

# Mental State of Central Sterile Supply Department Staff During COVID-19 Epidemic and CART Analysis

Wei Pan (✉ [491914619@qq.com](mailto:491914619@qq.com))

Sichuan University West China Second University Hospital

Juan Hu

Sichuan University West China Second University Hospital

Liangying Yi

Sichuan University West China Second University Hospital

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## Research article

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# Abstract

**Background:** During COVID-19 epidemic, the [central sterile supply department](#) (CSSD) staff need to handle a large number of devices, utensils and non-disposable protective articles used by suspected or confirmed COVID-19 patients. This may bring psychological stress to the CSSD staff. However, the mental state of the CSSD staff during COVID-19 epidemic has been rarely studied. We aim to investigate the mental state of the CSSD staff and the relevant influencing factors during COVID-19 epidemic.

**Methods:** Conduct the questionnaire survey with the general information questionnaire, Chinese perceived stress scale (CPSS), self-rating anxiety scale (SAS), and Connor-Davidson resilience scale (CD-RISC) among 423 CSSD staff from 35 hospitals in Sichuan Province, China. Analyse the data in SPSS 24.0, use classification and regression tree (CART) to analyse variables, and find variation between groups. Perform chi-square test on enumeration data, and perform t-test and analysis of variance on measurement data.

**Results:** The CSSD staff's SAS score was  $37.39 \pm 8.458$ , their CPSS score was  $19.21 \pm 7.265$ , and their CD-RISC score was  $64.26 \pm 15.129$  (Tenacity factor score:  $31.70 \pm 8.066$ , Strength factor score:  $21.60 \pm 5.066$ , Optimism factor scores:  $10.96 \pm 3.189$ ). The CPSS score was positively correlated with the SAS score ( $r = 0.66$ ;  $P < 0.01$ ), the CPSS score was negatively correlated with the CD-RISC score ( $r = -0.617$ ,  $P < 0.01$ ), and the SAS score was negatively correlated with the CD-RISC score ( $r = -0.477$ ,  $P < 0.01$ ). The job, age and political status of the CSSD staff were the main factors affecting their mental state. The CPSS score and SAS score of the CSSD nurses were significantly different from those of the CSSD logistic staff ( $P < 0.01$ ).

**Conclusion:** During the epidemic, the CSSD staff's psychological resilience was at a low level, and the anxiety level of the CSSD nurses was higher than that of the CSSD logistic staff. Therefore, more attention shall be paid to the mental health of the CSSD staff, and it is necessary to take the protective measures regarding the risk factors at work to ensure they can maintain a good mental state during the epidemic.

## Background

In December 2019, several patients with novel coronavirus infection dominated by pulmonary lesions were observed in Wuhan, Hubei, China. In the document (NHC ML [2020] No. 42) issued by the National Health Commission of China on 7 February 2020, 'Novel coronavirus infected pneumonia' was temporarily named as 'Novel coronavirus pneumonia' [1]. On 11 February 2020, the World Health Organization named the disease caused from 2019-nCoV as Coronavirus Disease 2019 (simplified as 'COVID-19') [2]. Before 00:00, 11 March 2020, the authorities of 31 provinces (autonomous regions and central municipalities) and Xinjiang Production and Construction Corps in China reported a total of 16,145 confirmed cases of COVID-19 (including 4,492 severe cases), 61,475 people discharged from the hospital after recovery, 3,158 deaths and 14,607 close contacts still under medical observation [3].

For COVID-19 infection, the hospital acquired infection is a factor that cannot be ignored [4]. The [central sterile supply department](#) (CSSD) which is the key department for controlling the hospital acquired infection assumes the important responsibility during the epidemic. Due to the special workplace and nature of the CSSD, the CSSD staff is prone to occupational injury, which may lead to the increased psychological

burden [5], particularly during the epidemic. CSSD staff need to handle a large number of devices, utensils and some non-disposable protective articles used by suspected or confirmed COVID-19 patients, so the close concern is required for the mental health of the CSSD staff. This study is intended for investigating the mental state of the CSSD staff and the relevant influencing factors during the COVID-19 epidemic.

## Methods

### Participants

The nurses and logistic staff in the CSSDs of Secondary A or above hospitals in Sichuan Province, China who had more than 1 year first-line work experience in sterile supply and had not been absent from duty for 3 months or above were invited to participate in the study in February 2020. The interns were excluded from participating in this study. All the participants were informed of the purpose and significance of this study, and they voluntarily participated in this study. Data was gathered with convenience sampling.

### Survey tools

The questionnaire survey was conducted with the general information questionnaire, Chinese perceived stress scale (CPSS), self-rating anxiety scale (SAS), and Connor-Davidson resilience scale (CD-RISC) among 423 CSSD staff from 35 Secondary A or above hospitals in Sichuan Province, China.

The general information questionnaire was used to gather information about job, gender, age, education background, hospital grade and political status from the respondents.

The Chinese perceived stress scale (CPSS) was translated and modified by Yang T and Huang H [6] in 2003. The CPSS was used for evaluating the participant's subjective stress perception level. The CPSS consisted of 14 items and analysed two factors, namely the sense of tension and the sense of uncontrollability. The 5-point Likert scale was used, with score range from 1-5 assigned for the five response options ranging from 'Never', 'Seldom', 'Sometime', 'Frequently' to 'Always'. The CPSS score was 14-70. Reverse scores were used with Item 4, 5, 6, 7, 9, 10 and 13, and these seven items indicated the level of the participant's sense of uncontrollability. The sum of the scores of the remaining items was the score of the sense of tension. The sum of score of the sense of uncontrollability and score of the sense of tension was the CPSS score. When the CPSS score is higher than 25, it could be judged that the participant was under the health risk stress. The higher the CPSS score, the higher the perceived stress. The Cronbach's alpha for CPSS was 0.797.

The self-rating anxiety scale (SAS) was used for evaluating the participant's subjective perception of anxiety and to accurately reflect the subjective anxiety level [7]. The self-rating anxiety scale consisted of 20 items. The sum of the 20 item scores was the raw score. To obtain the index score, multiply raw score by 1.25 and keep the integer part. The classification was made based on the Handbook of Common Psychological Evaluation Scales [8], i.e. Index score < 50, No anxiety; Index score of 50 – 59, Mild anxiety; Index score of 60 - 69, Moderate anxiety; and Index score of 69 or above, Severe anxiety.

The Connor-Davidson resilience scale (CD-RISC) was developed by US scholars Connor and Davidson. In this study, the Chinese version translated and modified by Yu X and Zhang J [9] was used. The Chinese version of

CD-RISC consisted of 25 items and analysed 3 different factors, namely tenacity, strength and optimism. The 5-point Likert scale was used, with score range from 0-4 assigned for the response option of 'Never', 'Seldom', 'Sometimes', 'Frequently' and 'Always' respectively. The CD-RISC score was 0-100. The higher the CD-RISC score, the higher the resilience. The Cronbach's alpha for CD-RISC was 0.91.

## Data collection

The electronic questionnaire was distributed via WJX, a professional online questionnaire system in Chinese version. The CSSD nurses and CSSD logistic staff scanned the QR code to complete the questionnaire anonymously. The head nurse of the CSSD of each hospital served as the supervisor who was responsible for reminding the CSSD staff to truthfully fill in the questionnaires. All the questions in the questionnaire were set as required questions. A total of 423 questionnaires were distributed, and 423 valid questionnaires were returned. The valid recovery rate is 100%. The reliability of the questionnaire survey was analysed by SPSS version 24.0, and the Cronbach's alpha was 0.674.

## Statistical methods

Preprocess the data from questionnaires in order to remove the unfinished questionnaires. After data preprocessing, 423 samples and 101 variables were identified. Use a scatter diagram to study the correlations among CD-RISC score, CPSS score and SAS score. The scatter diagram showed an obvious linear relationship between any two of the three variables, namely CD-RISC score, CPSS score and SAS score. Calculate the Pearson correlation coefficient and the corresponding t-test result in order to accurately calculate the strength of the relationship between variables. As all the variables of this study were nominal variables, classification and regression tree (CART) which was commonly used in study of sociology was used for studying the influence of the social-demographic variables on the CPSS score, SAS score and CD-RISC score. The analysis of variance (ANOVA) was used to evaluate the differences in mental state between the CSSD nurses and the CSSD logistic staff. SPSS version 24.0 was used for data analysis. The enumeration data was described with the number and percentage, and the measurement data was described with the mean and standard deviation. The influencing factors of variables were examined with CART analysis. Find variation between groups. Perform chi-square test on enumeration data, and perform t-test and ANOVA on measurement data.

## Results

The general information of CSSD staff participated in this study were presented in Table 1.

### CSSD staff's CD-RISC score, CPSS score, SAS score and correlation

The CSSD staff's CD-RISC score was  $64.26 \pm 15.129$  (Tenacity factor score:  $31.70 \pm 8.066$ , Strength factor score:  $21.60 \pm 5.066$ , Optimism factor scores:  $10.96 \pm 3.189$ ), their SAS score was  $37.39 \pm 8.458$ , and their CPSS score was  $19.21 \pm 7.265$ . As revealed in Pearson correlation coefficient between the variables and the corresponding t-test result, the CSSD staff's CPSS score was positively correlated with their SAS score ( $r = 0.66$ ,  $P < 0.01$ ), their CPSS score was negatively correlated with their CD-RISC score ( $r = -0.617$ ,  $P < 0.01$ ),

and their SAS score was negatively correlated with their CD-RISC score ( $r = -0.477, P < 0.01$ ), as shown in Figure 1.

### **Influencing factors for resilience, perceived stress and anxiety**

Classification and regression tree (CART) analysis showed that the job and age of the CSSD staff were the two factors having more influence on the perceived stress. The CPSS score ( $21.039 \pm 7.079$ ) of the CSSD nurses in the younger age groups (18 - 25, 26 - 30 and 31 - 40) was higher than the CPSS score ( $18.009 \pm 6.684$ ) of the CSSD nurses in the older age groups (41 - 50 and over 60); and the CPSS score ( $15.898 \pm 7.009$ ) of the CSSD logistic staff was lower than that of the CSSD nurses. The job was also a main influencing factor for anxiety. The SAS score ( $38.332 \pm 8.652$ ) of the CSSD nurses was higher than the SAS score ( $35.469 \pm 7.307$ ) of the CSSD logistic staff. The political status was the main factor influencing the resilience. The CD-RISC score of members of the Communist Party of China and other parties was  $69.73 \pm 12.071$ , the CD-RISC score of people without party affiliation was  $63.82 \pm 15.664$ , and the CD-RISC score of members of the Chinese Communist Youth League and probationary members of the Communist Party of China was  $59.04 \pm 13.676$ . The CD-RISC score of members of the Communist Party of China and other parties was higher than that of the other two groups, and the mean scores for CD - RISC scores of these three groups were different significantly, as shown in Figure 2, 3, 4.

### **One-way ANOVA for mental state**

The analysis of differences in CPSS score, SAS score and CD-RISC score between the CSSD nurses and the CSSD logistic staff was conducted with the one-way ANOVA. To compare variables, perform chi-square test on enumeration data; perform t-test between two groups of measurement data; and perform ANOVA between three groups or more groups of measurement data, as shown in Table 2.

## **Discussion**

### **Analysis on mental state of CSSD staff**

According to the survey results, the CPSS score of the CSSD staff was  $19.21 \pm 7.265$ , which was lower than that of the clinical nurses [10], but higher than that of community residents in China [11]. The perceived stress is the psychological response of the individual after perceiving and evaluating the threatening stimuli in the environment [12]. The novel coronavirus chiefly transmits via respiratory droplets and close contact [13], and the CSSD staff was not in direct contact with the confirmed or suspected COVID-19 patients, therefore the CSSD staff had the lower perceived stress for the COVID-19 epidemic as compared with the clinical nurses. Due to the nature of work in the CSSD, the CSSD staff was at risk of being infected with the novel coronavirus through occupational exposure, and the CSSD staff had higher perceived stress from the threat of the novel coronavirus as compared with the community residents during the epidemic.

The survey results showed that the CD-RISC score of the CSSD staff was  $64.26 \pm 15.129$ , lower than the norm in China [14]. It meant that the CSSD staff had lower resilience. The survey results also showed that the optimism factor score was the lowest and the tenacity factor score was the highest. It was possibly because the novel coronavirus transmitted quickly and widely, the number of confirmed and suspected cases

increased continuously with the development of the epidemic, the clinical work load and work pressure also increased [15], the CSSD staff had to handle a high workload and was at risk of infection from occupational exposure. At the early stage of the epidemic, the protective articles were in shortage in China, and the CSSDs were lack of the required protective articles, particularly the facial masks and protective gowns, the CSSD staff was usually unable to effectively cope with and adapt to the stress resulting from the emergent public health event. The CSSD staff with higher tenacity factor score had the higher control power in face of the stress and emergent public health event, and would not easily be influenced. Therefore, the managers are recommended to pay attention to the resilience level of the CSSD staff and provide them with the specific mental support to improve their resilience and decrease the negative impact from the epidemic on the CSSD staff.

According to the study results, the CSSD staff had the lower anxiety level. Their SAS score was  $37.39 \pm 8.458$ , lower than the threshold score of SAS, possibly because most of the participants were from Tertiary A hospitals and received strong support from the public and the governments, and the protective measures, disease screening tools and treatment conditions of Tertiary A hospitals could meet their job demands; and most of the participants were of the middle and upper level education background, and they were able to know about the relevant information on the COVID-19 epidemic through proper means and methods, and took the effective self protection.

#### **Analysis on correlation among CD–RISC score, CPSS score and SAS score of the CSSD staff**

The survey results showed that the CSSD staff's CPSS score was positively correlated with their SAS score ( $r = 0.66, P < 0.01$ ). That is to say, the higher the perceived stress, the more the anxiety. The possible reason was that the perceived stress was expressed as the tension and uncontrollability of the individual, and the individual experienced the negative mood of different extent [16]. As demonstrated by Rooij SRD, the perceived stress increased to some extent when the person was in a state of depression or anxiety [17]. According to the study of Wiegner L, the perceived stress was usually accompanied with increased depression and/or anxiety [18]. The CSSD staff felt the negative pressure brought to their work from the outbreak of coronavirus, and they were prone to anxiety after working under such a stressful condition for a long time. The CD–RISC score was negatively correlated with the CPSS score ( $r = -0.617, P < 0.01$ ), and the CD–RISC score was also negatively correlated with the SAS score ( $r = -0.477, P < 0.01$ ), which are basically consistent with the results of He C, et al. [16] and Xie Y, et al. [19]. It indicates that the higher the resilience level, the lower the perceived stress level and the anxiety level, because the individual with higher resilience usually adopts the optimistic and active attitude and handling methods under stressful conditions, and knows how to use the external resources to handle the problems [19]. During the epidemic, the higher the resilience, the higher the consciousness of self-protection. As long as the necessary protection measures are taken and the correct operation procedures are implemented, the stress as well as anxiety can be relieved.

#### **Analysis on influencing factors for CPSS score, SAS score and CD–RISC score**

As shown in this study, the job and age of the CSSD staff were two factors having higher influence over the CPSS score. The CPSS score of the CSSD nurses was  $20.081 \pm 7.008$ , significantly higher than the CPSS score ( $15.898 \pm 7.009$ ) of the CSSD logistic staff; and the SAS score of the CSSD nurses was  $38.332 \pm 8.662$ ,

higher than the SAS score ( $35.469 \pm 7.307$ ) of the CSSD logistic staff. Due to the simple staffing structure in the CSSD, i.e. there were only the nurses and the logistic staff in the CSSD, and the CSSD logistic staff was responsible for handling most of the devices which required more for the physical labors, while the CSSD nurses played the leading role and were chiefly responsible for guidance and supervision of sterile supply. The CSSD nurses played an important role in controlling hospital acquired infection. During the epidemic, controlling the hospital acquired infection was the top priority for fighting against the epidemic, so the CSSD nurses had the higher level of perceived stress and anxiety as compared with the CSSD logistic staff. Moreover, the CPSS score of the CSSD nurses in the younger age groups was higher than that of the CSSD nurses in the older age groups. The CSSD nurses in the younger age groups had shorter service period, insufficient work experience and few experiences of setbacks, and were lack of the strong will or the strategies in response to stressful conditions [20], but the CSSD nurses in the older age groups had the rich experience in work and life, so the CSSD nurses in the older age groups could maintain the stable mood and had the sufficient skills in response to the emergent public health event.

The political status was a factor having more influence on the CD-RISC score. The CD-RISC score of members of the Communist Party of China was  $69.726 \pm 12.071$ , higher than that of people without party affiliation ( $63.816 \pm 15.664$ ), and that of members of the Chinese Communist Youth League and probationary members of the Communist Party of China ( $59.039 \pm 13.676$ ). It was possibly because the members of the Communist Party of China always adhered to the mission of serving the public wholeheartedly, and maintain the spirit of contribution and perseverance.

## Conclusion

In summary, during the COVID-19 epidemic, the CSSD staff was under certain psychological stress, and more attention should be paid to the mental health of the CSSD staff. It was necessary to take some specific measures to tackle the unhealthy mood caused from the outbreak of the coronavirus, e.g. providing the CSSD staff more chances to learn new skills, organizing emergency response drills and providing the psychological counseling, to improve their psychological resilience, keep the team stable, and improve the working quality and satisfaction. However, there might be some biases in this study due to the small sample size of the CSSD logistic staff. The further survey and studies are required to be performed in the future.

## Abbreviations

ANOVA: Analysis of variance; CART: Classification and regression tree; CD-RISC: Connor-Davidson resilience scale; COVID-19: Coronavirus Disease 2019; CPSS: Chinese perceived stress scale score; CSSD: Central sterile supply department; SAS: Self-rating anxiety scale

## Declarations

### Ethics approval and consent to participate

Ethical approval of this study was obtained from the Medical Ethics Committee of West China Second University Hospital, Sichuan University (YXKY2020LSP(094)). Verbal consent was obtained from all study

participants, because this study was conducted based on the online questionnaires which were voluntarily and anonymously completed by participants. All data collected were confidential and used only by this study.

### **Consent for publication**

Not applicable

### **Availability of data and materials**

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

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No funding was obtained for this study.

### **Authors' contributions**

WP, JH and LY contributed to the questionnaire design. WP carried out the data collection. WP, JH and LY conducted the data analysis. WP drafted the manuscript. JH revised the manuscript. All the authors read and approved the final manuscript.

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### **Author detail**

<sup>1</sup>Central Sterile Supply Department, West China Second University Hospital, Sichuan University, 1416 Section 1 of Chenglong Avenue, Jinjiang District, Chengdu, Sichuan 610066 China. <sup>2</sup>Emergency Department, West China Second University Hospital, Sichuan University, 1416 Section 1 of Chenglong Avenue, Jinjiang District, Chengdu, Sichuan 610066 China.

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## Tables

**Table 1** General information of CSSD staff (n=423)

Variable	n	%
<b>Gender</b>		
Male	45	10.63
Female	378	89.37
<b>Job</b>		
Nurse	335	79.2
Logistic Staff	88	20.8
<b>Age</b>		
18 - 25 years old	40	9.45
26 - 30 years old	48	11.35
31 - 40 years old	136	32.15
41 - 50 years old	151	35.7
≥51 years old	48	11.35
<b>Educational Background</b>		
Junior High school and below	38	8.98
Senior high school / technical secondary school / technical school	61	14.42
Two or three years' higher education diploma	162	38.3
Undergraduate	162	38.3
<b>Hospital Grade</b>		
Tertiary A	216	51.05
Tertiary B	112	26.48
Secondary A	95	22.46
<b>Political status</b>		
People without party affiliation	299	70.69
Members of the Chinese Communist Youth League	46	10.88
Probationary members of the Communist Party of China	5	1.18
Members of the Communist Party of China	63	14.89
Members of other parties	10	2.36

**Table 2** Analysis of variance for differences in mental state between CSSD nurses and CSSD logistic staff

		Type III sum of squares	df	Mean square	F value	P value
SAS Score	Between groups	571.39	1	571.39	8.114	0.005
	Within groups	29645.594	421	70.417		
	Total	30216.984	422			
CPSS Score	Between groups	1219.371	1	1219.371	24.382	0
	Within groups	21054.903	421	50.012		
	Total	22274.274	422			
CD-RISC Score	Between groups	152.568	1	152.568	0.666	0.415
	Within groups	96434.827	421	229.061		
	Total	96587.395	422			

## Supplementary Files

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