Sleep quality and mental health of medical workers during the coronavirus disease 2019 pandemic

Yahua Zheng
Nursing Department, Ningbo Medical Center Lihuili Hospital, Ningbo, Zhejiang 315040, China
Lili Wang
Neurosurgery department, Ningbo Medical Center Lihuili Hospital, Ningbo, Zhejiang 315040, China
Lingfei Feng
Pediatrics department, Cixi Maternity & Child Health Care Hospital, Ningbo, Zhejiang, 315300, China
Lingxiao Ye
Cardiology department, Ningbo Medical Center Lihuili Hospital, Ningbo, Zhejiang 315040, China
Aiping Zhang
Department of chronic disease control and prevention, Zhenhai Center for Disease Control and Prevention, Ningbo, Zhejiang, 315200, China
Rui Fan (frnbdx@126.com)
Medical quality management office, Ningbo Medical Center Lihuili Hospital, Ningbo, Zhejiang 315040, China

Research Article

Keywords: sleep quality, mental health, medical workers, COVID-19

Posted Date: September 21st, 2020

DOI: https://doi.org/10.21203/rs.3.rs-80886/v1

Version of Record: A version of this preprint was published at Sleep and Biological Rhythms on January 10th, 2021. See the published version at https://doi.org/10.1007/s41105-020-00304-7.

Abstract

Purpose To assess the sleep quality, mental health status and associated factors among medical workers during the coronavirus disease 2019 (COVID-19) pandemic.

Methods A cross-sectional study was conducted and medical workers in Ningbo, China were recruited. Sleep quality was evaluated by Pittsburgh Sleep Quality Index (PSQI). Mental health status was evaluated by Symptom Checklist 90(SCL-90). Logistic regression and generalized multi-factor dimensionality reduction (GMDR) analysis were utilized to explore the risk factors and their interactions on sleep quality and mental health status.

Results 207 participants were surveyed, 34.3% were found with poor sleep quality (total PSQI score > 10), mainly manifested as sleep disturbance (92.8%). 27.05% were found with mental symptoms (Global severity index > 1.5), mainly manifested as obsessive-compulsive (25.6%). Multivariate logistic analysis showed male (OR = 3.886, 95%CI = 1.061-14.239, P = 0.040), working years >15 years (OR = 4.505, 95%CI = 1.561-12.998, P = 0.005), nurse (OR = 5.642, 95%CI = 1.347-23.632, P = 0.018), more night shifts (OR = 3.098, 95%CI = 1.308-7.336, P = 0.010), supporting Wuhan (OR = 3.413, 95%CI = 1.120-10.395, P = 0.031) were associated with poor sleep quality. GMDR analysis showed there was a two-factor interaction between working years and working shifts (P = 0.0107). No significant factors and interactions were found associated with mental symptoms.

Conclusions About one-third of medical workers suffered from sleep and mental problems during the COVID-19 pandemic in the current study. Interventions for sleep and mental problems among medical workers were needed based on related factors.

Introduction

Coronavirus disease 2019 (COVID-19), formerly known as 2019 novel coronavirus (2019-nCoV) and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has spread internationally. According to data published by the World Health Organization, a total of 25,541,380 cases were confirmed worldwide, 852,000 patients died as of September 2, 2020[1].

The COVID-19 pandemic not only caused great public concern, but also led to huge mental burden and sleep disturbances, especially for medical workers[2-8]. Previous studies have indicated adverse mental reactions to the 2003 SARS outbreak among health care workers [9,10]. Recently, Chenxi Zhang *et al.* reported that more than one-third of the medical workers suffered from insomnia symptoms during the COVID-19 pandemic[2]. The percentage of front-line medical workers with severe insomnia reached 26.67% [3]. Occupation, education level, an isolation environment and psychological worry about the COVID-19 pandemic were related to insomnia[2]. Jianbo Lai *et al.* suggested that medical workers also suffered from psychological problems, especially those in Wuhan, nurses, women and frontline medical workers[6]. Haitham Jahram *et al.*[11] found that 60% of healthcare workers had poor sleep quality combined with moderate-severe stress, professional background and female were the predictors; however,

there were no differences between frontline healthcare workers and non-frontline healthcare workers in sleep quality and stress. Thus, sleep quality and mental health status of medical workers during the COVID-19 pandemic should be concerned.

To date, studies on this topic are relatively scarce, the results reported previously are inconsistent, and the interactions among the factors associated with sleep quality and mental health are unclear. Therefore, we aimed to assess the sleep quality and mental health status, explore the related factors among medical workers during the COVID-19 pandemic.

Materials And Methods

Study participants

A cross-sectional, survey-based study was performed among medical workers from multiple hospitals in Ningbo City, Zhejiang province, China, including medical workers who supported Wuhan. Data were collected with a self-rated, anonymous questionnaire by Wenjuanxing (www.wjx.cn) which was delivered through the internet from 1st March 2020 to 15th March 2020**.** All subjects provided informed consent electronically prior to survey. Only subjects who chose yes on the informed consent page were surveyed, and subjects could quit the process at any time. This study was approved by the ethics committee of Ningbo Medical Center LiHuili Hospital (KY2020PJ066).

Questionnaire

The questionnaire consisted of three parts: basic demographic information, sleep quality assessment (the Pittsburgh Sleep Quality Index), mental health assessment (the Symptom Checklist 90).

Basic demographic information included age (≤30 years or >30 years), gender (male or female), working years (1-5 years, 6-10 years, 11-15 years, >15 years), educational level (college, undergraduate, postgraduate),occupation (doctor, nurse, technician), type of hospital(Grade I hospital or community, Grade II hospital, Grade III hospital), working shifts (as usual, more night shifts, more day shifts),working position(frontline or second-line), whether to support Wuhan (yes or no). Medical workers who were directly engaged in clinical activities of diagnosing, treating or providing nursing care to COVID-19 confirmed or suspected patients were defined as frontline workers.

Sleep quality assessment

Sleep quality was evaluated with the Pittsburgh Sleep Quality Index (PSQI)[12,13]. The PSQI includes 7 components and 18 entries in total. Each entry is scored with a 0 to 3 scale. The 7 components include subjective sleep quality (positive: 2 to 3 score, negative: 0 to 1 score), time to sleep (positive: 2 to 3 score, negative: 0 to 1 score), sleep time (positive: 2 to 3 score, negative: 0 to 1 score), sleep efficiency(positive: 2 to 3 score, negative: 0 to 1 score), sleep disturbance (positive: 1 to 3 score, negative: 0 score), hypnotic drugs(positive: 1 to 3 score, negative: 0 score), and daytime dysfunction (positive: 1 to 3 score, negative: 0 score). Of them, the positive for subjective sleep quality indicates subjective sleep quality is poor, the

positive for time to sleep indicates time to sleep is long, the positive for sleep time indicates sleep time is <6h, the positive for sleep efficiency indicates sleep efficiency is poor. The cumulative score of each component is the total PSQI score varying from 0 to 21. The higher scores people get, the worse sleep quality is. 0 to 5 scores indicate good sleep quality, 6 to 10 scores indicate average sleep quality, 11 to 15 scores indicate poor sleep quality, and 16 to 21 scores indicate very poor sleep quality. Thus, a total score >10 was identified as poor sleep quality in the current study. The PSQI has been widely used in previous studies with high reliability and validity, and the Cronbach's alpha was 0.811[14].

Mental health assessment.

Mental health was evaluated with the Symptom Checklist 90 (SCL-90)[15,16]. There are 90 items in total. 90 items made up 10 factors. Each item is scored with a 5-point Likert scale, ranging from 0 (none) to 4 (severe). Items are calculated and converted to get the total score and subscale scores. The 10 factors include somatization (positive: ≥24 score, negative: <24 score), obsessive-compulsive (positive: ≥20 score, negative: <20 score), interpersonal sensitivity (positive: ≥18 score, negative: <18 score), depression (positive: ≥26 score, negative: <26 score), anxiety(positive: ≥20 score, negative: <20 score), hostility (positive: ≥12 score, negative: <12 score), photic anxiety (positive: ≥14 score, negative: <14 score), paranoididefition (positive: ≥12 score, negative: <12 score), psychotieism (positive: ≥20 score, negative: <20 score), and other (positive: ≥14 score, negative: <14 score). If any subscale score is higher than 2, positive items are higher than 43, or the total score is higher than 160, it suggests psychological abnormality. The Global Severity Index (GSI) ranging from 1 to 5 is calculated as the mean of all 90 items, which is considered the overall index of mental symptoms. The higher scores people get, the worse mental health is. 1 to 1.5 scores indicate none mental symptom, 1.5 to 2.5 scores indicate mild mental symptom, 2.5 to 3.5 scores indicate moderate mental symptom, and 3.5 to 4.5 scores indicate moderate to severe mental symptom, 4.5 to 5 points indicate severe mental symptom. Thus, GSI >1.5 is defined with mental symptom in the current study. The SCL-90 has been widely used in previous studies with high reliability and validity, and the Cronbach's alpha was 0.983[17].

Statistical analysis

The original scores of above two measurement tools were not normally distributed and so were presented as medians with interquartile ranges (IQRs). Categorical variables were presented as percentages and analyzed using the chi-square test. To explore the associations among demographic factors and sleep quality, mental health, logistic regression was used. In addition, the generalized multi-factor dimensionality reduction (GMDR) method was used to explore potential high-order interactions [18,19]. Through GMDR method, high-dimensional data was finally transformed into one-dimensional data with two levels ("high risk", "low risk"), and the confounding factors were adjusted. In our analysis, the data was randomly divided into 10 equal parts, 9 of which were used as training samples for the construction of the interaction model, and the remaining one was used as a test sample for the test of the model. According to the analysis results, the model with P value less than 0.05 and the largest cross-validation consistency and maximum prediction accuracy was selected as the best model. A p-value of <0.05 was

considered statistically significant. Data analysis was performed using SPSS statistical software version 20.0 (IBM Corp) and GMDR v0.7 program (http://ibi.zju.edu.cn/software/GMDR/download.html).

Results

Characteristics of the Study Population

A total of 207 participants were surveyed in our study, 131(63.3%) aged> 30 years, 175(84.5%) were females, 38(18.4%) were doctors, 155 (74.9%) were nurses, and 14(6.8%) were technicians. Additionally, most of them came from Grade III hospital (167 [80.7%]), had worked for 6 to 10 years (85 [41.1%]), and had an educational level of undergraduate (166 [80.2%]). During the survey, 132(63.8%) subjects were in the front line, 101(48.8%) were supporting Wuhan, 87(42.0%) mainly worked in the day shift (Table 1).

Assessment of Sleep Quality and Associated Factors

As shown in table 2, the total PSQI score was 9 in the studied population, and 71(34.3%) subjects had poor sleep quality (total PSQI score > 10). 91(44.0%) were positive for subjective sleep quality, 125(60.4%) were positive for time to sleep, 70(33.8%) were positive for sleep time, 98(47.3%) were positive for sleep efficiency, 192(92.8%) were positive for sleep disturbance, 49(23.7%) were positive for hypnotic drugs, and 162(78.3%) were positive for daytime dysfunction. Compared with the subjects with good sleep quality, the positive rate of the above 7 indicators of the subjects with poor sleep quality increased (P <0.05).

Univariate logistic analysis showed that working years (11 to 15 years) (OR = 5.280, 95%CI=2.027-13.755, P = 0.001), working shifts (more night shifts) (OR = 2.940, 95%CI=1.369-6.311, P = 0.006), working position(frontline) (OR = 1.916, 95%CI=1.024-3.585, P = 0.042), whether to support Wuhan (yes) (OR = 2.710, 95%CI=1.494-4.915, P = 0.001) were associated with poor sleep quality. After adjusting for confounding factors, multivariate logistic analysis showed that gender (male) (OR = 3.886, 95%CI=1.061-14.239, P = 0.040), working years (>15 years) (OR = 4.505, 95%CI=1.561-12.998, P = 0.005), occupation (nurse) (OR = 5.642, 95%CI=1.347-23.632, P = 0.018),working shifts (more night shifts) (OR = 3.098, 95%CI=1.308-7.336, P = 0.010), supporting Wuhan (yes) (OR = 3.413, 95%CI=1.120-10.395, P = 0.031) were associated with poor sleep quality(Table 3).

Furthermore, GMDR interaction analysis of sleep quality was conducted among those factors which were significant by multivariate logistic regression analysis, including gender, working years, occupation, working shifts and supporting Wuhan. According to the screening principle of the best model (with a sign test P-value of < 0.05, and the highest cross-validation consistency, prediction accuracy), the two-factor interaction model of working years with working shifts was selected (Table 4).

Assessment of Mental Health and Associated Factors

As shown in table 5, the total SCL score was 106, global severity index (GSI) was 1.178 in the studied population, and 56 (27.1%) subjects had mental symptom (GSI >1.5). 26(12.6%) were positive for

somatization, 53(25.6%) were positive for obsessive-compulsive, 34(16.4%) were positive for interpersonal sensitivity, 30(14.5%) were positive for depression, 30(14.5%) were positive for anxiety, 31(15.0%) were positive for hostility, 20(9.7%) were positive for photic anxiety, 25(12.1%) were positive for paranoididefition, 25(12.1%) were positive for psychotieism, and 56(27.1%) were positive for other. Compared with the subjects without mental symptom, the positive rate of the above 10 indicators of the subjects with mental symptom increased (P <0.05). However, no significant factors were found associated with mental symptom by logistic analysis (Table 6), and no interactions were found by GMDR analysis (Data not shown).

Discussion

Our research found that 34.30%, 27.05% of medical workers suffered from sleep and mental problems, respectively. Sleep problems mainly manifested as sleep disturbance (92.8%), and mental problems mainly manifested as obsessive-compulsive (25.6%). Male, working years >15 years, nurse, more night shifts, supporting Wuhan and a two-factor interaction between working years and working shifts were all risk factors for sleep quality. Interventions for sleep and mental problems among medical workers were needed.

Previous studies indicated that the insomnia rate was 37% in Taiwan and 34.2% in Hong Kong during the SARS pandemic[20,21]. Chenxi Zhang *et al.* reported the insomnia rate was 36.1% among medical staff in their study during the COVID-19 pandemic[2]. Similarly, the present study found that the PSQI score of medical workers was 9, and the prevalence rate of poor sleep quality was 34.30%, mainly manifested as sleep disturbance (92.8%), which meant that the overall sleep quality of medical workers during the COVID -19 pandemic was poor. The reasons were as follows: on the one hand, the outbreak of the pandemic was sudden, the number of infected people was large, which made the workload of medical staff significantly increase. The overload work made the sleep quality decline. On the other hand, during the pandemic period, lots of clinical medical workers were infected, resulting in intense psychological pressure of clinical workers, easy to produce traumatic stress such as anxiety and fear, leading to neuroendocrine disorders and affecting sleep quality. Of note, Haitham Jahram *et al.*[11] found that 75% - 76% healthcare workers were poor sleepers, which is higher than ours. The difference may be related to the different populations and different definitions of poor sleep quality. In their study, poor sleep quality was defined as PSQI ≥ 5. In the current study, poor sleep quality was identified as PSQI >10. In a word, medical institutions should improve infectious disease prevention and control system, ensure adequate human resources, strengthen psychological counseling and humanistic care for medical workers, reduce their anxiety and work pressure, improve their sleep quality and mental health status.

The current study demonstrated that male, working years >15 years, nurse, more night shifts, supporting Wuhan were risk factors for poor sleep quality. Similarly, previous studies found that nurses were more susceptible to insomnia[2]. The reasons were as follows: In clinical work, doctors often work in the daytime, while nurses may have to work the whole night with frequent night shifts[22], and more night shifts may lead to insomnia, which was found in our study. Furthermore, more contact with patients with

higher-severity illness was demonstrated to result in higher IES scores[23]. Nurses often have more contact with patients than doctors, which resulted in poor sleep quality of nurses[2]. Consistent with our finding, Jianbo Lai *et al*[6] found medical workers in Wuhan showed more severe symptoms of insomnia compared with those outside Wuhan. These findings suggested more stress among medical workers in Wuhan, the epicenter of the pandemic in China, and their sleep quality might require special attention.

Of note, previous studies reported females were more susceptible to insomnia[11,24]. However, we found the sleep quality of males was worse than that of females. The reasons might be that the percentage of male supporting Wuhan (72%, 23 out of 32) was larger than females (45%, 78 out of 175) in the current study, and the medical workers supporting Wuhan were more likely to suffer from insomnia, which leaded to the sleep quality of males was worse than that of females. This study also found that people with working years > 15 years were more likely to suffer from insomnia, which might be related to the decline of physiological function. Moreover, medical workers with long working years often act as department directors or head nurses, so they need to coordinate and manage the work of the department, and consider more things, leading to the decline of sleep quality. Consistent with the study by Haitham Jahram *et al*.[11], there was no statistical correlation between front-line medical staff and insomnia after multivariate logistic analysis in the present study, but we found that front-line medical staffs were more prone to insomnia in univariate logistic analysis, suggesting that more attention should also be paid to the sleep problems of front-line medical staff [2].

As sleep and mental problems are complex multifactorial problems, the effect of a single factor may be weak, so we should focus on the interactions of multiple factors. However, due to the influence of "dimension disaster", traditional statistical models are not suitable for exploring potential high-order interactions. Generalized multivariate dimension reduction (GMDR), as a non-parametric testing method, can overcome the influence of dimension and correct the confounding factors, which significantly improves the accuracy of prediction. With this method, a three-factor interaction among red meat intake, pickled vegetable and cured meat intake was reported to increase the risk of colorectal cancer[25]. In this study, we found that there was a two-factor interaction of sleep quality among working years and working shifts, which means more attention should be paid on the subjects with more night shifts and working years longer than 15 years. However, it is different between statistical interaction and biological interaction[18], whether these statistical interactions obtained in the current study have biological effects, and the specific mechanisms are still unclear, which should be explored in future research.

Owing to the sudden outbreak of the pandemic, strong infectivity, and the occurrence of multiple clinical medical staff infection, medical workers are susceptible to psychological burden. A cross-sectional study reported the prevalence of psychological abnormality was 14.5% in medical workers during the COVID-19[17].Similarly, our study also showed the mental abnormality of medical workers, and the prevalence of mental abnormality was 27.05%, mainly manifested as obsessive-compulsive symptom, indicating that the mental status of medical staff during the COVID-19 pandemic was poor. However, no significant factors were found associated with mental symptom by logistic analysis and no interactions were found by GMDR analysis, which should be explored in future research.

Our study assessed the sleep quality, mental health status among medical workers during the COVID-19 pandemic, and explored associated factors and their interactions, which could help provide precise interventions of sleep and mental problems for medical workers. However, there were several limitations. First, the causal association between demographic data and sleep quality or mental health status was not certain because of the cross-sectional design. Second, owing to the severe pandemic situation, no large-scale was carried out, only the subjects in Ningbo were investigated, the sample size was limited. Third, due to the time limitation of the pandemic, we conducted a rapid survey based on the Wenjuanxing program, no long-term survey was carried out, which might have an impact on the data. Therefore, a prospective study with a large sample size is expected to be conducted and more objective data on sleep quality and mental health status should be collected.

Conclusion

The findings indicated that about one-third of the medical workers suffered from sleep and mental problems during the COVID-19 pandemic. Sleep-related factors included gender, working years, occupation, working shifts, whether to support Wuhan and a two-factor interaction between working years and working shifts. Interventions for sleep and mental problems among medical workers are needed.

Declarations

Acknowledgments: We want to thank all medical workers, especially the frontline medical workers, for their cooperation and support.

Compliance with ethical standards

Conflicts of Interest The authors declare no competing interests.

Ethical approval The study design was approved by the ethics committee of Ningbo Medical Center LiHuili Hospital.

Informed consent Informed consent was obtained from all individual participants included in the study.

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Tables

Table1.Characteristics of the study population (n=207).

Variables	Number(n=207)	Percentage (%)
Age(years)		
≤30	76	36.7
30	131	63.3
Gender		
Male	32	15.5
Female	175	84.5
Working years (years)		
1-5	43	20.8
6-10	85	41.1
11-15	39	18.8
15	40	19.3
Educational level		
College	29	14.0
Undergraduate	166	80.2
Postgraduate	12	5.8
Occupation		
Doctor	38	18.4
Nurse	155	74.9
Technician	14	6.8
Type of hospital		
Grade I hospital or community	8	3.9
Grade II hospital	32	15.5
Grade III hospital	167	80.7
Working shifts		
As usual	60	29.0
More night shifts	60	29.0
More day shifts	87	42.0
Working position		
Frontline	132	63.8
Second-line	75	36.2
Supporting Wuhan		
Yes	101	48.8
No	106	51.2
Total PSQI score, M(IQR)	-	9(7)
Sleep quality		
Poor(total PSQI score >10)	71	34.3
Good(total PSQI score ≤10)	136	65.7
Total SCL90 score, M(IQR)	-	106(47)
GSI, M(IQR)	-	1.178(0.522)
Mental symptom		
Positive(GSI >1.5)	56	27.1
Negative(GSI ≤1.5)	151	72.9

PSQI: Pittsburgh sleep quality Index; GSI:global severity index;IQR:interquartile range.

Table 2.Assessment of sleep quality usingthe PSQI.

Variables	Total (207), n (%)	Sleep quality, n (%)		χ^2	*P*
		Poor (71)	Good (136)		
Subjective sleep quality				82.482	<0.001
Positive	91(44.0)	62(87.3)	107(78.7)		
Negative	116(56.0)	9(12.7)	29(21.3)		
Time to sleep				65.940	<0.001
Positive	125(60.4)	70(98.6)	55(40.4)		
Negative	82(39.6)	1 (1.4)	81(59.6)		
Sleep time				50.627	<0.001
Positive	70(33.8)	47(66.2)	113(83.1)		
Negative	137(66.2)	24(33.8)	23(16.9)		
Sleep efficiency				43.096	<0.001
Positive	98(47.3)	56(78.9)	94(69.1)		
Negative	109(52.7)	15(21.1)	42(30.9)		
Sleep disturbance				8.443	0.004
Positive	192(92.8)	71(100)	121(89)		
Negative	15(7.2)	0(0)	15(11)		
Hypnotic drugs				53.291	<0.001
Positive	49(23.7)	38(53.5)	11(8.1)		
Negative	158(76.3)	33 (46.5)	125(91.9)		
Daytime dysfunction				26.255	<0.001
Positive	162(78.3)	70(98.6)	92(67.6)		
Negative	45(21.7)	1(1.4)	44(32.4)		

Table 3. Logistic regression analysisof risk factors associated with sleep quality.

Variables	No. of cases/No. of total cases (%)	Model 1		Model 2	
		OR(95%CI)	*P*	OR(95%CI)	*P*
Age(years)					
≤30	21/76(27.6)	1 (Reference)	NA	1 (Reference)	NA
30	50/131(38.2)	1.617(0.875-2.987)	0.125	1.674(0.592-4.733)	0.331
Gender					
Male	12/32(37.5)	1.180(0.540-2.577)	0.679	3.886(1.061-14.239)	0.040
Female	59/175(33.7)	1 (Reference)	NA	1 (Reference)	NA
Working years (years)					
1-5	10/43(23.3)	1 (Reference)	NA	1 (Reference)	NA
6-10	27/85(31.8)	1536(0.662-3.566)	0.318	0.991(0.221-4.443)	0.990
11-15	24/39(61.5)	5.280(2.027-13.755)	0.001	1.316(0.481-3.599)	0.593
15	10/40(25.0)	1.100(0.402-3.009)	0.853	4.505(1.561-12.998)	0.005
Educational level					
College	11/29(37.9)	1 (Reference)	NA	1 (Reference)	NA
Undergraduate	54/166(32.5)	0.789(0.348-1.787)	0.570	0.478(0.180-1.269)	0.138
Postgraduate	6/12(50.0)	1.636(0.421-6.360)	0.477	2.521(0.365-17.429)	0.349
Occupation					
Doctor	11/38(28.9)	1 (Reference)	NA	1 (Reference)	NA
Nurse	59/155(38.1)	1.509(0.697-3.266)	0.297	5.642(1.347-23.632)	0.018
Technician	1/14(7.1)	0.189(0.022-1.623)	0.129	0.493(0.043-5.621)	0.569
Type of hospital					
Grade I hospital or community	2/8(25.0)	1 (Reference)	NA	1 (Reference)	NA
Grade II hospital	11/32(34.4)	0.626(0.123-3.203)	0.574	2.129(0.291-15.563)	0.457
Grade III hospital	58/167(34.7)	0.984(0444-2.182)	0.969	1.337(0.217-8.218)	0.754
Working shifts					
As usual	16/60(26.7)	1 (Reference)	NA	1 (Reference)	NA
More night shifts	31/60(51.7)	2.940(1.369-6.311)	0.006	3.098(1.308-7.336)	0.010
More day shifts	24/87(27.6)	1.048(0.500-2.197)	0.902	1.338(0.580-3.088)	0.495
Working position					
Frontline	52/132(39.4)	1.916(1.024-3.585)	0.042	0.341(0.101-1.147)	0.082
Second-line	19/75(25.3)	1 (Reference)	NA	1 (Reference)	NA
Supporting Wuhan					
Yes	46/101(45.5)	2.710(1.494-4.915)	0.001	3.413(1.120-10.395)	0.031
No	25/106(23.6)	1 (Reference)	NA	1 (Reference)	NA

Model 1: Univariate logistic analysis; Model 2: multivariate logistic analysis.

Table4. GMDR models of sleep quality

Model	Prediction accuracy	Sign Test(*P*)	Cross-validation Consistency
Working shifts	0.5479	5 (0.6230)	7/10
Working years, working shifts	0.6462	9 (0.0107)	10/10
Working years, occupation, working shifts,	0.5504	7 (0.1719)	8/10
Working years, occupation, working shifts,supporting Wuhan	0.5570	7 (0.1719)	7/10
Gender, working years, occupation, working shifts, supporting Wuhan	0.6137	8 (0.0547)	10/10

P wasadjusted for age, educational level, type of hospital, working position using logistic regression in GMDR analysis.

Table 5. Assessment of mental health status using the SCL-90

Variables	Total (207), n (%)	Mental symptom, n (%)		χ^2	*P*
		Positive (56)	Negative (151)		
Somatization				64.160	<0.001
Positive	26(12.6)	24(42.9)	2(1.3)		
Negative	181(87.4)	32(57.1)	149(98.7)		
Obsessive-compulsive				154.402	<0.001
Positive	53(25.6)	49(87.5)	4(2.6)		
Negative	154(74.4)	7(12.5)	147(97.4)		
Interpersonal sensitivity				84.764	<0.001
Positive	34(16.4)	31(55.4)	3(2.0)		
Negative	173(83.6)	25(44.6)	148(98)		
Depression				94.604	<0.001
Positive	30(14.5)	30(53.6)	0(0)		
Negative	177(85.5)	26(46.4)	151(100)		
Anxiety				94.604	<0.001
Positive	30(14.5)	30(53.6)	0(0)		
Negative	177(85.5)	26(46.4)	151(100)		
Hostility				89.810	<0.001
Positive	31(15.0)	30(53.6)	1(0.7)		
Negative	176(85.0)	26(46.4)	150(99.3)		
Photic anxiety				59.696	<0.001
Positive	20(9.7)	20(35.7)	0(0)		
Negative	187(90.3)	36(64.3)	151(100)		
Paranoididefition				76.670	<0.001
Positive	25(12.1)	25(44.6)	0(0)		
Negative	182(87.9)	31(55.4)	151(100)		
Psychotieism				76.670	<0.001
Positive	25(12.1)	25(44.6)	0(0)		
Negative	182(87.9)	31(55.4)	151(100)		
Other				67.768	<0.001
Positive	56(27.1)	38(67.9)	18(11.9)		
Negative	151(72.9)	18(32.1)	133(88.1)		

Table 6. Logistic regression analysis of risk factors associated with mental health

Variables	No. of cases/No. of total cases (%)	Model 1		Model 2	
		OR(95%CI)	*P*	OR(95%CI)	*P*
Age(years)					
≤30	21/76(27.6)	1 (Reference)	NA	1 (Reference)	NA
30	35/131(26.7)	0.955(0.506-1.801)	0.887	1.875(0.655-5.365)	0.241
Gender					
Male	10/32(31.3)	1.275(0.562-2.894)	0.562	3.221(0.961-10.791)	0.058
Female	46/175(26.3)	1 (Reference)	NA	1 (Reference)	NA
Working years (years)					
1-5	13/43(30.2)	1 (Reference)	NA	1 (Reference)	NA
6-10	25/85(29.4)	0.962(0.432-2.142)	0.924	2.622(0.616-11.168)	0.192
11-15	9/39(23.1)	0.692(0.257-1.862)	0.466	1.824(0.674-4.937)	0.237
15	9/40(22.5)	0.670(0.250-1.798)	0426	1.430(0.463-4.418)	0.534
Educational level					
College	11/29(37.9)	1 (Reference)	NA	1 (Reference)	NA
Undergraduate	43/166(25.9)	0.572(0.250-1.307)	0.185	0.713(0.284-1.791)	0.472
Postgraduate	2/12(16.7)	0.327(0.060-1.780)	0.196	0.448(0.064-3.156)	0.420
Occupation					
Doctor	9/38(23.7)	1 (Reference)	NA	1 (Reference)	NA
Nurse	43/155(27.7)	1.237(0.541-2.827)	0.614	2.184(0.624-7.648)	0.222
Technician	4/14(28.6)	1.289(0.324-5.122)	0.718	0.756(0.135-4.234)	0.750
Type of hospital					
Grade I hospital or community	2/8(25.0)	1 (Reference)	NA	1 (Reference)	NA
Grade II hospital	13/32(40.6)	1.024(0.199-5.274)	0.977	3.706(0.537-25.574)	0.184
Grade III hospital	41/167(24.6)	2.103(0.956-4.627)	0.065	1.386(0.237-8.097)	0.717
Working shifts					
As usual	13/60(21.7)	1 (Reference)	NA	1 (Reference)	NA
More night shifts	18/60(30.0)	1.54(0.678-3.539)	0.299	2.045(0.829-5.043)	0.120
More day shifts	25/87(28.7)	1.458(0.675-3.148)	0.337	1.683(0.720-3.937)	0.230
Working position					
Frontline	32/132(24.2)	0.680(0.363-1.274)	0.228	0.874(0.318-2.404)	0.794
Second-line	24/75(32.0)	1 (Reference)	NA	1 (Reference)	NA
Supporting Wuhan					
Yes	22/101(21.8)	0.590(0.316-1.101)	0.097	0.532(0.202-1.400)	0.201
No	34/106(32.1)	1 (Reference)	NA	1 (Reference)	NA

Model 1: Univariate logistic analysis; Model 2: multivariate logistic analysis.