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ORIGINAL ARTICLE

WILEY

The relationship between sleep pattern and depression in Chinese shift workers: A mediating role of emotional exhaustion

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Abstract

Objectives: To explore the relationship between sleep pattern (morningness–eveningness) and depression in Chinese shift workers ("Three Shifts" workers), and to examine whether emotional exhaustion plays a mediating role in this relationship.

Study Design: We examined the impact of sleep pattern on the depression of three shifts workers, focusing on the mediating effect of emotional exhaustion.

Methods: A total of 1303 shift workers in the north and south of China were invited to participate in this study using convenience sampling. They completed a questionnaire which collected information on socio-demographic variables, along with measures of sleep pattern, depression, and emotional exhaustion. Using structural equation modelling, the mediating role of emotional exhaustion in sleep pattern and depression was explored.

Results: Of the three shifts workers 46.43% reported symptoms of depression; 27.84% identified as morning types while only 6.56% were evening types, with the remaining 65.60% falling into the intermediate category. There was a negative correlation between sleep pattern and depression, and between sleep pattern and emotional exhaustion, but a positive correlation between emotional exhaustion and depression. As predicted, emotional exhaustion played a mediating role in the relationship between sleep pattern and depression.

Conclusions: Having an evening sleep pattern was a risk factor for depression in three shifts workers; however, emotional exhaustion mediated the relationship between sleep pattern and depression. This finding may inform interventions aimed at reducing the level of depression within three shifts staff.

KEYWORDS
Chinese shift workers, depression, emotional exhaustion, sleep pattern

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1 | INTRODUCTION

While the stereotypical view of the workplace is one where employees work regular hours during the daytime (e.g., 9:00–17:00, 5 days a week), shift work and irregular hours are becoming increasingly common in a range of organisations. For example, it is now standard practice in many workplaces to assign staff into one of three shifts of 8-hr each (Demir Zencirci & Arslan, 2011; Jung & Lee, 2015), namely the "first shift" (e.g., 6.00–14:00), "second shift" or "swing shift" (e.g., 14:00–22:00), and "third shift" or "night shift" (typically 22:00–6:00). Shift work such as this is particularly prevalent in hospitals and many private or foreign-funded factories (e.g., in the steel or automobile industry), but is also becoming more frequent in the hospitality sector. Reflecting international trends, the expansion of Chinese cities and the resultant needs of citizens has meant that China has transitioned into a "24-hour" society (Yang, 2008), with all-night convenience stores and restaurants becoming widespread throughout large metropolises and smaller cities. This rapid economic development has consequently led to a significant growth in the number of "three shifts" staff. It is reported that 20% of employees are three shifts workers in industrial countries (Guo et al., 2015), and, according to the World Association of Sleep Medicine, there are 70 million shift workers in China (Tencent, 2014).

While the three-shift work system has promoted economic growth, it has also potentially led to an increase in sleep disorders. Given that the nature of shift work brings about irregular sleep, this is likely to impact negatively on well-being in a large proportion of the workforce. Sleep is a basic physiological need, with good sleep necessary for adults to take adequate care of their dependents as well as promoting social and economic development. Sleep also has an important effect on health, with strong associations demonstrated between sleep and diseases such as hypertension, cardiovascular disease, and cancer (Adan et al., 2012; Aggarwal, Loomba, Arora, & Molnar, 2012; H. S. Wang, Zhang, & Huang, 2010). For example, according to the National Center for Cardiovascular Diseases, the number of sudden cardiac deaths in China currently exceeds 540,000 every year, equivalent to about one per minute. As day and night inverted sleep/wake patterns is recognised as one cause of sudden death (Yangguang News, 2016), it is vital that a greater understanding of sleep patterns and related factors in shift workers is developed in order to improve their health (Kang, Miao, Tseng, Sithole, & Chung, 2015; Peplonska, Bukowska, & Sobala, 2015).

As well as implications for physical health, shift workers are also at risk of lower mental well-being. For example, compared to those working regular daytime hours, three shifts workers are more likely to suffer from depression (Moon, Lee, Lee, Lee, & Kim, 2015; Waage et al., 2014). This is likely due to the disruption in their circadian rhythms owing to their irregular sleep-wake cycle (Au & Reece, 2017). Long-term depression is, in turn, known to have adverse effects on physiological and social functioning, as

WHAT IS ALREADY KNOWN ABOUT THIS TOPIC

- Research investigating sleep patterns has concentrated on children and adolescents, with good sleep shown to be important for the development of children's growth, cognition, emotion, and health.
- Compared to individuals working regular daytime hours, shift workers are more likely to suffer from depression due to irregular circadian rhythmicity.
- Shift workers with higher burnout levels and short sleep time may experience emotional exhaustion.

WHAT THIS TOPIC ADDS

- The current study provides an in-depth exploration of the sleep patterns of shift workers in various professions in China, including those working in health care, the hospitality industry, and law enforcement.
- The study findings reveal that a relationship between sleep pattern and depression in shift workers, and that those with an evening sleep pattern are at greater risk of depression.
- As emotional exhaustion was found to be a mediator in the link between sleep pattern and depression, our findings suggest that mental well-being training based on the conservation of resource theory (COR) might an effective means of reducing depression in shift workers.

well as increasing the risk of suicide. Depression can reduce the body's immune function, slow down physical activity, decrease work and living capacity, and delay recovery from chronic diseases (Sun, 2008). Understanding the risk factors for depression in three shift workers is therefore particularly merited.

The extent to which shift workers are affected by their work schedules may be influenced by their unique preferred sleep pattern. An individual's sleep pattern can be considered as lying on a continuum with two extremes: morning type (or morningness) and evening type (or eveningness). Morning types prefer to go to bed and wake up early (e.g., sleep during the hours of 10 p.m.–6 a.m.), performing better in physical or intellectual activities in the day, while evening types prefer later bedtimes and later wake times (e.g., sleep during the hours of 12 p.m.–8 a.m.), performing greater in the evening or night. The majority of the population falls between these two extremes (Riedy et al., 2017). To date, research investigating sleep patterns has mostly concentrated on children and adolescents, given that sleep is known to play an important role in the development of children's growth, cognition, emotion and behaviour, as well as immune system regulation (Hsiao et al., 2015). However, sleep pattern also has an important influence on adult wellbeing and function with those exhibiting an evening-type pattern particularly at risk of lower wellbeing (Gulec et al., 2013). Some studies have indicated that a poor sleep pattern in older adults was a risk factor for depression (Kitabatake & Nagamatsu, 2010; Xavier et al., 2002). However, Arana-Lechuga et al. (2008) found that children's depression also varied with sleep pattern. Thus, while previous studies have shown that sleep pattern is associated with depression (Abe et al., 2011; DAĞ & Kutlu, 2017; Kanno, Tsugawa, & Yoda, 2014; Kitabatake & Nagamatsu, 2010; Togo, Yoshizaki, & Komatsu, 2017), there is a lack of research on the relationship between sleep pattern and depression in shift workers, and specifically within three shifts staff in China. Therefore, it is crucial to consider the negative impact of sleep pattern on depression and to find out the factors associated with it, which may provide a key target for alleviating depression in this group. Those identifying as evening types have been shown to experience more depressive symptoms than morning types, which might be because evening types have shorter sleep duration or worse sleep quality than morning types, which may, in turn, induce mood disturbance (Sullivan & Martin, 2016; Yoshizaki, & Komatsu, 2017). Our research hypothesizes that the sleep pattern of three shifts employees in China will be correlated with depression levels.

It is likely that shift workers who have a shorter sleep duration than preferred may also experience exhaustion, specifically defined as a loss of energy, confusion, emotional numbness, poorer sleep quality, and social disconnection (Porr, Olson, & Hegadoren, 2010). The conservation of resource (COR) theory, which holds that people actively strive to maintain, protect, and build resources (e.g., objects, personal characteristics, conditions that are valued in their own right), further states that threats to resources can lead to emotional and/or physical exhaustion (Hobfoll, 1989; Hobfoll, 2001). Jin et al (2016) defined resources as anything perceived by an individual to help attain his or her goals. Thus, we view sleep as a resource, and propose that the loss of sleep will lead to the experience of emotional exhaustion.

Emotional exhaustion can be defined as an experience where individuals feel that all their emotional resources have been exhausted, leading to a decreased desire to work, coupled with frustration, tension, and even fear in relation to their job. In the organisational behaviour literature such exhaustion is recognised as a core dimension of job burnout (Li & Shi, 2003; Maslach, Schaufeli, & Leiter, 2001). It has also been reported that a decline of sleep quantity (in hours) leads to increased levels of emotional exhaustion. For example, one study observed that subscale scores of emotional exhaustion increased from 8.5 to 68% within 1 year for interns who tolerated chronic sleep deprivation (Rosen, Gimotty, Shea, & Bellini, 2006). Thus, this study hypothesizes that an evening type sleep pattern, accompanied by insufficient sleep duration and poor sleep quality, will be associated with higher levels of emotional exhaustion. Emotional exhaustion may in turn have a detrimental impact on mental health. For example, nurses' emotional exhaustion has been shown to positively correlate with depression (Rosen et al., 2006; Ruiz et al., 2014; Xavier et al., 2002). Thus, personal factors, such as emotional exhaustion, may have a considerable influence on the relationship between sleep pattern and depression (Arana-Lechuga et al., 2008; Tourigny, Baba, & Wang, 2010). This study hypothesizes that emotional exhaustion will mediate the relationship between sleep pattern and depression.

In light of the above literature, the current study aims to examine: (a) sleep pattern and depression levels of three shift employees in China; (b) whether there is a significant negative correlation between the sleep pattern of three shifts workers and depression; (c) whether there is a significant positive correlation between the emotional exhaustion and depression; and (d) whether the emotional exhaustion of employees on three shifts mediates the relationship between sleep pattern and depression. The study of sleep patterns in Chinese three shift workers has the potential to not only enrich adult sleep theory theoretically, but also help improve shift workers' physical and mental health. As such the results of this study can provide scientific evidence for organisations wishing to improve the work shifts system, and may promote the development of interventions aimed at

improving the sleep quality of three shifts staff, including how to advise organisations on how best to reasonably arrange shift work in line with employees' sleep pattern.

2 | METHODS

2.1 | Participants

A total of 1,303 participants in the north and south of China were invited to take part in the study, including a mixture of doctors, nurses, prison police officers, hotel workers, and railway workers. Inclusion criteria were: being a three-shifts worker, being able to read Chinese, and willing to participate in the study. After excluding questionnaires with significant amounts of missing data, the valid sample was 1,189 (completion rate = 91.3%).

2.2 | Ethical statement

Ethical approval for this study was obtained from the Academic Board of Shandong Normal University. All procedures performed in studies involving human participants were in accordance with the ethical standards of the Academic Board of Shandong Normal University and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The participants voluntarily completed the questionnaire. All were asked to sign a consent form, and were informed that they could withdraw from the study at any time. The information from the study was kept strictly confidential.

2.3 | Measures

2.3.1 | Socio-demographic background questionnaire

A set of structured questionnaires was used to collect socio-demographic data, including information on participants' gender, age, height, weight, degree of education, working years, occupation, fitness level, whether or not they were a smoker, whether or not they consumed alcohol, and whether or not they took any sleep medications.

2.3.2 | Morning/evening questionnaire

The Morning/Evening Questionnaire (MEQ) is an instrument and has been widely used to measure sleep pattern (Deng, Fu, & Xie, 2016; Horne & Östberg, 1976; Sullivan & Martin, 2016). Zhang, Hao, and Rong (2006) successfully validated the Chinese revised edition of MEQ (Zhang et al., 2006). There are a total of 19 items (e.g., The expected wake up time is …) in MEQ. Higher scores obtained in the questionnaire indicate that the sleep pattern is more inclined towards a morning type, while lower scores indicate an evening type. Participants are divided into three categories on the basis of total scores: morning type (59–86), intermediate type (42–58), and evening type (16–41). Zhang et al. (2006) have demonstrated good reliability and validity of the Chinese version of MEQ, with Cronbach's coefficient of 0.701–0.738 and Spearman–Brown coefficient of 0.584–0.697, and the retest reliability was 0.638–0.831, which reached the acceptable level of psychometrics (Horne & Östberg, 1976). In the present study, the Cronbach's alpha was 0.661.

2.3.3 | Maslach burnout inventory

Maslach and Jackson jointly developed the original version of Maslach Burnout Inventory (MBI) (Li & Shi, 2003; Maslach et al., 2001). It initially comprised three dimensions: emotional exhaustion, depersonalization, and personal accomplishment. The MBI has been widely applied and validated, with good internal consistency reliability, retest reliability, structural validity, and construct validity demonstrated. For the purpose of this study, we only included the dimension of emotional exhaustion, which has five questions and each item was scored on a 6-point scale, ranging from 0 (never) to 5 (everyday). Higher scores are indicative of more severe emotion exhaustion. In the present study, the Cronbach's alpha was 0.923.

2.3.4 | Self-rating depression scale

The self-rating depression scale (SDS), a standard assessment instrument, has been verified to accurately reflect subjective feelings of depression severity. It is a self-reported 20-item questionnaire with each item scored on a 4-point scale, ranging from 1 (never) to 4 (always). It has been validated and widely used in China. A higher SDS score indicates a higher level of depression (Wang et al., 2017). In the present study, the Cronbach's alpha was 0.804.

2.4 | Statistical analysis

We first performed a descriptive statistical analysis of control variables, sleep pattern, and depression to analyse the frequency, percentage, mean, and *SD* using SPSS 19.0. (IBM Corp. Armonk, NY, USA) Independent sample *t* tests and one-way ANOVAs were used to explore the demographic differences in sleep pattern and depression, and the sleep pattern difference in depression and exhaustion. Spearman correlation analysis was used to investigate whether demographic variables, sleep pattern, depression, and emotional exhaustion were significantly related.

TABLE 1 Demographic characteristics of participants

Variable	N (%)	Sleep pattern Mean (SD)	*F/t*	*p*	Depression Mean (SD)	*F/t*	*p*
Gender			44.15	0.000		1.91	0.167
Women	683 (61.48)	2.78 (.38)			2.48 (.55)		
Man	427 (38.43)	2.93 (.36)			2.53 (.56)		
Marital status			43.52	0.000		5.18	0.006
Married	642 (57.67)	2.92 (.35)			2.45 (.55)		
Unmarried	449 (41.50)	2.71 (.39)			2.56 (.56)		
Other	9 (0.83)	2.85 (.33)			2.54 (.67)		
BMI			11.03	0.000		7.63	0.000
0	116 (11.05)	2.72 (.40)			2.72 (.54)		
1	600 (57.14)	2.82 (.38)			2.47 (.57)		
2	247 (23.52)	2.94 (.35)			2.45 (.52)		
3	87 (8.28)	2.88 (.36)			2.48 (.59)		
Education			8.33	0.000		5.84	0.000
Junior school and below	26 (2.41)	2.94 (.43)			2.90 (.55)		
High school/technical secondary school	67 (6.22)	2.83 (.39)			2.56 (.55)		
Junior college education	327 (30.39)	2.74 (.39)			2.55 (.53)		
Regular college education	583 (54.18)	2.88 (.37)			2.45 (.56)		
Master's degree or above	73 (6.78)	2.87 (.34)			2.41 (.61)		
Age			17.59	0.000		2.43	0.02
25 and less	280 (26.05)	2.70 (.36)			2.57 (.55)		
26–30	313 (29.12)	2.77 (.37)			2.50 (.56)		
31–35	185 (17.21)	2.88 (.37)			2.51 (.56)		
36–40	96 (8.93)	2.98 (.33)			2.36 (.58)		
41–45	106 (9.86)	3.02 (.36)			2.43 (.52)		
46–50	56 (5.21)	2.97 (.33)			2.41 (.52)		
51 and more	39 (3.62)	3.00 (.36)			2.54 (.51)		
Working years			22.56	0.000		4.50	0.001
1 and less	173 (15.74)	2.78 (.36)			2.58 (.57)		
1–5	390 (35.49)	2.75 (.38)			2.54 (.56)		
6–10	192 (17.47)	2.81 (.37)			2.53 (.52)		
11–15	130 (11.83)	2.91 (.37)			2.41 (.54)		
16 and more	214 (19.47)	3.03 (.33)			2.39 (.54)		
Occupation			14.71	0.000		11.50	0.000
Nurse	567 (53.38)	2.76 (.39)			2.50 (.53)		
Doctor	107 (10.08)	2.91 (.33)			2.29 (.61)		
Hotel worker	78 (7.34)	2.90 (.37)			2.80 (.56)		
Railway worker	10 (0.94)	2.85 (.36)			2.90 (.24)		
Police	300 (28.25)	2.95 (.36)			2.46 (.55)		
Fitness level			11.86	0.000		2.29	0.04
Everyday	114 (10.48)	3.02 (.36)			2.52 (.59)		
Once a week or several times	283 (26.03)	2.90 (.36)			2.48 (.57)		

TABLE 1 (Continued)

Variable	N (%)	Sleep pattern Mean (SD)	*F/t*	*p*	Depression Mean (SD)	*F/t*	*p*
Severe times a month	182 (16.74)	2.85 (.36)			2.39 (.57)		
Once a month or less	111 (10.21)	2.80 (.34)			2.51 (.53)		
Once a year or less	176 (16.19)	2.77 (.38)			2.54 (.50)		
Never	221 (20.33)	2.74 (.39)			2.56 (.56)		
Daily smoking			2.06	0.08		9.26	0.000
0	894 (81.87)	2.83 (.38)			2.45 (.55)		
1–5	63 (5.77)	2.95 (.38)			2.72 (.52)		
6–10	52 (4.76)	2.83 (.37)			2.67 (.62)		
11–15	39 (3.57)	2.90 (.30)			2.71 (.46)		
16 and more	44 (4.03)	2.89 (.33)			2.75 (.42)		
Alcoholism			.20	.65		12.70	0.000
Yes	47 (4.26)	2.86 (.35)			2.78 (.50)		
No	1,056 (95.74)	2.84 (.38)			2.49 (.55)		
Use of sleep medication			.33	.80		9.75	0.000
Never	986 (90.05)	2.84 (.38)			2.47 (.55)		
Once in a while	102 (9.32)	2.81 (.42)			2.68 (.56)		
Always	5 (.05)	2.86 (.49)			3.44 (.72)		
Everyday	2 (.02)	3.03 (.26)			3.05 (.07)		

BMI: using China's BMI standard, "0" stands for normal, "1" for mildly overweight, "2" for moderately overweight and "3" for severe overweight.
The *p*-value is analysed by ANOVA or *t* test.

Second, we conducted the mediation analysis using the PROCESS macro for SPSS 19.0 that can estimate the direct, indirect, and total effects with covariates simultaneously. In addition, we estimated 95% bias corrected confidence intervals for all regression coefficients and effect coefficients using 5,000 iterations of bootstrapping.

3 | RESULTS

3.1 | Participants' demographic characteristics

Participants' demographic characteristics are shown in Table 1. As can be seen here, 53.38% of the respondents were nurses, 10.08% were doctors, and 28.25% were in the police force. As can also be seen from the table, 61.48% of the participants were female and 57.67% were married; 31.80% had an abnormal weight with BMI of 2 or above. More than half of the participants (60.96%) had completed at least a college education. The majority of participants (70.33%) were aged between 26 and 50 years, with 52.23% of total participants working 5 years or less. Only a few participants (36.52%) exercised daily or weekly, and most of the participants did not smoke (81.87%), drink (95.74%), or take sleeping pills (90.05%). Table 1 also shows that sleep pattern scores were significantly different in gender ($t = 44.15$, $p < 0.001$), marital status ($F = 43.52$, $p < 0.001$), BMI (normal and abnormal) ($F = 11.03$, $p < 0.001$), degree of education (bachelor degree above or below) ($F = 8.33$, $p < 0.001$), age ($F = 17.59$, $p < 0.001$), working years ($F = 22.56$, $p < 0.001$), occupation ($F = 14.71$, $p < 0.001$), and fitness level ($F = 11.86$, $p < 0.001$). Results also indicate that depression scores differ according to education level ($F = 5.84$, $p < 0.001$), age ($F = 2.43$, $p < 0.05$), marital status ($F = 5.18$, $p = 0.006$), BMI ($F = 7.63$, $p<0.001$), working years ($F = 4.50$, $p < 0.001$), occupation ($F = 11.50$, $p < 0.001$), fitness level ($F = 2.29$, $p < 0.05$), and use of sleep medication ($F = 9.75$, $p < 0.001$).

Further post hoc tests showed that for BMI, the sleep pattern scores of overweight and underweight workers were significantly different, $p < 0.01$; the sleep pattern scores of employees working less than 10 years and more than 10 years were significantly different, $p < 0.01$; the sleep pattern scores of nurses were significantly different from those of doctors, hotel employees, and police officers, $p < 0.01$; for fitness situation, there was a significant difference in sleep pattern scores between employees who exercised a few times a month and ones who hardly exercised, $p < 0.05$. There was a significant difference in depression scores

TABLE 2 Descriptive analysis of sleep pattern and depression

Variable	Component	Frequency	%
Sleep pattern (53.95 ± 7.24)	Evening type(≦42)	78	6.56
	Intermediate type (43–58)	780	65.60
	Morning type (≧59)	331	27.84
Depression (50.25 ± 11.06)	Normal (≦52)	637	53.57
	Minor depression (53–62)	426	35.83
	Intermediate depression (63–72)	114	9.59
	Severe depression (≧72)	12	1.01

between employees under 35, over 51 and those who were 36–50 years old, $p < 0.05$; The scores of depression among married and unmarried employees were significantly different, $p < 0.001$; employees who never used sleeping pills and those who took sleeping pills were significantly different in depression scores, $p < 0.01$. Specific analysis can be found in the attached material.

As noted by Table 2, participants with an evening type sleep pattern accounted for only a small proportion of the overall sample (6.56%), with 27.84% exhibiting a morning type sleep pattern. Most participants (65.60%) had an intermediate sleep pattern. Approximately, half of the three shifts staff exhibited some symptoms of depression, with 35.83% experiencing minor depression, 9.59% experiencing greater levels of depression, and 1.01% experiencing severe depression.

An univariate ANOVA showed that depression scores varied significantly between participants exhibiting the three different sleep patterns (evening type, intermediate type, morning type), $F = 10.95$, $p < 0.001$ (see Table 3). Post hoc analysis revealed that depression levels were higher in evening types than both intermediate types, $p < 0.01$, and morning types, $p < 0.001$, and also that depression levels of intermediate types were significantly greater than that morning types, $p < 0.01$.

As shown in table 3, the emotional exhaustion scores also varied significantly between the different sleep patterns (evening type, intermediate type, morning type), $F = 10.85$, $p < 0.001$. Post hoc analysis found that evening types had significantly higher levels of emotional exhaustion than intermediate type, $p < 0.001$, and morning types, $p < 0.001$, but that emotional exhaustion levels did not differ between intermediate types and morning types, $p = .53$.

3.2 | Correlations between sleep pattern, emotional exhaustion, and depression

As can be seen in Table 4, sleep pattern was negatively correlated with both emotional exhaustion ($r = -.12$, $p < 0.01$) and depression ($r = -.14$, $p < 0.01$), while there was a positive correlation between depression and emotional exhaustion ($r = .24$, $p < 0.01$). This indicates that lower sleep pattern scores (specifically more evening types) were associated with higher emotional exhaustion and higher depression, and that higher emotional exhaustion was correlated with higher levels of depression.

3.3 | Mediation effect of emotional exhaustion on "three shifts" workers' sleep pattern and depression

As the data comes from the same participants at a single time point, the study may exhibit common method bias (CMB). To determine whether CMB was present in the data, the Harman' Single-Factor test was used. The results of exploratory factor analysis using non-rotational principal component analysis showed that there was no single factor, and that the first factor explained the total variation to 23.77%, much less than 30%. It was therefore concluded that CMB was not present in the data.

Table 5 shows the regression coefficients of sleep pattern and depression through emotion exhaustion with covariates. These results suggest that emotion exhaustion mediated the relationship between sleep pattern and depression (see Figure 1). The direct effect of sleep pattern on depression was −.16, 95% CI [−.24, −.08], indicating that the direct effect of sleep pattern on depression was significant. Sleep pattern had significant indirect effects on depression through emotion exhaustion (indirect effect = −.04, 95% CI [−.07, −02]). The total effect of sleep pattern on depression was −.20, 95% CI [−.29, −.12].

TABLE 3 ANOVA of sleep pattern, depression, and emotional exhaustion

Variable	Depression Mean (SD)	*F*	*p*	Emotion exhaustion Mean (SD)	*F*	*p*
Sleep pattern		10.95	0.000		10.85	0.000
Evening type	2.73 (.53)			2.55 (1.27)		
Intermediate type	2.53 (.54)			2.02 (.97)		
Morning type	2.42 (.55)			1.95 (1.11)		

TABLE 4 Correlation of demographic variables, sleep pattern, depression and emotional exhaustion

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gender	–													
2. Marital status	−.26**	–												
3. BMI	.44**	−.32**	–											
4. Education	−.02	−.25**	.05	–										
5. Age	.44**	−.68**	.40**	.22**	–									
6. Working years	.29**	−.65**	.32**	.21**	.82**	–								
7. Occupation	.83**	−.24**	.40**	.08**	.43**	.26**	–							
8. Fitness level	−.25**	.02	−.10**	−.10**	−.10**	−.01	−.28**	–						
9. Daily smoking	.52**	−.09**	.23**	−.16**	.23**	.11**	.48**	−.06*	–					
10. Alcoholism	−.17**	−.02	−.08**	.11**	−.05	.01	−.16**	.01	−.40**	–				
11. Use of sleep medication	.09**	.05	.02	−.07*	.05	.04	.09**	−.02	.32**	−.49**	–			
12. Depression	.06	.09**	−.08**	−.12**	−.08**	−.12**	.03	.04	.20**	−.13**	.15**	–		
13. Sleep pattern	.19**	−.23**	.16**	.11**	.28**	.23**	.21**	−.21**	.05	−.03	.01	−.14**	–	
14. Emotional exhaustion	−.08**	−.01	.03	−.06*	−.03	.02	−.12**	.12**	.02	.04	.02	.24**	−.12**	–
Mean	1.38	1.42	2.57	3.57	2.78	2.84	2.41	3.57	1.42	1.96	1.11	2.51	2.83	2.03
SD	0.47	0.49	0.99	0.77	1.60	1.31	1.64	1.64	0.98	0.19	0.33	.55	.38	1.04

Notes: *$p < .05$; **$p < .01$; ***$p < .001$.

TABLE 5 Regression coefficients of sleep pattern and depression through emotion exhaustion

	Mediator			Outcome		
Antecedent	**Coeff.**	**LLCI**	**ULCI**	**Coeff.**	**LLCI**	**ULCI**
Covariates						
Gender	−.07	−.30	.15	.10	−.01	.21
Marital status	−.10	−.25	.06	.01	−.06	.09
BMI	.08*	.02	.15	−.06***	−.09	−.03
Education	−.04	−.12	.04	−.04	−.08	.00
Age	−.08*	−.16	−.01	.64	−.01	.07
Working years	.10*	.01	.18	−.07**	−.11	−.03
Occupation	−.04	−.10	.03	−.01	−.04	.02
Fitness level	.04*	.00	.08	.01	−.01	.03
Daily smoking	.08*	.01	.15	.07***	.03	.11
Alcoholism	−.06	−.37	.25	−.12	−.28	.04
Use of sleep medication	.20*	.02	.39	.16***	.07	.25
Sleep pattern	−.37***	−.53	−.21	−.16***	−.24	−0.08
Emotion exhaustion				.12***	.09	.15
R^2	.05***			.15***		

Abbreviations: Coeff, Coefficient; LLCI, lower level of 95% confidence interval; ULCI, upper level of 95% confidence interval.
*$p < .05$; **$p < .01$; ***$p < .001$.

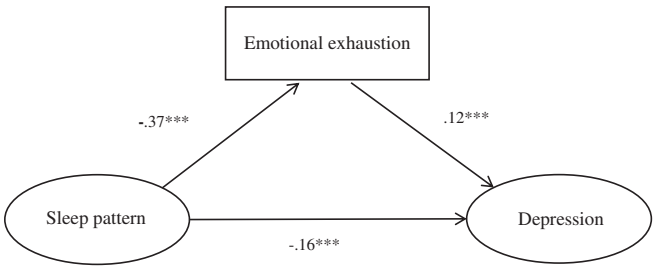

FIGURE 1 Graphic presentation of coefficients for each path in the process model for depression

4 | DISCUSSION

The results of this study have revealed some interesting insights into the characteristics of three-shift workers in China, as well as uncovering relationships between workers' sleep patterns, depression levels, and extent of emotional exhaustion. These findings have important implications for understanding the impact that shift work can have on employee well-being.

4.1 | Individual differences in sleep patterns

We found that the sleep pattern of three shifts workers in China were comparable to those in Japan according to statistics from a similar study (Togo et al., 2017). Specifically, the lowest number of three shifts employees exhibited an evening sleep pattern, (6.56% in China and 7.7% in Japan), most exhibited an intermediate sleep pattern (65.6% in China and 71.4% in Japan), with the remaining employees having a morning sleep pattern (27.84% in China and 20.9% in Japan). Our study also revealed a number of interesting differences in the sleep pattern among our sample of shift workers, some of which are detailed below.

One interesting finding from our study is the revelation that a greater amount of men exhibited an evening-type sleep pattern, compared to women. This may, for some, be related to greater life responsibilities in the context of Chinese culture (Hart, Ward, Haney, & Foltin, 2003). As a result of "mian zi" (a Chinese temperament in which people carry out dramatic actions to avoid appearing weak and losing respect or admiration in social interaction) (Smith, 1894), Chinese men are often expected to make more money than women to keep "mian zi" in modern society. Reflecting this, it has been shown that they often work longer and have less sleep time than Chinese women (Zhao, 2015).

In addition, three shifts employees who had worked more than 10 years were also more inclined to exhibit a morning-type sleep pattern than those who had worked less than 10 years. This is probably because they were experienced in shift work, meaning that their body had adapted to the work-rest mode maintaining an early schedule (Pires et al., 2009). Conversely, compared with doctors, hotel staff and police officers, nurses were more likely to exhibit an evening sleep pattern. This may be related to nurses' professional

characteristics. For example, they may need to pay close attention to the patient's physical condition, and track their condition even after they finish work (Holliday, 1961).

A report on the status of nutrition and chronic diseases of Chinese residents (2015) revealed that 30% of Chinese adults over the age of 18 were overweight, and that the obesity rate was 6.4%. In our study, 31.80% of three shifts workers were overweight, with 8.28% obese. This suggests that the BMI of three shifts workers was slightly higher than that in the normal population. Night shift work is a known risk factor for obesity, since circadian rhythm disorders may reduce metabolism, and increase hunger and food intake. Circadian rhythm disturbances may also lead to changes in the body's hormone levels and neurological disorders, increasing the probability of gaining weight (Peplonska et al., 2015).

4.2 | Depression among shift workers and the influence of marital status, age, and sleep medication on depression

Our study revealed that 46.43% of three shifts workers had symptoms of depression, which suggests that three shift workers are at greater risk of depression than the general population (38.6% prevalence) (China Youth Daily, 2011). Those with an evening-type sleep pattern are particularly at risk as this might impact the health of three shifts workers, leading to eating disorders, excessive daytime sleepiness, and behavioural/emotional problems (Tonetti, Fabbri, Filardi, Martoni, & Natale, 2015). Depression is in turn a risk factor for suicide (Minkoff, Bergman, Beck, & Beck, 1973), the onset of coronary heart disease (Lesperance & Frasure-Smith, 2000), and intestinal diseases (Taillard, Philip, Chastang, & Bioulac, 2004). The results of this study provide a new insight into how the physical and mental health of Chinese workers on three shifts might be improved by helping them to better regulate their sleep pattern.

Based on the impact of demographic variables, we found that the married staff on three shifts had lower levels of depression than those who were not married, which is in line with previous studies (Sun, 2008). This may be attributed to the greater levels of social support that is available from families. Research from Hou, Cerulli, Wittink, Caine, and Qiu (2015) and Jensen et al. (2014) also showed that social support could relieve depression. Employees under the age of 35 and over the age of 51 had higher levels of depression than those in the 36–50 age group. Similar to findings from Kim et al. (2010), this may be because the intrinsic circadian rhythm in young adulthood and older age contains circadian instability or irregular sleep–wake cycles.

In addition, social factors may impact on this effect. For example, employees under the age of 35 may have just started shift work and may be less adaptable, whereas employees over the age of 51 may have degradations in their physical health or could be facing retirement problems. However, the majority of our sample tended to have an intermediate sleep pattern, while Kim's participants were adults of the evening type. Inconsistency in sleep pattern may arise from differences in the participants' groups and the measurement of the sleep pattern questionnaire.

In our study, 9.39% of the three shifts employees took some sleep medications. Employees taking sleeping pills were more likely to have depression than those who did not. It is established that, while sleeping pills can improve three shifts staff's sleep quality, next-day mood is typically worsened when using such medications (Hart et al., 2003). Sleeping pills are therefore not recommended for prescription to patients suffering from symptoms of maladjustment to shiftwork due to its impairment for cognitive functions (Lemmer, 2007). Reducing the reliance on sleeping pills by three shift workers will instead require changing their sleeping pattern. Therefore, in order to better guarantee the physical and mental health of three shifts employees and improve the work efficiency, the sleep pattern and depression levels of the employees on three shifts should be taken into account.

4.3 | The relationship between sleep pattern, depression, and emotion exhaustion

A number of notable findings were observed regarding the relationships between sleep pattern, depression, and emotional exhaustion. First, we found that sleep pattern was negatively associated with depression. In other words, workers with an evening-type sleep pattern had higher levels of depression than those with morning-types, which supports previous research in this area (Chen, 2007; Kim et al., 2010; Togo et al., 2017). A large number of empirical studies have found that when individuals lose resources (e.g., sleep loss) at work, they are more likely to experience strain in the form of burnout (Shirom, 1989), depression (Kessler, Turner, & House, 1988), and other negative physiological outcomes (DeVente et al., 2003; Melamed et al., 2006). Furthermore, Selvi, Gulec, Agargun, and Besiroglu (2007) found that having an evening type was related to mood changes, which could be directly attributed to disruptions in the circadian rhythm of such shift workers. There is accordingly a strong correlation between biological rhythm disorders and depression (Churchill & Farrell, 2017) which may explain the findings of our study where depression levels were increased in three shifts workers of an evening-type (Jensen et al., 2014). This implies that three shifts work affects the circadian rhythm of staff, making them vulnerable to biological rhythm disorders and depression.

Second, this article illustrated that sleep patterns were positively correlated with emotional exhaustion, in that three shifts workers with evening-type sleep patterns had higher levels of emotional exhaustion compared to morning or intermediate types. Sleep does not only involve a process of resource recovery, but is also the outcome of resource recovery, and may, as such, help employees renew and replenish their personal resources (Manville, Akremi, Niezborala, & Mignonac, 2016). However, irregular work hours and increased nighttime social activity are two factors that can interfere with sleep restoration. While the circadian clock typically gives rise to a sleep drive in most people, this activity can be artificially delayed or interrupted in those with an evening sleep pattern, resulting in a greater likelihood of sleep loss. This in turn will impair alertness, mood, and performance capacity (Åkerstedt, Nilsson, & Kecklund, 2009), which explains why evening types are more likely to experience emotional exhaustion.

Lastly, the results of this study showed that the greater the level of emotional exhaustion, the higher the level of depression—a finding which was consistent with previous studies in the area (Ahola et al., 2005; Santa Maria et al., 2018; Toker, Shirom, Berliner, & Melamed, 2005). For example, one study using behavioural, electrophysiological, and immunological measures found that emotional exhaustion overlapped with some symptoms of depression, and also that health problems were characterised by increased incidence of infections due to dysregulation of the immune system, overexpression of proinflammatory cytokines, and cognitive deficits, particularly related to executive functions (Schermuly & Meyer, 2016). The partial mediating effect of emotional exhaustion on sleep pattern and depression indicates that three shifts workers with an evening type were more prone to symptoms of depression due to high levels of emotional exhaustion. On the contrary, morning type three shifts workers tended to have lower levels of emotional exhaustion and, consequently, lower level of depression.

According to the conservation of resource (COR) theory, when individuals think that their own resources are insufficient, they are vulnerable to the negative impact of the lack of resources, such as experiencing emotional exhaustion at work, which in turn hinders them from regaining resources (Hobfoll, 1989; Hobfoll, 2001). Individuals in this situation may find themselves in a vicious cycle. Compared with morning types, the three shifts employees with evening sleep patterns have to consume more resources to deal with the work demands of irregular sleep and emotional exhaustion, because they have shorter sleep duration and experience more fatigue. Moreover, service-oriented workers like nurses, doctors, and police officers need to employ more resources to perform intense, often emotional work every day. An undesirable sleep pattern within night shift employees in these occupations may result in greater levels of emotional exhaustion and depression. If three shift employees have enough emotional resources, they may be able to reduce the negative consequences of their evening sleep pattern and reduce their risk of depression.

4.4 | Strengths and limitations

This study has a number of strengths. First, we have focused on a large sample of three shifts staff in China giving insight into their characteristics and sleep pattern. Second, we have discussed the relationship between sleep pattern and depression of three shifts staff, and further explored the mediating mechanism of sleep pattern and depression through emotional exhaustion, which may expand the current sleep theory and depression theory. Finally, we have considered a number of individual differences in our study of sleep pattern and depression. There are however several limitations in this study: The first limitation is the cross-sectional design employed, meaning that we cannot comment on how the relationship between sleep pattern, depression, and emotional exhaustion may change over time. A longitudinal study could be applied to supplement the model in the future. Another limitation is that this study relied solely on self-report measurement. Consequently, diversified and objective measurement methods should be utilised in future research. Also, although we included a diversified sample of shift workers, an even greater sample size is worthy of consideration.

5 | CONCLUSIONS

One worrying finding from this study was that the depression rate of three shifts staff was higher than that of the non-three shift staff in China. We also found that, while most staff exhibited an intermediate type sleep pattern, 28% were morning types, with 7% exhibiting an evening type sleep pattern. Our results suggest that sleep patterns can affect depression levels directly, and that emotional exhaustion can mediate the relationship between sleep pattern and depression. The mediating effect of emotional exhaustion on sleep pattern and depression provides new insights into those factors influencing the depression of employees on three shifts.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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