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Symptom Cluster of ICU Nurses Treating COVID-19 Pneumonia Patients in Wuhan, China

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Abstract

Background. In treating highly infectious coronavirus disease-19 (COVID-19) pneumonia, intensive care unit (ICU) nurses face a high risk of developing somatic symptom disorder (SSD).The symptom clusters in one population may show overlaps and involvements, a phenomenon that should be deliberately resolved to improve the management efficiency.

Objectives. The present study aims to investigate the symptoms and causes of SSD of ICU nurses treating COVID-19 pneumonia. The research results are expected to provide evidence for the establishment of a better management strategy.

Methods. This study enrolled a total of 140 ICU nurses who were selected by Jiangsu Province Hospital to work in Wuhan (the epicenter of the COVID-19 epidemic in China) on February 3, 2020. A questionnaire, Somatic symptom disorders for ICU nurses in Wuhan No. 1 Hospital, was designed based on the International Classification of Functioning, Disability and Health. Exploratory factor analysis was performed to cluster the symptoms and logistic regression analysis to find the risk factors of the symptoms.

Results. Five major symptoms were chest discomfort and palpitation (31.4%), dyspnea (30.7%), nausea (21.4%), headache (19.3%), and dizziness (17.9%). In exploratory factor analysis, the symptoms were classified into three clusters: Cluster A of breathing and sleep disturbances (dizziness, sleepiness, and dyspnea); Cluster B of gastrointestinal complaints and pain (nausea and headache), and Cluster C of general symptoms (xerostomia, fatigue, as well as chest discomfort and palpitation). In Cluster A, urine/feces splash, sex, and sputum splash were independent predictive factors. In Cluster B, fall of protective glasses and urine/feces splash were independent predictive factors. In Cluster C, urine/feces splash and urine/feces clearance were independent predictive factors.

Conclusion. The ICU nurses in Wuhan showed varying and overlapping SSDs. These SSDs could be classified into three symptom clusters. Based on the characteristics of their SSDs, specific interventions could be implemented to safeguard the health of ICU nurses. J Pain Symptom Manage 2020;60:e48–e53. © *2020 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.*

Key Words

COVID-19, intensive care units, symptom cluster, symptoms, occupational exposure

Introduction

Coronavirus disease-19 (COVID-19) pneumonia has been listed as Category B infectious disease and is being treated in a category similar to that of Category A by the National Health Commission of China. A large proportion of COVID-19 patients will progress to a critical condition, which needs intensive care. However, given the challenges in treating this disease, intensive care unit (ICU) nurses are highly prone to somatic symptom disorder (SSD), which is associated with the interaction of biology, cognition, emotion, behavior,

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and environment.[1] The ICU nurses must manage a heavy workload requiring frequent invasive procedures and high attention levels. Therefore, safeguarding the physical and psychological health of ICU nurses can provide a major contribution to the success of epidemic control.[2,3] A symptom cluster is a stable group of two or more coexisting symptoms. The symptom clusters in one population may show overlaps and interactions, a phenomenon that should be resolved to improve the efficiency of managing the disorder.[4,5] Currently, no study has investigated SSDs in ICU nurses fighting at the frontline against the COVID-19 epidemic. Previous studies have confirmed that an individual's response to SSD is dependent on physical, emotional, and social factors.[6] This study aims to analyze SSDs and associated risk factors in 140 ICU nurses who were sent by Jiangsu Province Hospital to No. 1 Hospital of Wuhan, the epicenter of COVID-19 epidemic.

Methods

Sample

A total of 140 nurses at COVID-19 pneumonia ICUs were selected through convenience sampling. Inclusion criteria included the following: employed as a full-time nurse at Jiangsu Province Hospital; aged 20–50 years; has worked at an ICU for serious/critical COVID-19 pneumonia patients in Wuhan; and presented informed consent. Exclusion criteria included the following: no experience in an ICU in Wuhan and lactation.

Table 1
ICF Categories and Symptoms

Symptom	ICF Categories
Sleepiness	b134—Sleep functions
Dry eyes	b220—Sensations associated with seeing and adjacent structure function
Dizziness	b240—Sensation associated with hearing and vestibular functions
Stomachache	b280—Sensation of pain
Headache	
Waist pain	
Neck pain	
Dyspnea	b440—Respiration functions
Cough	b450—Additional respiratory functions
Fatigue	b455—Exercise tolerance functions
Chest discomfort and palpitation	b460—Sensations associated with cardiovascular and respiratory functions
Emesis	b510—Ingestion functions
Diarrhea	b525—Defecation functions
Nausea	b535—Sensations associated with the digestive system
Xerostomia	b545—Water, mineral, and electrolyte balance functions
Sweating	

ICF = International Classification of Functioning, Disability and Health.

The Symptom Scale

A questionnaire, *Somatic symptom disorders for ICU nurses in Wuhan No. 1 Hospital*, was designed based on International Classification of Functioning, Disability and Health (ICF).[7] The questions were set out during an expert meeting attended by team leaders, rehabilitation therapists, psychologists, and ICU nurses. Twelve second-level ICF categories were selected from the component of body function in ICF (Table 1). At this step, standardized ICF-linking rules were used.[8,9] Finally, a list of ICF categories was compiled that was intended to cover 16 symptoms that ICU nurses could reasonably have experienced when treating COVID-19 pneumonia patients in Wuhan, China (Table 1). The frequency and severity of each symptom were scaled (0, no; 1, mild; 2, moderate; and 3, severe).

Another questionnaire was designed to evaluate the possible risk factors. Included in this questionnaire were three data sets: demographic data (sex, age, educational background, marriage, etc.), career data (working years, working years in a particular department, previous in-hospital rotation, title, position, technical level, etc.), and data about ICU work in Wuhan (frequency and time in ICU, extra work, exposure to contaminants and treatment, invasive procedures, etc.).

Procedures

The questionnaires were handed out through WeChat, an online application (https://weixin.qq.com/). Participants who met the study criteria logged onto a Web site (http://www.wjx.cn) to complete the survey. The investigators informed the nurses of the details of the research. All the questionnaires were completed and returned (an efficiency of 100%) five to seven days after the first group of ICU nurses started work in Wuhan. The study was approved by the ethics committee of Jiangsu Province Hospital (2020-SR-101).

Data Analysis

The data were analyzed with SPSS, Version 25.0 (https://www.ibm.com/analytics/spss-statistics-software). Descriptive analysis was performed for the data on general characteristics and SSDs. Enumeration data were presented as frequencies and percentages, measurement data in normal distributions as mean ± SD, and measurement data in skewed distributions as medians and interquartile ranges. Exploratory factor analysis was performed to assess the presence of correlations between particular types of symptoms, which might reflect symptom complexes. To express the symptoms accurately, this study included the variables ranking in the top 10 in both frequency and severity. Factor loading was calculated through principal component analysis and rotation through varimax. The factors were selected according to

the following criteria: eigenvalue >1 (Kaiser criterion); suitable for Cattell's 16 Personality Factors Test; containing at least two within-factor variance; having psychological implications; and loadings of 0.5 or higher. Logistic regression analysis was used to explain the interrelationships of symptom clusters and variables in three data sets (demographic data, career data, and data about ICU work); $\alpha = 0.05$.

Results

Sample Characteristics

During one week (February 15−22, 2020) after the nurses started the work in ICUs in Wuhan No. 1 Hospital, 63 person-times of COVID-19 pneumonia cases were admitted, including 35 serious/critical cases (55.56%) and three deaths (4.76%). A total of 140 nurses were surveyed, including 118 females (84.3%) and 63 married nurses (45%). The mean age was 29.35 ± 4.92 years (range 22−43). The nurses had worked for a mean of 7.03 ± 5.44 years (range 1−23) and a mean of 3.66 ± 3.70 years (range 1−18) in a particular department (such as ICU, emergency department, respiratory department, and infectious disease department). Other general data are shown in Table 2.

Scores of SSD Symptoms

Each nurse showed a median of 1.5 (mean 2.04 ± 2.11) SSD symptoms and a median of 2 (3.88 ± 6.13) symptom onsets. The 10 most frequent symptoms were chest discomfort and palpitation (31.4%), dyspnea (30.7%), nausea (21.4%), headache (19.3%), dizziness (17.9%), xerostomia (15.7%), fatigue (15.0%), sleepiness (9.3%), sweating (8.6%), and waist pain (7.1%). The 10 most severe symptoms were dyspnea (0.74 ± 1.17), chest discomfort and palpitation (0.62 ± 1.02), headache (0.40 ± 0.90), fatigue (0.30 ± 0.77), xerostomia (0.30 ± 0.75), dizziness (0.29 ± 0.71), nausea (0.29 ± 0.61), sleepiness (0.19 ± 0.66), dry eyes (0.14 ± 0.56), and diarrhea (0.13 ± 0.61).

Table 2
General Data of the Nurses

Information	*n* (%)
Educational background	
Junior college degree	30 (21.4)
Bachelor's degree	109 (77.9)
Master's degree	1 (0.7)
Title	
Nurse	23 (16.4)
Senior nurse	81 (57.9)
Supervisor nurse	32 (22.9)
Co-chief superintendent nurse	4 (2.9)
Position	
Nurse	136 (97.1)
Head nurse	4 (2.9)
Technical level	
N0−N1	74 (52.9)
N2	36 (25.7)
N3	28 (20)
N4	2 (1.4)
In-hospital rotation (x ± standard deviation)	2.14 ± 1.38

Symptom Clusters

Exploratory factor analysis was performed based on eight SSDs, the frequency and severity of which both ranked in the top 10, including nausea, chest discomfort and palpitation, dyspnea, sleepiness, dizziness, fatigue, xerostomia, and headache. Kaiser-Meyer-Olkin value of 0.694 and $P < 0.001$ (Bartlett's Sphericity Test) indicated that these factors were suitable for factor analysis. The results showed three common factors (eigenvalue >1) explaining 55.75% of common variance. After rotation with varimax, the factor loadings were calculated, as shown by the matrix in Table 3. Finally, three symptom clusters were defined: Cluster A of breathing and sleep disturbances (dizziness, sleepiness, and dyspnea); Cluster B of gastrointestinal complaints and pain (nausea and headache); and Cluster C of general symptoms (xerostomia, fatigue, as well as chest discomfort and palpitation). The score of each cluster was the total of each symptom score (Table 3).

Risk Factors of Symptom Clusters

Table 4 shows the 15 types of nursing operations and 11 types of exposure. A total of 599 person-times of invasive operations (4.28 ± 7.49 times per person) and 46 person-times of body fluid/blood exposure (0.33 ± 0.58 times per person) were reported. On average, one nurse accomplished 2.57 ± 0.95 shifts of ICU work. A total of 16 nurses (11.4%) had taken on extra work.

Taking the occurrence of symptom clusters as a dependent variable and the factors in the three data sets as independent variables, the univariate Cox regression analysis showed that sex, sputum splash, urine/

Table 3
Symptom Clusters of ICU Nurses

Symptom	No. 1	No. 2	No. 3	Cluster Score (x ± Standard Deviation)
Dizziness	0.71	–	–	1.22 ± 1.88
Sleepiness	0.68	–	–	
Dyspnea	0.621	–	–	
Nausea	–	0.819	–	0.69 ± 1.17
Headache	–	0.596	–	
Xerostomia	–	–	0.815	1.22 ± 1.89
Fatigue	–	–	0.637	
Chest discomfort and palpitation	–	–	0.51	
Explained variance (%)	21.75	17.1	16.91	–

Table 4
Nursing Operations and Types of Exposure

Operation	Person-Times	Proportion	Exposure	Person-Times	Proportion
Endotracheal intubation	6	1.00	Fall of protective glasses	12	26.09
Deep vein catheterization	3	0.50	Fall of mask	4	8.70
Venous indwelling needle	26	4.34	Fall of shield	1	2.17
Artery indwelling needle	0	0.00	Glove fall	8	17.39
Open suction	21	3.51	Glove broken	8	17.39
Close suction	137	22.87	Protective garment broken	0	0.00
Clearing oral and nasal secretions	84	14.02	Protective garment contaminated	3	6.52
Replacing the instruments fixing the endotracheal tube	3	0.50	Blood splash	1	2.17
Sputum sample collection	16	2.67	Sputum splash	3	6.52
Blood sample collection	35	5.84	Urine/feces splash	1	2.17
Venous transfusion	91	15.19	Others	5	10.87
Venous injection	35	5.84			
Urine/feces clearance	116	19.37			
Corpse treatment	5	0.83			
Others	19	3.17			

feces splash, and urine/feces clearance were risk factors for the occurrence of symptom clusters ($P < 0.05$). Using these risk factors as independent variables and the occurrence of symptom clusters as a dependent variable, the multiple linear regression analysis showed that urine/feces splash, female, and sputum splash were independent predictive factors for Cluster A; fall of protective glasses and urine/feces splash were independent predictive factors of Cluster B; and urine/feces splash and urine/feces clearance were independent predictive factors for Cluster C (Table 5).

Discussion

On January 30, 2020, the World Health Organization declared COVID-19 as a public health emergency of international concern. The infection, with a route of human-to-human transmission, caused clusters of severe respiratory illness that was associated with ICU admission and high mortality.[10] China has quickly pooled medical personnel into Wuhan, the origin of the epidemic in China. A major workforce are ICU nurses, who are exposed to a broad range of mental and physical health disorders. Particular efforts to mitigate these challenges must be directed to the ICU nurses under the greatest workload.[10] By investigating the symptom clusters experienced by nurses and associated risk factors, a better management model may be developed to relieve the SSDs in ICU nurses.[11]

We found that the ICU nurses reported symptoms, which could be grouped into three symptom clusters and that the median number of symptoms in each nurse was 1.5. A night shift could be expected to lead to sleepiness and fatigue.[12] Previous studies have studied symptom clusters in patients with cancer or chronic disease.[11,13] The present study is the first to investigate symptom clusters in ICU nurses in an epidemic.

Our study showed that dizziness, sleepiness, and dyspnea co-occurred in Cluster A; headache and nausea in Cluster B; xerostomia, fatigue, as well as chest discomfort and palpitation in Cluster C. We confirmed that the occurrence of symptom clusters was caused by the environmental and personal stress disorders. For infection control, personal protective equipment (PPE), such as a fluid-resistant gown, gloves, eye protection, full face shield, and fit-tested N95 respirators, should be worn.[14] However, accidental events when using this equipment, such as

Table 5
Logistic Regression Analysis on the Risk Factors of Three Symptom Clusters

Cluster	Variables	Regression Coefficient	SE	Standardized Regression Coefficient	t	*P*
Cluster A	(Constant)	1.924	0.755		2.55	0.012
	Urine/feces splash	1.252	0.195	0.457	6.417	0.000
	Sex	−0.82	0.397	−0.133	−2.063	0.041
	Sputum splash	1.46	0.237	0.4	6.16	0.000
	$r = 0.669$, $F = 27.306$, $P = 0.000$					
Cluster B	(Constant)	0.41	0.092		4.475	0.000
	Fall of protective glasses	0.55	0.266	0.153	2.066	0.041
	Urine/feces splash	0.69	0.106	0.48	6.483	0.000
	$r = 0.789$, $F = 27.547$, $P = 0.000$					
Cluster C	Urine/feces splash	1.982	0.17	0.693	11.651	0.000
	Urine/feces clearance	0.32	0.105	0.186	3.06	0.003
	$r = 0.789$, $F = 31.097$, $P = 0.000$					

fall of protective glasses, may harm both the physical and mental health of nurses. In this study, we showed an association between PPE failure and Symptom Cluster B. It was previously reported that sleepiness coexisted with other symptoms in a single cluster.[15] Interventions, including physical exercise or cognitive behavioral therapy, could relieve the symptoms in the sleepiness-related cluster.[16–18]

In Wuhan, most ICU patients required high-flow nasal cannula or high-level oxygen support to correct hypoxemia.[2] Nursing of critical patients included condition monitoring, sequential oxygen care, sequential treatment nursing, infection prevention, nutrition support, and psychological nursing.[19] In our study, 55.56% of patients were in critical condition. Our results showed that supervisor nurses had more exposures to infectious material and a heavier workload (4.28 ± 7.49 invasive operations and 0.33 ± 0.58 exposures per person).

We identified urine/feces splash as an independent risk factor associated with the occurrence of all symptom clusters, which can be explained by three reasons. First, patients' excreta may create aerosols that can allow airborne transmission to those closely involved in the procedure.[13] Second, the fecal-oral route of transmission is possible.[20] Third, the proportion of patients needing urine/feces clearance (116; 19.37%) was high, second only to that of closed sputum aspiration (137; 22.87%). Our finding suggested that it is important to develop standard procedures to prevent ICU nurses from urine/feces splash.

We found that female was a significant factor associated with occurrence of the symptom cluster of breathing and sleep disturbances. Several previous studies showed that female nurses have a higher risk of daytime sleepiness than male nurses.[21,22] To mitigate this risk, care should be given to female ICU nurses if they suffer from daytime sleepiness.

Finally, our results showed that fall of protective glasses was an independent risk factor for the occurrence of the pain symptom cluster. Blocking transmission is a leading strategy against COVID-19.[23] This finding shows the importance of PPE. A nurse may develop adverse reactions caused by heavy PPE, including nausea and vomiting.[24] We suggest identifying infection control nurses as observers to monitor staff compliance with infection control guidance, give clarification and advice where appropriate, and record significant issues relating to infection control procedures.[25]

Limitations

Our study has several limitations. First, only 140 nurses were included; the findings should be validated with studies covering more professionals. Second, other centers should be included to get a more comprehensive understanding.

Conclusions

The ICU nurses in Wuhan showed varying and overlapping SSDs. These SSDs could be classified into three symptom clusters. Based on the characteristics of their SSDs, specific interventions could be implemented to guarantee the health of ICU nurses. Future research should still focus on the change of SSDs through a long-term outbreak.

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