ISSN: 2572-4037

Jiang et al. Int J Psychol Psychoanal 2021, 7:048
DOI: 10.23937/2572-4037.1510048
Volume 7 | Issue 1
Open Access

International Journal of
Psychology and Psychoanalysis

RESEARCH ARTICLE

Risk Perception and Psychological Impact in the Early Stage of the COVID-19 on General Hospital Workers in China

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Abstract

Aims: In order to improve the efficiency of hospitals in public sudden pandemic diseases, it is important to understand how it affects the hospital workers. The purpose of this study was to discuss the risk perception and psychological impact in the early stage of the COVID-19 on hospital staff, as well as the impact of hospitals of different levels, gender, age, post and working environment on it.

Methods: In late February 2020, shortly after the COVID-19 epidemic situation had clearly controlled in China, a questionnaire was distributed consisting of questions on sociodemographic characteristics, 19 stress-related questions and the 15 risk perceptional questions to all 1837 workers from different levels of hospitals in different regions of China. Exploratory factor analysis was applied to these questions, and this produced four stress-related factors for evaluation (anxiety about infection, depression about infection, exhaustion, and feeling of hypothetical scenario), three risk perceptional factors for evaluation (risk percept about the pandemic in the region, concern pandemic, and influence). Multiple regression models were used to evaluate the association of individual characteristics with each score of the 7 factors, risk perception and psychological rating scale (RPAS).

Results: 1837 valid questionnaires were obtained. The medical staff with more mental or psychological counseling was less affected, and the hospitals with lower frequency of pandemic information were more likely to feel unprotected. Working in a high-risk environment, people had a higher total score of RPAS and were more likely to feel anxious and tired, but they had a higher awareness of risk protection.

Conclusions: It is necessary for medical institutions to protect hospital staff during the early stage of the pandemic via rapidly share information about the COVID-19, and provide necessary risk perception and psychological support can help to reduce the impact of the epidemic situation (COVID-19) on hospital staff.

Keywords

COVID-19 epidemic, Hospital staff, Impact, Risk perception and psychological services, Stress

Introduction

On 1 December 2019, the domestically first case with COVID-19 influenza virus infection in China was admitted and treated by Wuhan Jinyintan Hospital in

Citation: Jiang C, Wang T, Guo J, Zhang Q, Fang B, et al. (2021) Risk Perception and Psychological Impact in the Early Stage of the COVID-19 on General Hospital Workers in China. Int J Psychol Psychoanal 6:048. doi.org/10.23937/2572-4037.1510048

Accepted: June 12, 2021: **Published:** June 14, 2021

Hubei Province. In January 2020, Chinese experts announced the existence of human-to-human transmission of COVID-19 flu. On March 13, 2020, COVID-19 influenza was declared a worldwide pandemic by the World Health Organization. So far, this serious pandemic has plunged the general public into endless confusion and anxiety in March 2020. Every day, a large number of news reports on the number of COVID-19 infections in various countries and cities around the world were filled with various media channels. This attracted a great deal of public attention.

Soon, the COVID-19 developed in a blowout, and many hospitals in China had set up fever consultation centers to provide services to patients suspected of having COVID-19 flu. Up to now (April 4, 2020), 81669 people suspected of being infected with COVID-19 flu had came to these designated hospitals for treatment. Of these, 76964 had been cured and discharged from hospital. Only 1376 patients diagnosed with COVID-19 were admitted to hospital for continue treatment [1].

Although the currently prevent-control in epidemic in China is good, there will still be some overseas imported cases and those who return to the positive. It will still impose a great psychological burden on the society, especially on the front-line medical workers. During these more than 2 months, the majority of medical staff would have suffered great physical and psychological pressure. Some studies have found that the incidence of all kinds of mental disorders after major disasters is about 10% to 20% [2]. In addition, WHO had analyzed the data of about 17,000 COVID-19 patients in China on February 7, 2020, of which 82% were mild, 15% were severe and 3% were critically ill. The case fatality rate of COVID-19 in other provinces except Hubei was 0.36%, which was comparable to the global case fatality rate of influenza A (H1N1) in 2009 (0.4%), but lower than that of severe acute respiratory syndrome ((sever acute respiratory syndrome) in 2003. SARS) 6.55% case fatality rate [3]. It was reported that about 80% of the patients with sequelae of SARS in Beijing leaved work due to illness, 60% had family accidents, and symptoms such as osteonecrosis, pulmonary fibrosis and depression were common [4]. Different severity of diseases had different psychological and physiological effects on patients after cure, so it was necessary to pay attention to the occurrence of post-disaster-related mental disorders.

To clarify the impact in the early stage of the COVID-19 epidemic of hospital staff, we distributed questionnaires to the vast number of medical staff who were fighting on the front line for the fight against the epidemic at different grades' hospitals (Level III, II and others) from all over China. Several studies on small samples had found the stress experienced by single hospital nurse groups in the COVID-19 and other epidemics [5-8]. To the best of our knowledge, however, few researches have been conducted to investigate the impact of sociodemographic or occupational characteristics including the workplace, on the stress of hospital staff. The psychological reaction of hospital staff to the pandemic may be related to the working environment or the characteristics of the hospital. This study investi-

Table 1: The characteristics of included hospital.

	Hospital A (Grade 3A)	**Hospital B (Grade 3A)**	**Hospital C (Grade 3B)**	**Hospital D (Grade 2 and below)**
No. doctors	214	351	30	34
No. nurses	121	569	159	177
No. others	31	142	4	5
Infectious ward (COVID-19)	Yes	Yes	Yes	No
Epidemic prevented measures in the pandemic (COVID-19) in 2020	Hospitalization and ambulant care	Hospitalization and ambulant care	Hospitalization and ambulant care	ambulant care
Provide assistance to medical staff in hospitals	Frequent provide service for information and psychiatric	Frequent provide service for information and psychiatric	Frequent provided service for information	Infrequent provide service for information
Fixed staff in the ward for COVID-19 infection	Yes	Yes	Yes	Yes
Fixed staff in the fever consultation center	Yes	Yes	Yes	Yes
Area type				
Villages	0	0	0	0
Towns	0	0	0	16
County	0	0	17	33
Prefecture-level cities	172	955	60	43
Provincial capital cities (municipalitcities directly under the Central Government)	197	105	116	123

gated the psychological effects of COVID-19 on hospital staff in the early stage of the epidemic, as well as the psychological effects of hospital characteristics, gender, age, occupation and working environment.

Methods

The subjects in this study came from various hospitals, which are designated hospitals for the treatment of COVID-19 patients in China. Included hospitals' characteristic was listed in Table 1. Hospital A was the provincial or university affiliated hospital and hospital B was the municipal hospital, which are all Grade 3A. COVID-19's outpatients and inpatients can be treated at the same time in both Hospital A&B and Hospital C, while only outpatients can be treated in Hospital D. In addition, the number of inpatients in hospital A were significantly higher than that of in hospital C.

Information about the pandemic was provided frequently by hospital OA system and mobile phone Wechat to all staff from the Infectious Control Team in hospital A and hospital B, whereas in hospital C, it was rarely provided to each relevant department with similar reports. The staff in the fever consultation center or the ward for COVID-19 infection, the number of staff differed from that in the high-risk area.

We distributed a questionnaire to 2019 staff form hospitals of different levels in different regions of China and a total of 1997 valid questionnaires (98.90%) were received. Of these responses, 160 were excluded for missing at least one answer, remaining 1837 questionnaires (90.99%) for analysis. The number of valid questionnaires collected by each hospital was as follows: hospital A, 366 (55.0%); hospital B, 1062 (14.7%); hospital C, 193 (14.7%); hospital D, 216 (30.3%). Table 2 listed the characteristics of interviewers.

Table 2: Characteristics of staff.

	Total staff (n)	Proportion (%)
Job		
Medical doctor	629	34.28
Nurse	1026	55.80
Others	182	9.92
Gender		
Female	1428	77.14
Male	409	22.26
Degree		
Senior High School/Technical Secondary School and below	21	1.14
College	339	18.45
undergraduate	1146	62.38
Master	285	15.51
Doctor and above	46	2.52
Age groups (years)		
≤ 25	117	6.37
26-35	944	51.39
36-45	509	27.71
≥ 45	267	14.44
Work environment		
Medical observation at home	10	0.54
Hospital isolated ward	938	51.12
Hospital general ward	498	27.15
Hospital observated ward	179	9.75
Others	210	11.44
Contact with suspected or diagnosed COVID-19		
direct	1272	69.32
Indirect	136	7.41
No	77	4.20
Possible	86	4.68
Unknown	264	14.39

Occupation classification: Doctor; nurse; or others (Interns, workers in radiology, laboratory, pharmacy, nutrition, administrative office, security room, etc.).

Procedure

Self-administered anonymous questionnaires were conducted online by the or code made via "questionnaire Star" (Changsha Ranxing Information Technology Co., Ltd., ICP card: 43019002000245) starting on 25th March 2020 and were collected from different hospital until 31st March 2020, which was about 1 month after the peak of COVID-19's epidemic in China.

Content of questionnaire

The purpose of the questionnaire was to investigate the stress and risk perception of hospital staff during the COVID-19 outbreak in 2020, and stated the results would be released, while the interviewees remained anonymous. The whole questionnaire consists of social demographic characteristics, risk perception and stress-related questions for COVID-19 incident. The answer to the questionnaire requires that it be answered in accordance with the design content of the questionnaire, and the unapproved answer was omitted in the analysis.

The personal characteristics included gender, age group, job, degree and and the work environment during the COVID-19 epidemic period, which can be divided into high-risk environment (COVID-19 infection isolation/observation ward and pre-examination fever sub-diagnosis area) and low-risk environment (all other medical places). We found that 1272 (69.32%) had directly contact with novel coronavirus infected people, 136 (7.41%) had indirectly contact, 77 (4.20%) had no contact, and 350 (19.07%) might have been exposed or did not know whether they had contact.

19 items related to stress in the questionnaire (Table 3). The respondents were describe the frequency of these 19 items they experienced during COVID-19's epidemic with a 4-point Likert scale (0, never; 1, rarely; 2, sometimes; 3, always), of which 16 were based on COVID-19's or hypothetical COVID-19 pandemics research project. In addition, we added 15 risk perception items about influence to work during the pandemic (Table 4).

The risk perception and psychological assessment scale (RPAS) was developed by Professor Qiang Zhang, et al. as a measure of psychological stress response after emergencies, it has been widely used in related research. The RPAS, which was used to assess risk per-

Table 3: Factor analysis of the stress-related questions.

Questions	F1	F2	F3	F4
Factor 1: Anxiety about infection (Cronbach a = 0.81)				
Q23. Fidgeting about new information of pandemic	**0.810**	0.005	0.174	-0.057
Q21. Nervous about the pandemic	**0.760**	0.043	0.127	-0.133
Q24. Panic about pandemic	**0.729**	-0.076	-0.011	0.152
Q22. Anxiety about pandemic in the last week	**0.678**	-0.059	-0.027	0.034
Q26. Fretful degree about pandemic	**0.669**	-0.252	0.011	0.043
Q19. Emotion in the last week after the COVID-19 outbreak	**0.553**	0.156	0.345	-0.026
Q17. Anxiety about being infected	0.330	0.094	**0.501**	-0.261
Q20. Anxiety about having similar infected symptoms	-0.089	-0.023	**0.846**	0.156
Factor 2: Depression about infection (Cronbach a = 0.81)				
Q25. Lack of interesting in doing anything but the epidemic	**0.818**	-0.108	0.119	-0.005
Q29. Hesitation to work	**0.673**	-0.021	0.018	-0.022
Q27. Complain about pandemic	**0.662**	0.091	0.115	0.022
Q28. Worry about the prevent-control measures of the pandemic	0.331	-0.333	0.004	0.236
Q34. Confidence in overcoming the pandemic	-0.175	0.749	-0.013	0.025
Q42. Lacking of COVID-19's prevention knowledge	-0.024	0.687	0.069	0.029
Factor 3: Exhaustion (Cronbach a = 0.72)				
Q30. Overwashing and disinfecting hand but feeling of having no clean at home	**0.458**	0.079	0.381	-0.024
Q35. Elevated mood for the currental pandemical prevent-control	0.039	0.052	0.026	**0.918**
Factor 4: Feeling of hypothetical scenario (Cronbach a = 0.68)				
Q33. Overworry about being infected or out-of-controled	**0.669**	-0.144	0.097	0.102
Q32. Fear of meeting someone unweared masks	**0.648**	0.225	0.038	-0.007
Q36. Anger and willingness of persuade to someone uncared about the pandemic	0.392	**0.610**	0.047	0.008

Cronbach a was computed without excluded items; Bold, factor loading ≥ 0.40.

Table 4: Factor analysis of the 15 risk percept-related questions.

Questions	F1	F2	F3
Factor 1: Risk percept about the pandemic in the region (Cronbach a = 0.626)			
Q18. The prevent-control measures of the pandemic in your region	**0.664**	0.182	0.180
Q7. The severity of the pandemic in your region	0.051	0.381	-0.141
Factor 2: Concern pandemic (Cronbach a = 0.81)			
Q11. Concern channels	**0.879**	-0.033	0.047
Q31. Unconfirmed gossip	**0.761**	0.208	-0.114
Q10. Concern degree	0.044	0.273	**0.604**
Q12. Reliability of information sources	-0.248	-0.052	0.224
Q13. Key contents	-0.687	0.295	0.086
Factor 3: Influence (Cronbach a = 0.80)			
Q38. Protective measures	**0.529**	-0.009	0.128
Q39. Traveling and purpose	0.145	0.005	0.009
Q14. Threat to health caused by the pandemic	0.154	**0.809**	0.060
Q15. Threat to life caused by the pandemic	0.086	**0.843**	0.066
Q41. Volunteer work	0.047	-0.014	**0.770**
Q40. Suggestion about prevent-control measures of the pandemic	-0.038	-0.014	**0.531**
Q16. Threat to work and study caused by the pandemic	-0.360	0.723	0.055
Q37. Doing no choice but at home due to pandemic	-0.768	0.054	0.207

ception and psychological response to stressful events caused by COVID-19's epidemic, consists of 42 projects, and respondents taking a 4-point Likert scale (0, not at all; 1, rarely; 3, sometimes; 5, often).

Previous pre-experiments had proved that RPAS had certain validity and reliability, so we had reason to believe that RPAS can effectively evaluate the risk cognitive and psychological impact of COVID-19 epidemic on medical staff.

Excluding the three items (Q1-6, Q8, Q9), the Cronbach α coefficient of stress and risk perception was 0.829 (n = 1837), showing good internal consistency and acceptable reliability. There was a moderate correlation between the total score of 34 items and the RPA score ($r = 0.512$, $r^2 = 0.26$, $P < 0.001$), so the validity of the 34 items was confirmed (KMO = 0.918 > 0.7, the construct validity of the questionnaire was good).

The survey adopted the principle of voluntary participation and was approved by the Ethics Review Committee of the second affiliated Hospital of Xi'an Medical University.

Statistical analysis

Given the factor structure had not been developed according to previous studies, we took factor analysis separately to the 19 stress-related/15 risk percept-related questions with the maximum likelihood method and promax rotation. According to different factor models, the number of factors was determined by the size of eigenvalues and the relative size of values.

Calculated the total score of issues related to stress/risk perception must be based on each factor. The influence of personal characteristics on the total score and RPA of each factor was evaluated by using a multiple regression model with fictitious coded demographic variables (sex, age, occupation, education, hospital and working environment) to calculate the standardized partial regression coefficient (β) (statistical significance: two-tailed $P < 0.05$ in the present study).

Statistical analysis was carried out using SPSS (20.0: SPSS, Xi'an, China).

Results

Factor analysis

We conducted an exploratory factor analysis on 19 problems related to stress. Four factors were extracted from 19 items with factor loadings of 0.40 (Table 3). Factor 1 was marked "anxiety about infection" and included 8 sub-items. Factor 2 with 6 sub-items was labeled 'depression about infection'. Factor 3 with 2 sub-items was marked 'exhaustion'. Factor 4 with 3 sub-items was labeled 'feeling of hypothetical scenario'.

Next, exploratory factor analysis was used to analyze 15 issues related to risk perception. 3 factors were extracted from 15 sub-items with factor loadings of 0.40 (Table 4). Factor 1 with 2 sub-items was labeled 'risk percept about the pandemic in the region'. Factor 2 with 5 sub-items was marked 'concern pandemic'. Factor 3 with 3 sub-items was labeled 'influence'.

Multiple regression analysis

Table 5 lists the estimated associations between the sociodemographic characteristics with the total score in each of the 8 (4 stress-related/3 risk percept-related) and the RPAS. All regression models were significant.

DOI: 10.23937/2572-4037.1510048

Table 5: Total scores and multiple regression analysis (mean ± SD, β).

		For factor							RPAS
		Stress-related				Risk percept-related			Total score►
Variables	**n**	**F1***	**F2****	**F3#**	**F4$**	**F1▲**	**F2△**	**F3▼**	
Job									
MD	629	3.2 ± 1.9,-	2.5 ±1.3,-	2.0 ± 1.3,-	3. 3 ± 1.9,-	3.6 ± 1.9,-	4.4 ± 1.5,-	4.3 ± 1.5,-	3.3 ± 1.6,-
Nurse	1026	3.8 ± 1.9, 0.22^^^	2.9 ± 1.4, 0.25^^^	2.4 ± 1.6, 0.16^^^	3.5 ± 1.9, 0.13^^^	4.0 ± 1.8, 0.07^	4.5 ± 1.5, 0.08^	4.6 ± 1.5, 0.21^^	3.6 ± 1.7, 0.25^^^
Others	182	3.4 ± 1.9, 0.02	2.6 ± 1.4, 0.00	2.2 ± 1.5, 0.04	3.2 ± 1.9, 0.02	3.4 ± 1.9, -0.01	4.3 ± 1.6, -0.04	4.3 ± 1.6, -0.01	3.3 ± 1.6, 0.01
Gender									
Male	409	3.2 ± 1.8, -	2.5 ± 1.4,-	2.0 ± 1.4,-	3.2 ± 2.0,-	6.9 ± 3.8,-	4.6 ± 1.5,-	4.5 ± 1.5,-	3.8 ± 1.9,-
Female	1428	3.7 ± 1.9, 0.04	2.8 ± 1.4, 0.056	2.4 ± 1.6, 0.05	3.4 ± 1.9, 0.03	4.2 ± 2.1, 0.07^^	4.5 ± 1.6,-0.01	4.3 ± 1.6, 0.00	3.6 ± 1.7, 0.04
Degree									
College	339	3.8 ± 2.0,-	2.8 ± 1.4,-	2.3 ± 1.6,-	3.4 ± 1.9,-	3.8 ± 1.8,-	4.5 ± 1.6,-	4.5 ± 1.5,-	3.5 ± 1.7,-
Senior High School/ Technical Secondary School and below	21	3.6 ± 2.0, -0.06	2.8 ± 1.5,-0.14	2.2 ± 1.4,-0.04	3.2 ± 1.8, 0.05	3.5 ± 1.6, 0.00	4.5 ± 1.7,-0.01	4.3 ± 1.6, 0.07	3.4 ± 1.6,-0.02
undergraduate	1146	3.6 ± 1.9, -0.11	1.8 ± 1.4,-0.17	2.3 ± 1.5,-0.04	3.4 ± 1.9, 0.04	3.8 ± 1.9,-0.01	4.6 ± 1.6, 0.02	4.3 ± 1.5, 0.04	3.3 ± 1.9,-0.06
Master	285	3.2 ± 1.9, -0.13	2.5 ± 1.3,-0.10	2.1 ± 1.4,-0.03	2.7 ± 2.0, 0.10	3.6 ± 1.9, 0.00	4.5 ± 1.6, 0.00	4.2 ± 1.6, 0.03	3.2 ± 1.6,-0.04
Doctor and above	46	3.6 ± 2.0, -0.05	2.3 ± 1.3,-0.06	1.9 ± 1.5,-0.04	3.5 ± 2.1, 0.04	4.0 ± 1.8, 0.04	4.4 ± 1.6,-0.02	4.4 ± 1.5, 0.02	3.4 ± 1.7,-0.01
Age groups (years)									
≤ 25	117	3.7 ± 1.9,-	2.6 ± 1.5,-	2.5 ± 1.6,-	3.4 ± 1.9,-	4.0 ± 2.0,-	4.5 ± 1.5,-	4.3 ± 1.4,-	3.5 ± 1.6,-
26-35	944	3.7 ± 1.9, 0.03	2.7 ± 1.4, 0.16^^	2.3 ± 1.5,-0.04	3.4 ± 1.9, 0.07	3.8 ± 1.9, 0.01	4.4 ± 1.5, 0.04	4.5 ± 1.5, 0.10^	3.5 ± 1.7, 0.11^
36-45	509	3.4 ± 2.0, -0.03	2.7 ± 1.6, 0.17^^^	2.2 ± 1.5,-0.04	3.4 ± 1.9, 0.07	3.7 ± 1.8,-0.02	4.5 ± 1.6, 0.07	4.4 ± 1.6, 0.08	3.4 ± 1.7, 0.06
≥ 45	267	3.3 ± 2.1, -0.08	2.7 ± 1.3, 0.17^^	2.1 ± 1.4,-0.08	3.3 ± 1.9, 0.07	3.5 ± 2.0,-0.03	4.4 ± 1.6, 0.01	4.2 ± 1.6, 0.00	3.3 ± 1.7,-0.01
Area type									

ISSN: 2572-4037

DOI: 10.23937/2572-4037.1510048

Villages	5	3.9 ± 2.4,-	2.5 ± 1.4,-	3.6 ± 1.8,-	2.9 ± 1.7,-	4.4 ± 1.2,-	4.2 ± 1.7,-	4.6 ± 1.5,-	3.7 ± 1.6,-
Towns	80	3.6 ± 1.9, -0.08	2.7 ± 1.5, 0.01	2.4 ± 1.4,-0.26^^	3.6 ± 1.9, 0.07	4.1 ± 1.9, 0.17^	4.5 ± 1.6, 0.04	4.4 ± 1.4, 0.00	3.6 ± 1.6,-0.02
County	96	3.3 ± 1.8, -0.09	2.6 ± 1.2, 0.01	2.1 ± 1.4,-0.30^^^	3.5 ± 1.8, 0.05	3.6 ± 1.8, 0.14	4.5 ± 1.6, 0.04	4.3 ± 1.5, 0.02	3.4 ± 1.5,-0.02
Prefecture-level cities	1174	3.7 ± 2.0, -0.12	2.8 ± 1.5, 0.09	2.3 ± 1.5,-0.62^^^	3.3 ± 1.8, 0.10	3.6 ± 1.8, 0.32	4.5 ± 1.6, 0.10	4.5 ± 1.5, 0.06	3.5 ± 1.7,-0.02
Provincial capital cities (municipalitcities directly under the Central Government)	480	3.3 ± 1.9, -0.17	2.6 ± 1.4, 0.10	1.6 ± 1.4,-0.58^^^	3.6 ± 1.9, 0.18	4.2 ± 2.1, 0.41^	4.6 ± 1.6, 0.15	4.4 ± 1.4, 0.09	3.4 ± 1.6, 0.03
Current state(Subjects)									
Medical observation at home	10	4.6 ± 1.4,-	3.2 ± 1.3,-	2.4 ± 1.8,-	3.1 ± 1.7,-	3.6 ± 1.8,-	4.5 ± 1.6,-	4.8 ± 1.1,-	3.2 ± 1.5,-
Hospital isolated ward	938	4.0 ± 1.9, 0.06^^^	2.8 ± 1.4, 0.04	2.3 ± 1.7, 0.00	3.3 ± 1.7,-0.01	3.7 ± 1.9, 0.09^^^	4.5 ± 1.7,-0.02	4.3 ± 1.5, 0.06^^	3.5 ± 1.6, 0.05^
Hospital general ward	498	3.7 ± 1.9, 0.05^	2.8 ± 1.4, 0.02	2.3 ± 1.6, 0.01	3.4 ± 1.9,-0.01^	4.3 ± 2.1, 0.10^^^	4.6 ± 1.5, 0.04	4.5 ± 1.5, 0.08^^^	3.6 ± 1.7, 0.08^^^
Hospital observated ward	179	3.5 ± 2.0,-0.03	2.8 ± 1.4, 0.02	2.2 ± 1.5, 0.03	3.5 ± 1.9, 0.05	3.4 ± 1.3, 0.06^^	4.4 ± 1.6, 0.02	4.6 ± 1.5, 0.00	3.5 ± 1.6, 0.02
Others	210	3.5 ± 1.9,-0.01	2.7 ± 1.4, 0.00	2.2 ± 1.5,-0.02	3.4 ± 2.0, 0.02	3.7 ± 1.8, 0.03	4.5 ± 1.6,-0.01	4.4 ± 1.6, 0.01	3.4 ± 1.6, 0.01
Hospital									
X (Grade 3A)	366	3.4 ± 1.9,-	2.5 ± 1.2,-	2.1 ± 1.4,-	3.4 ± 1.9,-	3.8 ± 2.0,-	4.4 ± 1.5,-	4.4 ± 1.4,-	3.4 ± 1.6,-
X_1 (Grade 3A)	1062	3.7 ± 1.9, 0.07^	2.8 ± 1.4, 0.08^	2.3 ± 1.5, 0.03	3.3 ± 1.9, 0.00	3.6 ± 1.8,-0.02	4.4 ± 1.5 ,0.00	4.5 ± 1.5, 0.06	3.5 ± 1.6, 0.06
Y (Grade 3B)	193	3.7 ± 1.9,-0.00	2.6 ± 1.3,-0.09^	2.3 ± 1.6,-0.03	3.0 ± 1.8, -0.13^^^	3.8 ± 1.6,-0.08^^	4.2 ± 1.3,-0.08^^^	4.5 ± 1.4,-0.85^^	3.4 ± 1.5,-0.08^
Z (Grade 2 and below)	216	3.3 ± 1.5,-0.10^^^	2.6 ± 1.3,-0.02	2.2 ± 1.2,-0.06^	3.5 ± 1.5, 0.18^^^	4.9 ± 2.1, 0.19^^^	4.7 ± 1.3, 0.11^^^	4.4 ± 1.3,-0.05	3.6 ± 1.4, 0.02

Adjusted for job, gender, degree, age group, area type, current state, hospital; ^P < 0.05; ^^P < 0.01; ^^^P < 0.001; *R^2 = 0.14, adjusted R^2 = 0.12; **R^2 = 0.09, adjusted R^2 = 0.06; #R^2 = 0.05, adjusted R^2 = 0.04; $$R^2$ = 0.08, adjusted R^2 = 0.07; ▲R^2 = 0.11, adjusted R^2 = 0.06; △R^2 = 0.06, adjusted R^2 = 0.04; ▼R^2 = 0.07, adjusted R^2 = 0.06; ►R^2 = 0.12, adjusted R^2 = 0.11; β, standardized partial regression coefficient; RPAS, The risk perception and psychological assessment scale; MD, medical doctor.

ISSN: 2572-4037

4 stress-related factors

For factor 1, 'anxiety about infection', workers in hospital A (Grade 3A) and C (Grade 3B) had more anxiety than workers in other hospitals (hospital B (Grade 3A): Partial regression coefficient (B) = 1.21, SE = 0.53, β = 0.07, P < 0.05; hospital D (Grade 2 and below): B = -2.62, SE = 0.72, β = -0.10, P < 0.001). Professionally, nurses seem to be more anxiety about infection than doctors (nurses: B = 3.65, SE = 0.58, β = 0.22, P < 0.001). Staff in front-line contacted with patients in high-risk work environments (hospital isolated/general ward) had a higher sense of anxiety than those worked in a low-risk work environment (at home or others) (B = 4.06, SE = 2.23, β = 0.06, P < 0.001).

Factor 2, 'depression about infection', staff at hospital A (Grade 3A) and D (Grade 2 and below) had less depression than workers in other hospitals (hospital B (Grade 3A): B = 0.69, SE = 0.36, β = 0.08, P < 0.05; hospital Y (Grade 3B): B = -1.10, SE = 0.49, β = -0.09, P < 0.05). And workers who under the age of 25 had more depression than those aged 26-35, 36-45, and over 45 (26-35: B = 1.37, SE = 0.53, β = 0.16, P < 0.01; 36-45: B = 1.58, SE = 0.57, β = 0.17, P < 0.01; 45: B = 2.14, SE = 0.63, β = 0.17, P < 0.001). Professionally, nurses seem to be more depression than MDs (B = 2.09, SE = 0.41, β = 0.25, P < 0.001).

Factor 3, 'exhaustion', nurses were more likely to feel more exhaustion than MDs (B = 0.66, SE = 0.15, β = 0.16, P < 0.001). In regard to the type of area of work and life, workers in big cities are more likely to get tired than those in the countryside, especially in provincial capitals (Towns: B = -2.57, SE = 0.93, β = -0.26, P < 0.01; County: B = -2.78, SE = 0.93, β = -0.30, P < 0.001; Prefecture-level cities: B = -2.63, SE = 0.91, β = -0.62, P < 0.001; Provincial capital cities (municipal cities directly under the Central Government): B = -2.71, SE = 0.91, β = -0.58, P < 0.001). But interestingly, the medical staff in D Hospital feel less tired than the staff in other hospitals (B = -0.41, SE = 0.19, β = -0.06, P < 0.05).

For factor 4, 'feeling of hypothetical scenario', nurses replied that they had a more over worry than MDs (B = 0.96, SE = 0.27, β = 0.13, P < 0.001). Compared with the staff of A and B hospitals, the staff of C and D hospitals feel much less protected (hospital A: B = -1.54, SE = 0.34, β = -0.13, P < 0.001; hospital B: B = 1.99, SE = 0.33, β = 0.18, P < 0.001). In addition, workers in the general ward of the hospital had a higher over worry and anxiety than those observed at home (B = 0.43, SE = 0.21, β = 0.05, P < 0.05).

3 risk percept-related factors

For factor 1, 'risk percept about the pandemic in the region', female nurses had a higher feeling of risk awareness than MDs (female: B = 0.52, SE = 0.19, β = 0.07, P = 0.007; nurses: B = 0.44, SE = 0.21, β = 0.07, P = 0.038). Staff in cities and towns, especially in provincial capitals, have a higher awareness of the risk of infectious diseases (Towns: B = 2.56, SE = 1.32, β = 0.17, P = 0.043; Provincial capitals: B = 2.78, SE = 1.29, β = 0.41, P = 0.032). People working in different wards of the hospital had a stronger risk perception than others (Hospital isolated ward: B = 1.40, SE = 0.38, β = 0.09, P < 0.001; Hospital general ward: B = 0.65, SE = 0.18, β = 0.06, P < 0.001; Hospital observed ward: B = 0.91, SE = 0.36, β = 0.05, P = 0.011). In addition, the staff of hospital A and B had a higher feeling of being protected than workers at hospital C and D (hospital C: B = -0.72, SE = 0.27, β = -0.08, P = 0.007; hospital D: B = 1.79, SE = 0.27, β = 0.19, P < 0.001).

Factor 2, 'concern pandemic', nurses were more concerned about the development of the epidemic than MDs (B = 0.48, SE = 0.24, β = 0.08, P = 0.041). The staff of C/D hospital are more urgent to pay attention to the epidemic situation than A/B hospital (hospital C: B = -1.40, SE = 0.30, β = -0.13, P < 0.001; hospital D: B = 1.07, SE = 0.29, β = 0.11, P < 0.001). People who worked in a high-risk environment feel more tired than those in a low-risk environment (B = 1.35, SE = 0.14, β = 0.25, P < 0.001).

Factor 3, 'influence', 26-35y nurses replied had a serious influence than MDs (Nurses: B = 1.39, SE = 0.25, β = 0.21, P < 0.001; 26-35y: B = 0.66, SE = 0.34, β = 0.10, P = 0.048). Staff at hospital C felt a intenser influence than those at hospital A (B = -0.85, SE = 0.31, β = -0.08, P = 0.006). Staff isolated ward in hospital felt a higher influence than those in other environments (Hospital isolated ward: B = 1.07, SE = 0.43, β = 0.06, P = 0.013).

The total score of the overall RPAS would be affected by factors such as gender, occupation, hospital as well as differentiated environment (working and lifting). In terms of occupation, nurses had a higher total score of RPAS than MDs (nurses: B = 6.18, SE = 1.01, β = 0.25, P < 0.001). Staff at hospital C had a lower total score of RPAS than hospital A (B = -2.83, SE = 1.22, β = -0.04, P = 0.021). People worked in a high-risk environment had a higher total RPAS scores than those in a low-risk environment (Hospital isolated ward: B = 2.30, SE = 1.03, β = 0.05, P = 0.025; Hospital general ward: B = 1.88, SE = 0.46, β = 0.10, P < 0.001). The average total RPAS score was 3.82 ± 0.66 and ranged from 0 to 150.

Discussion

In this study, there were no significant differences in 4 stress-related factors and 3 risk perception-related factors between males and females, except risk percept about the pandemic in the region. Interestingly there was no significant difference in RPAS scores between genders. Similar results were reported for studies of a psychological status of medical staff in fighting against COVID-19 in Wuhan, China [9,10]. These studies found that stress in the face of outbreaks such as COVID-19 was not significantly affected by age, gender, and degree, whereas in this study' serious influence of being

infected' was stronger among workers in 26-35y than among those in others' age. This may be because it was well known that younger were more likely to be infected during COVID-19 breaks out in 2020. The fact that medical staff who under the age of 25 were more depression than those aged 26-35y, 36-45y, and over 45y could be due to lacking of necessary work experience and enough psychological endurance with age. Older would accumulate more work experience and had a stronger sense of belonging to the organization with the increasing of theirs' age, which was undoubtedly a prominent feature of Chinese workers, 'risk awareness degree' appeared to be stronger in over-aged 26y workers than in workers who under the age of 25, however, it is less affected by the epidemic. Most of the employees in their 40s are managers of various hospitals, responsible for providing all kinds of security for their subordinates, and in a variety of positions, the group of nurses seems to be more worried about whether they will be infected. Specifically, because of the impaction of the epidemic, the "pressurion" and "risk awareness" of nurses were significantly higher than those of MDs groups. Our study found that the total score of RPAS of nurses was significantly higher than that of MDs, which was similar to the results of the study of SARS outbreak in 2003 and the study of H1N1 pandemic in China in 2009 [11,12]. The amount of time spent with infected people may lead to different work efficiency. Although hospitals An and B informed all hospital staff of the development of COVID-19's epidemic situation through the hospital's internal OA system or in the form of written notice, these written messages were only posted on the hospital bulletin board or in the doctor's lounge, which may lead to a low awareness rate among medical staff. Facing the serious epidemic, it was unclear whether this important information can be seen by the staff, which was very important to protect them from infection and to improve their risk awareness. In hospitals C and D, the latest important information about epidemic infections would only be distributed to more the MDs and managers in each department, while nurses and others might be less informed successfully than the previous two groups. This might be one of the reasons why nurses were more anxious about the COVID-19 epidemic. In that case, it was clear that updating information about infection as soon as possible was particularly important to reduce the pressure and impact caused by the epidemic, raise risk awareness so as to create a good working environment. During the pandemic (COVID-19) 2020, the number of outpatients and inpatients in these hospitals was roughly the same, but the the overall number of attendances has decreased significantly compared with the same period before. Most of the hospitals included in the survey were in big cities (Prefecture-level cities and aboved), but Z Hospital does not had the ability to treat COVID-19 patients, only set up basic screening clinics (Table 1). As a result, basically no the employees in a high-risk work environments at hospitals D, and necessary psychological counseling support were not provided for the staff, while at hospital A, B and C, clinical psychologists made a rounds in the infectious disease area every day, providing necessary psychological counseling support for the anti-epidemic staff on the front line, which is very important for the physical and mental health of medical workers. In addition, Medical staff in hospitals C and D with feeling of being protected effectively away from infection were much weaker than that of hospitals A and B (Table 5). The reason may be due to the relatively higher quality of staff in large general hospitals in big cities, both in terms of medical technology and experience in the face of the epidemic.

In this study, we also found that medical workers in high-risk environments were more likely to feel that "anxiety" and "depression" caused by infection, also especially Grade 3B and 2 hospitals, the total RPAS scores were significantly higher than those in low-risk environments. A study of 145 hospital quarantined personnels in Hubei province, China in the 2020 COVID-19 outbreak found a similar difference in investigation of psychological and mental health [13]. The mean total stress-related factor score of 3.26 and risk percept-related of 4.38 in this study, nevertheless, was much lower than than the 13.97 score of the were conducted from the study in Hubei Province, China. This may be due to the higher virulence of COVID-19 in the early stage of its outbreak in 2020 had not yet been clearly recognized, no clinical specific drug for the time being, the number of confirmed cases is soaring every day, and the majority of residents are related to COVID-19's panic and helplessness. In addition, almost all medical staff had encountered such a serious epidemic for the first time, lacking of work experience and adequate ideological preparation in dealing with severe infectious diseases, and were highly alert to novel coronavirus's lack of awareness at work. Up to date, the COVID-19 influenza pandemic in China still continued to develop, but there has been no large-scale outbreak and no large number of serious deaths. At present, the large-scale outbreak in China had been well controlled, although China had paid a serious price for its economy and people's livelihood. Some good practices, however, were still worthy of reference by countries with epidemic conditions in the world, so as to develop a series of effective epidemic prevention and control programs suitable for their own countries.

The 'feeling of hypothetical scenario' has no significant difference in different work environments. Nevertheless, workers in cities and towns, with more self-media means, such as Wechat, Douyin, Express, etc., to spread information about the epidemic and to be known by more people, especially in provincial capitals, have a higher awareness of the risk of infectious diseases. Unfortunately, during the pandemic (COVID-19) 2020 in

China, particularly in the first half of February, the Chinese government and provincial or municipal local governments were trying to carry out epidemic prevention and control actively, but it was a pity that few departments in the early stage of the epidemic would provided medical staff with timely protection or compensation information about COVID-19 infection obtained during the performance of hospital duties. In preparing for the outbreak, some studies have stressed that employers in both communities and institutions should take all reasonable and scientific precautions to prevent those workers from being infected as much as possible. Then they should be provided with reliable compensation if the staff in hospital were infected in the performance of their duties [14,15]. Fortunately, with the further outbreak of the epidemic, the Chinese government had formulated corresponding policies to help those workers on the front line of the fight against the epidemic, such as additional living allowances, preferential evaluation programs for professional titles, care of staff children, school affairs, and so on, all of which show the advantages of the Chinese government's humanistic care. In addition, the recovery rate of the questionnaire in this study is as high as 98.90%, leaving 1837 questionnaires (90.99%) for analysis. In that case, it can be considered that this study can preliminarily explain the psychological impact and risk perception of staff in the hospital during the pandemic. Unfortunately, the sample size of this study was relatively small, although the source of the staff participating in the questionnaire was concentrated in the areas with high incidence of the epidemic, its distribution cannot fully covered the whole of China. It only represents the psychological problems and risk awareness level of some regional hospital workers. It may be more scientifically meaningful to include participants from a wider range of sources in future studies.

Conclusions

This study investigated the stresses and risk perception ability experienced by hospital workers responding to the early stage of pandemic (COVID-19) 2020 in many cities, China.

In order to enable medical personnel, especially those who work in high-risk departments, those can deal more effectively with sudden epidemics such as COVID-19 with minimal stress and maximum risk awareness in a relatively favorable working environment that is safe and unconcerned, it is essential for hospitals and governments to carry out as many public campaigns as possible to protect their workers as soon as possible. In addition, timely and frequently provide some up-to-date information about the epidemic, and provide as many effective and positive psychological services and assistance as possible, which may undoubtedly be more helpful to reduce the heavy pressure and adverse psychological impact of explosive epidemic diseases such as COVID-19 (2020) on medical staff.

Acknowledgement

In particular, we would like to thank a number of hospitals from various regions in China for their great help and support in this study. The author claims that there is no competing interest between them.

Funding

The trial is funded by the Project funded by China Postdoctoral Science Foundation (2020M670046ZX), Emergency Committee of the World Federation of Chinese Medicine Societies and Shanghai Society of Traditional Chinese Medicine, Novel Coronavirus Pneumonia Emergency Tackling Key Project (SJZLJZ.N01). The study also received funding from the Wuhan Health Commission COVID-19 epidemic Prevention and Control Emergency Research Project (EX20C01), the National Key Research and Development Program of China (2018YFC1705900) and Xi'an Science and Technology Plan Project (XA2020-RXYYJ-0086). The Emergency Committee of the World Federation of Chinese Medicine Societies, Shanghai Society of Traditional Chinese Medicine, and National Key Research and Development Program of China play no part in the study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication.

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