisfaction	439 (15.8)	170 (38.7)	214 (48.7)	55 (12.5)		
Uncertain	1057 (38.0)	315 (29.8)	581 (55.0)	161 (15.2)		
Satisfaction	1284	296 (23.1)	716 (55.8)	272 (21.2)		

	(46.2)					
Stressor						
Late night shift	2291 (82.4)	699 (30.5)	1253 (54.7)	339 (14.8)	83.758	< .001**
Work environment	1252 (45.0)	372 (29.7)	663 (53.0)	217 (17.3)	3.007	.222
Workload	1638 (53.9)	483 (25.9)	889 (54.3)	266 (16.2)	6.687	.035*
Work time	1439 (51.8)	436 (30.3)	781 (54.3)	222 (15.4)	12.853	.002**
Salary income	1563 (56.2)	485 (31.0)	825 (52.8)	253 (16.2)	16.379	< .001***
Work difficulty	607 (21.8)	200 (32.9)	307 (50.6)	100 (16.5)	9.069	.011*
Job role	604 (21.7)	171 (28.3)	329 (54.5)	104 (17.2)	0.064	.968
Career development	1195 (43.0)	324 (27.1)	640 (53.6)	231 (19.3)	4.730	.094
Interpersonal relationships	597 (21.5)	188 (31.5)	319 (53.4)	90 (15.1)	5.902	.052
Parent-child relationship	383 (13.8)	100 (26.1)	220 (57.4)	63 (16.4)	1.711	.425
Marriage relationship	340 (12.2)	119 (35.0)	176 (51.8)	45 (13.2)	11.170	.004**
MEQ	54.41±8.92					
MBI-HSS						
EE	19.71±9.19	21.90±9.50	19.30±8.84	17.44±9.04	2.663	< .001***
DP	6.01±4.27	6.92±4.44	5.88±4.14	4.99±4.12	4.633	< .001***
PA	21.79±8.17	20.23±8.01	22.05±7.90	21.79±8.17	3.106	< .001***
PSS						
Total Score	27.12±8.17	28.56±8.15	26.93±7.96	25.43±8.45	2.035	< .001***
Uncontrol	14.33±4.90	14.94±4.63	14.29±4.90	13.45±5.20	1.855	0.004**
Tension	12.80±4.75	13.62±5.06	12.63±4.54	11.98±4.69	3.181	< .001***

PSQI						
Total score	8.63±3.72	9.86±3.95	8.36±3.54	7.50±3.38	9.971	< .001***
Subjective sleep quality	1.52±0.88	1.76±0.91	1.46±0.85	1.33±0.82	29.990	< .001***
Sleep latency	1.67±0.97	1.96±0.98	1.62±0.94	1.34±0.90	50.304	< .001***
Sleep duration	1.45±0.69	1.56±0.67	1.44±0.68	1.33±0.73	12.240	< .001***
Habitual sleep efficiency	0.39±0.67	0.45±0.72	0.37±0.67	0.32±0.59	4.393	.004**
Sleep disturbances	1.39±0.77	1.54±0.85	1.34±0.73	1.31±0.71	14.264	< .001***
Hypnotic use	0.27±0.73	0.40±0.90	0.24±0.67	0.13±0.48	15.918	< .001***
Daytime dysfunction	1.94±0.96	2.19±0.94	1.87±0.94	1.74±0.99	28.749	< .001***

Quality Index; PSS, Perceived Stress Scale.

[a] All tests were 2-sided.

*P< .05.

**P< .005.

***P< .001.

Table 2 Correlation between continuous variables and chronotype (N=2780)

	MEQ	EE	DP	PA	PSS	Uncontrol	Tension	PSQI
MEQ	1.000							
EE	-0.202***	1.000						
DP	-0.187***	0.683***	1.000***					
PA	0.159***	-0.102***	-0.223***	1.000				
PSS	-0.149***	0.424***	0.333***	-0.164***	1.000			
Uncontrol	-0.102***	0.212***	0.201***	-0.210***	0.852***	1.000		
Tension	-0.152***	0.510***	0.366***	-0.065***	0.841***	0.433***	1.000	
PSQI	-0.259***	0.486***	0.427***	-0.258***	0.379***	0.269***	0.373***	1.000

Abbreviations: DP, Depersonalization; EE, Emotional Exhaustion; MBI-HSS, Maslach Burnout Inventory-Human Services Survey; MEQ, Morning and Evening Questionnaire; PA, Personal Accomplishment; PSQI, Pittsburgh Sleep Quality Index; PSS, Perceived Stress Scale.

*** P< .001. All tests were 2-sided.

Table 3 Multiple linear regression analysis for total MEQ score (N = 2780)

Variables	Unstandardized coefficient		Standardized coefficients	95% CI	t	P [a]
	B	Std. error beta				
(Constant)	57.160	0.832		(55.529, 58.729)	66.692	.000***
Individual characteristics						
Age						
36-40	1.041	0.505	0.041	(0.051, 2.031)	2.062	.039*
Marital status						
Widowed/divorced	-2.146	0.788	-0.047	(-3.692, -0.600)	-2.721	.007*
Children						
0	-3.398	0.401	-0.175	(-4.182, -2.608)	-8.459	.000***
BMI						
≥25	-1.533	0.549	-0.048	(-2.608, -0.457)	-2.794	.005*
Chronic disease						
Yes	-0.929	0.375	-0.043	(-1.664, -0.194)	-2.478	.013*
Time of exercise						
None	-1.750	0.323	-0.095	(-2.384, -1.117)	-5.420	.000***
Job-related factors						
Working years						
21 years and above	4.138	0.559	0.145	(3.041, 5.235)	7.398	.000***
11-20	1.317	0.412	0.070	(0.509, 2.124)	3.197	.001**
Pressure sources						
Parent-child relationship-Without	1.013	0.460	0.039	(0.111, 1.916)	2.202	.028*
MBI-HSS						
EE	-0.080	0.018	-0.082	(-0.116, -0.044)	-4.404	.000***
PA	0.073	0.019	0.067	(0.035,	3.782	.000***

				0.111)		
PSS	-0.047	0.021	-0.043	(-0.088, -0.006)	-2.223	.026*
PSQI						
Hypnotic use	-1.243	0.225	-0.101	(-1.684, -0.802)	-5.523	.000***
Sleep latency	-0.867	0.185	-0.094	(-1.230, -0.503)	-4.672	.000***
Sleep duration	-0.813	0.238	-0.063	(-1.281, -0.346)	-3.411	.001**

Abbreviations: DP, Depersonalization; EE, Emotional Exhaustion; MBI-HSS, Maslach Burnout Inventory-Human Services Survey; MEQ, Morning and Evening Questionnaire; PA, Personal Accomplishment; PSQI, Pittsburgh Sleep Quality Index; PSS, Perceived Stress Scale.

[a] All tests were 2-sided.

*P< .05.

**P< .005.

***P< .001.

Supplementary File

Supplementary File 1 is not available with this version

Figures

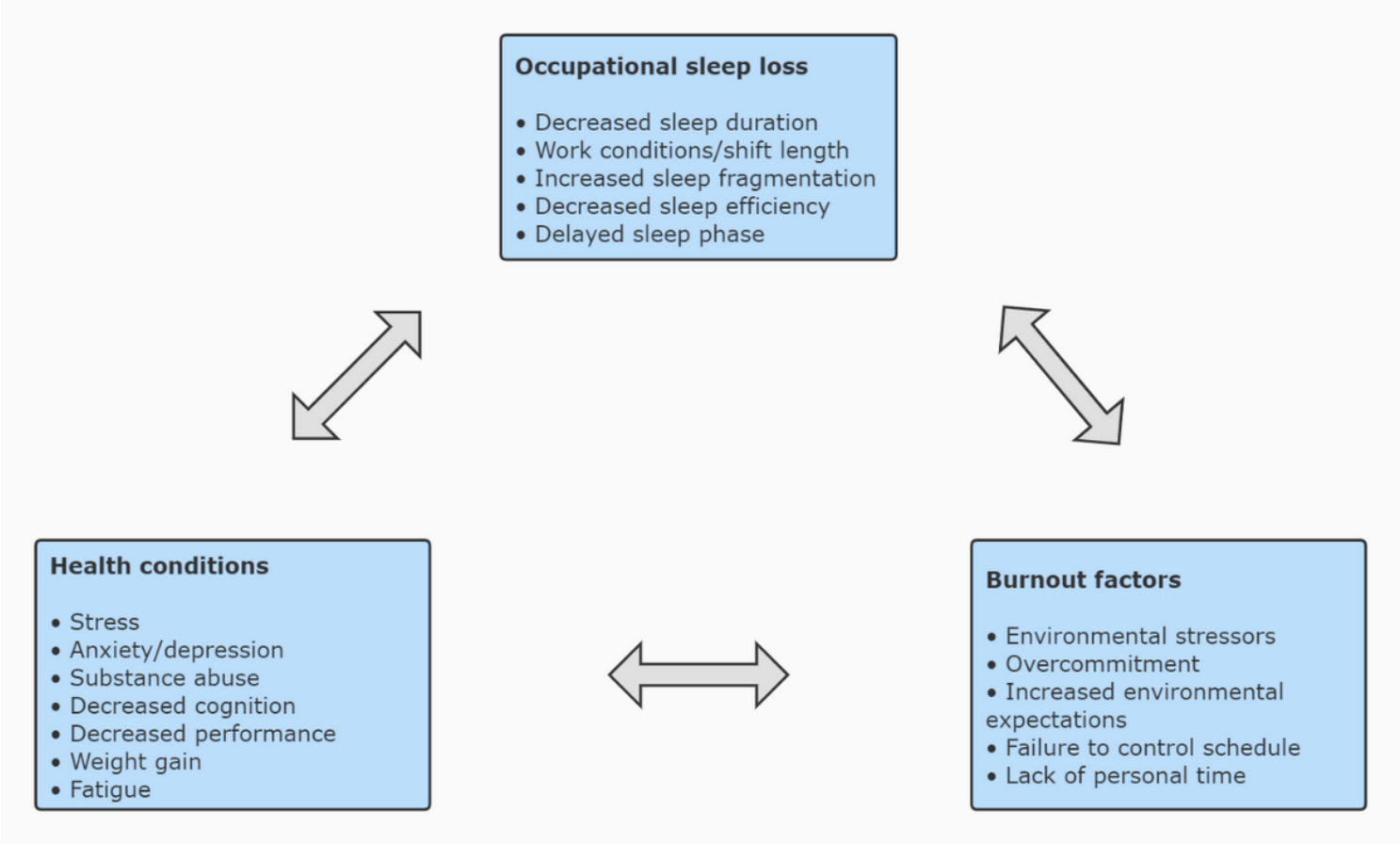

Figure 1

The multidimensional association of occupational sleep loss, health conditions, and burnout factors (Ref).