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The impact of COVID-19 pandemic on healthcare workers under the "Ten New Guidelines" in Taizhou, China

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ABSTRACT

Purpose: We explored the influence of the "Ten new guidelines" on healthcare workers' preparedness, work impact, personal life impact, concerns, and support in Taizhou, China.
Methods: A hospital-based self-administered online survey was conducted to investigate the levels of COVID-19 related experience among healthcare workers in December 2022. In total, 472 out of 2080 healthcare workers (22.7 % response rate) completed the questionnaires with valid responses. Stepwise linear regression was used to investigate the independence of factors associated with preparedness, work impact, personal life impact, concerns, and support.
Results: The results revealed that working position ($p < 0.001$), pressure ($p = 0.005$), and negative affect ($p < 0.001$) were significantly associated with preparedness. Working position ($p = 0.015$), number of children ($p = 0.040$), working years ($p = 0.019$), COVID-19 risk perception ($p < 0.001$), work overload ($p < 0.001$), and negative affect ($p < 0.001$) were significantly associated with work impact. In addition, COVID-19 risk perception ($p < 0.001$), work overload ($p < 0.001$), pressure ($p = 0.002$), history of COVID-19 infection ($p = 0.008$), and awareness of possible infectious time ($p = 0.031$) were significantly associated with personal life impact. COVID-19 risk perception ($p < 0.001$), negative affect ($p < 0.001$), and work overload ($p = 0.020$) were significantly associated with concerns. Sex ($p = 0.020$) and negative affect ($p = 0.016$) were significantly associated with support.
Conclusion: Negative affect was the most significant factor associated with COVID-19 related questions among healthcare workers under "Ten new guidelines" during COVID-19 pandemic.

1. Introduction

COVID-19 has been an ongoing global public health problem for almost three years (Khandia et al., 2022). Given that the virus strains are capable of resisting natural or vaccine-elicited immunity and the absence of an effective treatment for COVID-19, the pandemic has significantly influenced and impacted human health and the economy (Planas et al., 2022). Prolonged lockdowns and stringent screening policies have resulted in a heavy burden on governments, industries, organizations, and individuals (Peng et al., 2022; Dzimbiri et al., 2022; Nazzal et al., 2022). Meanwhile, COVID-19 has also disturbed the healthcare systems in many countries worldwide (Aymerich et al., 2022; Andhavarapu et al., 2022). As the main force of medical treatment, normalized COVID-19 prevention and control, strict testing, and contact tracing systems were implemented in China. Healthcare workers face a high risk of psychosocial problems when confronted with the infection and workload over long working hours (Chen et al., 2022).

Previous academic study indicated found that COVID-19 related questions included preparedness, work impact, personal life impact, concerns, and support were identified by healthcare practitioners involved in the prevention and control of the COVID-19 pandemic (Zeng et al., 2021). Healthcare workers have experienced work and personal life related impacts during the COVID-19 pandemic (Pappa et al., 2020; Preti et al., 2020; Marceau et al., 2022). Previous studies reported that

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concerns among healthcare workers during pandemics included the perceived risk (Murray et al., 2021) and concerns regarding work conditions (Barello et al., 2020). Factors associated with high psychological distress levels include low preparedness and high levels of work impact, personal life impact, and concerns (Zeng et al., 2021). In addition, common social and occupational factors may have contributed to adverse psychological well-being among healthcare practitioners.

China has experienced significant challenges in COVID-19 prevention and control. On December 7, 2022, the Notice on Further Optimizing the Implementation of COVID-19 Prevention and Control Measures (referred to as the "Ten new guidelines") was proposed (Table S1), which further optimize measures for the treatment and isolation of COVID-19 infected persons and close contacts, implying a shift in prevention and control policy from dynamic clearance to normal prevention (Comprehensive Group of the Joint Prevention and Control Mechanism of the State Council for COVID-19, 2022). The "Ten new guidelines" proposes that medical institutions at all levels should ensure normal medical services and provide medical convenience for patients. To explore the impact of COVID-19 policy change in China on healthcare workers, this study aimed to identify possible associated factors relevant to preparedness, work impact, personal life impact, concerns, and support on healthcare workers who were confronted with the "Ten new guidelines" during COVID-19 pandemic in Taizhou, China.

2. Methods

2.1. Study design and data collection

This cross-sectional study was conducted to investigate the levels of COVID-19 related experience among healthcare workers who participated in the routine prevention of COVID-19 at a medical center in Taizhou, China. Participants were recruited via convenience sampling. We conducted an anonymous, hospital-based online survey from December 23 to 31, 2022 via the WeChat questionnaire platform, the largest online survey platform in mainland China. The researchers shared the questionnaire with the WeChat groups of the respective departments. The selected participants were informed that the survey was voluntary and there were no right or wrong answers.

To calculate an appropriate study sample, G-power version 3.1 was used with 90 % power, an effect size 0.05, and 10 predictors with a significance level (alpha) of 0.05 (Jacob, 1988). A sample size of 420 was achieved. Hence, 484 out of 2080 healthcare workers who completed and submitted their questionnaires (response rate = 23.3 %) were included. Questionnaires that provided significantly unreasonable answers, completed within 360 s, or done randomly were viewed as those completed without serious consideration and were excluded. Thus, our final sample consisted of 472 healthcare workers in Taizhou, with 97.5 % (472/484) of the responses being valid. This study was approved by the Taizhou Hospital Committee of Zhejiang Province (K20221221). All the procedures observed the ethical review guidelines set by the included institutes and the principles of the Declaration of Helsinki and all its future amendments in all procedures.

2.2. Measurements

Data were collected via a self-administered questionnaire. It included participants' basic demographic information, COVID-19 risk perception, negative affect, and a COVID-19 related questionnaire.

2.2.1. Demographic characteristics

Demographic data included sex, age, education level, working position, number of working years, number of children (age < 18 years), experience in preventing COVID-19 transmission, history of COVID-19 infection, awareness of possible infectious time, pressure, work overload, and possibility to reduce clinical working time (Table S4).

2.2.2. COVID-19 risk perception

We utilized the Chinese COVID-19 Risk Perception Scale, which had confirmed reliability and validity at a reasonable level (Cui et al., 2021). The scale comprised nine items that evaluated the three dimensions of epidemic severity; susceptibility and controllability (Table S2). Participants were asked to rate each item on a 5-point Likert scale that ranged from 1 "strongly disagree" to 5 "strongly agree." A summed average score was calculated for each dimension. A summed average score of above 3 was considered high in risk perception (Ning et al., 2020). Cronbach's alpha coefficient for the questionnaire was 0.778.

2.2.3. Negative affect

Negative affect means general dimension of subjective distress and unpleasurable engagement that subsumes a variety of aversive mood states such as anger, contempt, disgust, guilt, fear, and nervousness. Calmness and serenity implied low negative affect status (Watson et al., 1988). The Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988) was developed by Watson and Clark based on a two-dimensional model of emotions: positive and negative affect. The scores of items on the two subscales were summed respectively to yield total scores for positive affect and negative affect (He et al., 2019). This study used the 10 items from the Negative Affect factor (e.g., sad, nervous, or upset). Each item was scored on a 5-point Likert scale (1 = not at all to 5 = extremely). Cronbach's alpha coefficient for the negative affect subscale of this study was 0.951.

2.2.4. COVID-19 related questionnaire

A 23-item self-administered questionnaire was developed with good content validity and overall internal consistency to assess healthcare workers' experiences and impact of the COVID-19 pandemic in China (Zeng et al., 2021). We used five subscales that included preparedness, work impact, personal life impact, concerns and support to measure COVID-19 related questions (Table S3). The items were rated on a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree). Cronbach's alpha coefficients for the total scale and five subscales were 0.881, 0.865, 0.906, 0.908, 0.819 and 0.913, respectively.

2.3. Statistical analysis

The results were presented as mean ± standard deviations (SD) or percentage (%) for continuous or categorical variables. Two-sample independent t-tests and one-way analysis of variance (ANOVA) were used to compare the differences in the demographic and personal background variables. Pearson's correlation coefficient method was used to investigate the relationship of associated continuous factors.

After accounting for all univariate significant factors, a stepwise linear regression analysis was performed to explore the independent effects of relevant factors on preparedness, work impact, personal life impact, concerns, and support after controlling for the covariates among healthcare workers. Statistical significance level (α) was set at 0.05, two-tailed. All statistical analyses were performed via IBM SPSS version 26.0 (IBM Corporation, Armonk, USA).

3. Results

3.1. Characteristics of the participants

In this study, 484 healthcare workers completed the survey. Of these, 97.5 % (472/484) had valid responses and included in the analysis. Table 1 shows the participants' basic demographic characteristics. Among the 472 participants, 80 (16.9 %) were male and 392 (83.1 %) were female. Of these, 58.9 % (278/472) were aged younger than 35 years. The majority had an undergraduate degree (67.6 %), and 53.0 % of participants were worked under 10 years. The participants included 106 clinicians (22.5 %), 231 nurses (48.9 %), and 135 (28.6 %) medical technicians or administration position. In addition, the mean ± SD of

Table 1
The demographic characteristics of healthcare workers (n = 472) in Taizhou, Zhejiang, China: 2022.

Variables	Categories	n (%) or mean ± SD
Categorical variables		
Sex	Males	80 (16.9)
	Females	392 (83.1)
Age (years)	<35	278 (58.9)
	≥35	194 (41.1)
Education level	College and below	60 (12.7)
	Undergraduate	319 (67.6)
	Postgraduate	93 (19.7)
Working position	Clinicians	106 (22.5)
	Nurse	231 (48.9)
	Medical technicians or administration position	135 (28.6)
Working years	<10 years	250 (53.0)
	≥10 years	222 (47.0)
Number of children	≥1 child	268 (56.8)
	No	204 (43.2)
Experience in preventing COVID-19 transmission	Yes	253 (53.6)
	No	219 (46.4)
History of COVID-19 infection	Yes	22 (4.7)
	No	450 (95.3)
Awareness of possible infectious time	<1 month	254 (53.8)
	≥1 month	218 (46.2)
Pressure	Yes	399 (84.5)
	No	73 (15.5)
Work overload	Yes	322 (68.2)
	No	150 (31.8)
Possibility to reduce clinical working time	Yes	100 (21.2)
	No	372 (78.8)
Continuous variables		
COVID-19 risk perception	28.50 ± 5.18	
Negative affect	21.47 ± 8.28	
COVID-19 related questions		
Preparedness	24.99 ± 3.72	
Work impact	17.79 ± 4.38	
Personal life impact	23.21 ± 7.20	
Concerns	12.07 ± 3.63	
Support	23.15 ± 4.09	

preparedness, work impact, personal life impact, concerns, and support were 24.99 ± 3.72, 17.79 ± 4.38, 23.21 ± 7.20, 12.07 ± 3.63 and 23.15 ± 4.09, respectively. The mean ± SD of COVID-19 risk perception and negative affect were 28.50 ± 5.18 and 21.47 ± 8.28.

3.2. Univariate analysis of the factors related to COVID-19–related experience

There were statistically significant differences between the descriptive characteristics and preparedness mean scores points of healthcare workers by sex ($p = 0.001$), education level ($p = 0.002$), working position ($p < 0.001$), experience in preventing COVID-19 transmission ($p = 0.041$), pressure ($p < 0.001$), work overload ($p = 0.037$), and possibility to reduce clinical working time ($p = 0.036$). In addition, there were significant differences in the mean scores of work impact by education level ($p = 0.001$), working position ($p < 0.001$), number of working years ($p = 0.021$), number of children ($p < 0.001$), experience in preventing COVID-19 transmission ($p = 0.035$), awareness of possible infectious time ($p < 0.001$), pressure ($p = 0.001$), and work overload ($p < 0.001$). There were also significant differences in the mean scores of personal life impact by working position ($p = 0.005$), number of children ($p = 0.008$), possible infectious time ($p < 0.001$), pressure ($p < 0.001$), and work overload ($p < 0.001$). Significant differences were also observed in the mean scores of concerns by age (<35 vs ≥35 years) ($p = 0.006$), number of children ($p = 0.012$), awareness of possible infectious time ($p = 0.009$), pressure ($p < 0.001$), and work overload ($p < 0.001$). In addition, significant differences were observed in the mean scores of support by sex ($p = 0.001$), working position ($p = 0.011$), and awareness of possible infectious time ($p = 0.041$) (Table 2).

Table 3 presented the correlations among preparedness, work impact, personal life impact, concerns, support, COVID-19 risk perception, and negative affect. Work impact (r = 0.380, $p < 0.001$), personal life impact (r = 0.532, $p < 0.001$), concerns (r = 0.492, $p < 0.001$), and COVID-19 risk perception (r = 0.444, $p < 0.001$) had significant positive correlations with negative affect. Work impact (r = 0.377, $p < 0.001$), personal life impact (r = 0.460, $p < 0.001$), and concerns (r = 0.565, $p < 0.001$) also had significant positive correlations with COVID-19 risk perception. Furthermore, positive correlations were also found between preparedness and support (r = 0.534, $p < 0.001$), work impact and personal life impact (r = 0.576, $p < 0.001$) and concerns (r = 0.429, $p < 0.001$), and personal life impact and concerns (r = 0.630, $p < 0.001$). Preparedness (r = −0.203, $p < 0.001$) and support (r = −0.114, $p < 0.05$) had significant negative correlations with negative affect.

3.3. Related factors of COVID-19 related experience

Independent variables that were significant in the univariate analyses and Pearson's correlation analysis were included in the stepwise multivariate linear regression model. Table 4 showed that nurses had a higher preparedness than clinicians (β = 1.592, 95 %CI: 0.772, 2.412, $p < 0.001$). Participants with pressure (yes vs no; β = −1.319, 95 %CI: −2.242, −0.396, $p = 0.005$) and negative affect (β = −0.077, 95 %CI: −0.118, −0.037, $p < 0.001$) were significantly negative associated with preparedness (Model 1). In model 2, medical technicians or administration position had a lower work impact than clinicians (β = −1.165, 95 %CI: −2.100, −0.230, $p = 0.015$). Subjects with work overload had a higher work impact (yes vs no; β = 3.193, 95 %CI: 2.452, 3.934, $p < 0.001$). Number of children (≥1 vs no; β = 0.754, 95 %CI:0.036, 1.473, $p = 0.040$), working years (≥10 vs. <10 years, β = 1.168, 95 %CI:0.638, 6.993, $p = 0.019$),), COVID-19 risk perception (β = 0.177, 95 %CI:0.106, 0.249, $p < 0.001$), and negative affect (β = 0.094, 95 %CI:0.049, 0.139, $p < 0.001$) were also positively related to work impact (Model 2).

Table 4 also indicated that COVID-19 risk perception (β = 0.493, 95 %CI:0.380, 0.606, $p < 0.001$), pressure (yes vs no; β = 2.564, 95 % CI:0.961, 4.168, $p = 0.002$), history of COVID-19 infection (β = 3.538, 95 %CI:0.915, 6.161, $p = 0.008$), and awareness of possible infectious time (<1 vs ≥1 month; β = 1.246, 95 %CI:0.117, 2.375, $p = 0.031$) and higher work overload (yes vs no; β = 3.380, 95 %CI: 2.162, 4.598, $p < 0.001$) were significantly positively associated with personal life impact (Model 3). In addition, COVID-19 risk perception (β = 0.296, 95 % CI:0.240, 0.351, $p < 0.001$), negative affect (β = 0.122, 95 %CI:0.086, 0.157, $p < 0.001$) and work overload (yes vs no; β = 0.688, 95 %CI: 0.110, 1.266, $p = 0.020$) were significantly positively associated with concerns (Model 4). Lastly, sex (males vs females, β = −1.259, 95 %CI: −2.323, −0.195, $p = 0.020$) and negative affect (β = −0.054, 95 %CI: −0.099, −0.010, $p = 0.016$) were significantly negative associated with support (Model 5).

4. Discussion

4.1. Clinical implications

Understanding healthcare workers' preparedness, work impact, personal life impact, concerns, and support after the new guidelines is essential to effectively plan and manage the provision of care. This study showed that several work (working position and years and work overload), personal (number of children, sex, pressure, and negative affects), and COVID-19 related factors (history of COVID-19 infection, possible infectious time, and COVID-19 risk perception) were associated with healthcare workers' preparedness, work impact, personal life impact, concerns, and support. Our results will provide a deeper understanding

Table 2
Univariate analysis of factors associated with COVID-19–related questions among healthcare workers (n = 472) in Taizhou, Zhejiang, China: 2022.

Variables	Categories	Preparedness mean ± SD	*P* value	Work impact mean ± SD	*P* value	Personal life impact mean ± SD	*P* value	Concerns mean ± SD	*P* value	Support mean ± SD	*P* value
Sex	Males	23.69 ± 4.32	0.001	18.11 ± 4.12	0.471	23.66 ± 7.00	0.536	11.86 ± 3.16	0.579	21.78 ± 4.31	0.001
	Females	25.26 ± 3.53		17.72 ± 4.44		23.11 ± 7.24		12.11 ± 3.72		23.44 ± 3.99	
Age (years)	<35	25.06 ± 3.70	0.627	17.64 ± 4.45	0.374	23.05 ± 7.29	0.570	12.45 ± 3.53	0.006	23.27 ± 4.05	0.465
	≥35	24.89 ± 3.75		18.01 ± 4.29		23.43 ± 7.08		11.52 ± 3.71		22.99 ± 4.16	
Education level	College and below	25.97 ± 3.12	0.002	15.83 ± 5.44	0.001	22.08 ± 7.63	0.426	11.87 ± 3.56	0.455	23.43 ± 3.91	0.159
	Undergraduate	25.13 ± 3.67		17.97 ± 4.17		23.34 ± 7.21		12.21 ± 3.74		23.31 ± 4.14	
	Postgraduate	23.90 ± 4.00		18.45 ± 4.03		23.49 ± 6.89		11.71 ± 3.29		22.43 ± 4.00	
Working position	Clinicians	23.97 ± 3.90	<0.001	18.58 ± 3.84	<0.001	23.41 ± 7.14	0.005	11.85 ± 3.36	0.069	22.49 ± 3.86	0.011
	Nurse	25.71 ± 3.56		18.32 ± 4.52		24.07 ± 7.04		12.45 ± 3.72		23.73 ± 4.05	
	Medical technicians or administration position	24.56 ± 3.61		16.27 ± 4.20		21.57 ± 7.29		11.59 ± 3.63		22.70 ± 4.23	
Working years	<10 years	25.03 ± 3.66	0.821	17.35 ± 4.42	0.021	23.24 ± 7.10	0.918	12.37 ± 3.41	0.053	23.18 ± 3.91	0.904
	≥10 years	24.95 ± 3.79		18.28 ± 4.31		23.17 ± 7.32		11.73 ± 3.84		23.13 ± 4.30	
Number of children	≥1 child	24.81 ± 3.75	0.233	18.43 ± 4.23	<0.001	23.98 ± 7.12	0.008	12.43 ± 3.52	0.012	23.01 ± 4.36	0.371
	No	25.23 ± 3.67		16.95 ± 4.45		22.20 ± 7.19		11.59 ± 3.72		23.35 ± 3.71	
Experience in preventing COVID-19 transmission	Yes	25.32 ± 3.58	0.041	18.19 ± 4.27	0.035	23.67 ± 7.26	0.135	12.15 ± 3.77	0.596	23.39 ± 4.17	0.184
	No	24.62 ± 3.84		17.33 ± 4.48		22.68 ± 7.10		11.97 ± 3.47		22.89 ± 3.99	
History of COVID-19 infection	Yes	25.55 ± 3.91	0.475	19.50 ± 3.64	0.061	27.32 ± 6.29	0.006	12.45 ± 3.54	0.609	24.77 ± 3.31	0.057
	No	24.96 ± 3.71		17.71 ± 4.40		23.01 ± 7.19		12.05 ± 3.64		23.08 ± 4.11	
Awareness of possible infectious time	<1 month	24.83 ± 3.90	0.299	18.48 ± 4.05	<0.001	21.69 ± 7.24	<0.001	12.47 ± 3.56	0.009	22.80 ± 4.28	0.041
	≥1 month	25.18 ± 3.49		16.98 ± 4.62		24.51 ± 6.92		11.60 ± 3.66		23.57 ± 3.83	
Pressure	Yes	24.71 ± 3.71	<0.001	18.07 ± 4.14	0.001	24.09 ± 6.82	<0.001	12.48 ± 3.38	<0.001	23.03 ± 4.03	0.130
	No	26.51 ± 3.38		16.26 ± 5.30		18.41 ± 7.36		9.81 ± 4.10		23.82 ± 4.40	
Work overload	Yes	24.75 + 3.71	0.037	19.15 ± 3.45	<0.001	24.83 ± 6.58	<0.001	12.73 ± 3.38	<0.001	23.04 ± 3.97	0.388
	No	25.51 ± 3.70		14.87 ± 4.74		19.72 ± 7.24		10.65 ± 3.76		23.39 ± 4.34	

(*continued on next page*)

Table 2 (*continued*)

Variables	Categories	Preparedness mean ± SD	*P* value	Work impact mean ± SD	*P* value	Personal life impact mean ± SD	*P* value	Concerns mean ± SD	*P* value	Support mean ± SD	*P* value
Possibility to reduce clinical working time	Yes	24.30 ± 4.23	0.036	17.93 ± 4.05	0.720	24.39 ± 6.67	0.064	12.49 ± 3.47	0.190	23.01 ± 4.75	0.691
	No	25.18 ± 3.55		17.75 ± 4.47		22.89 ± 7.31		11.95 ± 3.67		23.19 ± 3.90	

Table 3
Pearson's correlation between the independent and dependent variables among healthcare workers (n = 472) in Taizhou, Zhejiang, China: 2022.

Variables	Preparedness	Work impact	Personal life impact	Concerns	Support	COVID-19 risk perception	Negative affect
Preparedness	1.00						
Work impact	−0.014	1.00					
Personal life impact	−0.046	0.576**	1.00				
Concerns	−0.021	0.429**	0.630**	1.00			
Support	0.534**	−0.011	0.006	0.064	1.00		
COVID-19 risk perception	−0.060	0.377**	0.460**	0.565**	−0.001	1.00	
Negative affect	−0.203**	0.380**	0.532**	0.492**	−0.114*	0.444**	1.00

Note: * $p < 0.05$ ** $p < 0.01$

of the impact of COVID-19 on healthcare workers.

In China, a new guideline or policy may influence healthcare quality such as irrational and negative actions by physicians for cost-control (Yan et al., 2019). From the health management viewpoint, policy-makers still have used a number of approaches to improve services in health care systems to the COVID-19 pandemic (Alkathlan et al., 2023). Innovative interventions could effectively reduce healthcare providers' physical workload and increase clinical productivity (Alkathlan et al., 2023). Nevertheless, it was inevitable that emotion-related affects were possible reactions to the unpredictable and threatening COVID-19 pandemic, which has particularly directly affected healthcare workers (Vinkers et al., 2020). To identify challenges and priorities then find solutions for healthcare workers could increase clinical performance of health care services (Sharififar et al., 2022).

This study indicated that working position was significantly associated with preparedness and work impact, higher number of working years was significantly associated with higher work impact, and work overload was significantly related to work impact, personal life impact, and concerns. A previous study showed that almost 80 % of healthcare workers felt somewhat or well prepared to treat patients with COVID-19 (Farooq et al., 2022). In this study, nurses showed the highest levels of preparedness. Similar findings showed that majority (82.3 %) of nurses believed they were "moderately" or "extremely" prepared to manage patients with COVID-19 (Nahidi et al., 2022). However, a survey among clinicians reported that 8.9 % of the participants were unwilling to work during the pandemic, and 21.4 % expressed uncertainty regarding their willingness (Rafi et al., 2021). A noticeable finding was that woman received a higher level of support. This implied that women accounted for the vast majority of healthcare workers.

This study further revealed that not only longer working years was significantly associated with higher work impact, but also work overload was positively related to work impact, personal life impact, and concerns. Previous studies indicated the positive relationship between worked longer, work impact, and psychological status (Zeng et al., 2021; Li et al., 2022; He et al., 2021). This implied that timely responses to increased workload, which in turn increased tiredness and tension of healthcare workers was essential (Kang et al., 2020). In addition, healthcare workers were nervous both physically and mentally due to being tired to deal with medical uncertainties and critical conditions (Jeleff et al., 2022). A previous study showed that the over-workload during the pandemic was significantly heavier than before the pandemic (66.1 % vs 48.6 %) (Fernández-Aguilar et al., 2021).

In this study, the number of children were significantly associated with work impact, higher pressure was significantly associated with poorer preparedness and higher personal life impact. After the new policy, the number of cases increased rapidly in the short time. Therefore, healthcare workers' job may have been intertwined with their private life, especially for those families with children, who were expected to balance the dual roles of healthcare workers and parents simultaneously. This may have triggered a family-work conflict (Yayla and Eskici, 2021; Hong et al., 2021). Healthcare workers have the duty to care for both patients with and without COVID-19 while also protecting themselves and their own families from infection. An Irish survey on stress among doctors during COVID-19 found that the majority of respondents had moderate stress prior to any COVID-19 surge (Farooq et al., 2022). It was reported that concerns regarding their family and the risk of infecting their family members were major factors that undermined the performance of healthcare workers during the pandemic (Rafi et al., 2021; Hossain and Clatty, 2021), with family health (86 %), personal health (72 %), and social life (17 %) being their primary concerns. Evidence demonstrates that taking care of patients during the pandemic negatively impacted healthcare workers' psychological well-being (Hossain and Clatty, 2021; Stuijfzand et al., 2020). In addition, we also found that negative affect was significantly associated with preparedness, work impact, concerns, and support. Depression and anxiety were considered common negative emotions in healthcare workers (Bozdağ and Ergün, 2021). A significant number of healthcare workers experienced symptoms of depression and anxiety during the COVID-19 pandemic (Lai et al., 2020; Liu et al., 2020).

History of COVID-19 infection and awareness of possible infectious time were significantly associated with personal life. A positive significant relationship was found between COVID-19 risk perception and work impact, personal life impact, and concerns. This implied the new policy may have disproportionately affected infected healthcare workers and those who thought they would be infected in the near future. Due to concern for their safety and increased personal stress during the crisis, healthcare workers found it difficult to balance personal health risks against risks for the patients and their families when they felt at risk (Muñoz-Rubilar et al., 2022). A study conducted in general hospitals in Germany found that while 21 % of the participants on average thought they might have got infected, only 1 % were actually infected according to medical tests. This suggested that there was a gap between personal

Table 4
Stepwise linear regression models for the COVID-19-related questions among healthcare workers (n = 472) in Taizhou, Zhejiang, China: 2022.

Variables	COVID-19–related questions			
	β	SE	95 %CI	*P*
Model 1 (preparedness)				
Working position				
Nurse vs clinicians	1.592	0.417	0.772, 2.412	<0.001
Medical technicians or administration position vs clinicians	0.251	0.465	−0.663, 1.165	0.589
Pressure (yes vs no)	−1.319	0.470	−2.242, −0.396	0.005
Negative affects	−0.077	0.021	−0.118, −0.037	<0.001
Model 2 (work impact)				
Working position				
Nurse vs clinicians	−0.284	0.427	−1.123, 0.556	0.507
Medical technicians or administration position vs clinicians	−1.165	0.476	−2.100, −0.230	0.015
Number of children (≥1 vs no)	0.754	0.366	0.036, 1.473	0.040
Working years (≥10 vs. <10 years)	1.168	0.363	0.638, 6.993	0.019
COVID-19 risk perception	0.177	0.036	0.106, 0.249	<0.001
Work overload (yes vs no)	3.193	0.377	2.452, 3.934	<0.001
Negative affects	0.094	0.023	0.049, 0.139	<0.001
Model 3 (personal life impact)				
COVID-19 risk perception	0.493	0.058	0.380, 0.606	<0.001
Work overload (yes vs no)	3.380	0.620	2.162, 4.598	<0.001
Pressure (yes vs no)	2.564	0.816	0.961, 4.168	0.002
History of COVID-19 infection	3.538	1.335	0.915, 6.161	0.008
Awareness of possible infectious time (<1 vs ≥1 month)	1.246	0.575	0.117, 2.375	0.031
Model 4 (concerns)				
COVID-19 risk perception	0.296	0.028	0.240, 0.351	<0.001
Negative affects	0.122	0.018	0.086, 0.157	<0.001
Work overload (yes vs no)	0.688	0.294	0.110, 1.266	0.020
Model 5 (support)				
Sex (Males vs Females)	−1.259	0.541	−2.323, −0.195	0.020
Negative affects	−0.054	0.023	−0.099, −0.010	0.016

Model 1: Adjusted for sex, undergraduate, postgraduate, experience in preventing COVID-19 transmission, work overload, and possibility to reduce clinical working time.
Model 2: Adjusted for undergraduate, postgraduate, experience in preventing COVID-19 transmission, awareness of possible infectious time, and pressure.
Model 3: Adjusted for nurse, medical technicians or administration position, and number of children.
Model 4: Adjusted for age, number of children, awareness of possible infectious time, and pressure.
Model 5: Adjusted for awareness of possible infectious time and working position.

subjective perception and technical objective measurement and organizational conditions (Kuhlmann et al., 2022).

4.2. Clinical practice

Policies should focus on structural resources and technical apparatuses, including proper personal protective equipment and monitoring measurements, especially in hospitals (Kuhlmann et al., 2021; Burau et al., 2022). The number of working staff dealing with patients with COVID-19 should be carefully planned and expanded so that long-term overwork is avoided (Jeleff et al., 2022). Proper shift frequency and length and sufficient rest between shifts should help improve the work-life balance (Yayla and Eskici, 2021). Colleagues, managers, and institutions should keep an eye on the negative emotions and behaviors among healthcare workers. Furthermore, training courses should be initiated to help them overcome their sense of fear and learn to satisfy their basic needs (Yayla and Eskici, 2021).

5. Limitations

This study has several limitations. First, the data are cross-sectional and collected at a single time point, the cause-and-effect relation among all the variables could not be explained and we could not explore the open answers provided by the participants.

Thus, the results may not be comprehensive. Second, those surveyed were chosen based on voluntary participation. This may have led to bias since those who were more concerned regarding their health and the risk of COVID-19 were more likely to participate than those who were not. Third, the response rate was low. Though the comparatively large sample size enabled us to evaluate the factors related to COVID-19 and the 95 % confidence interval was narrow enough to guarantee the reliability of our results, the low response rate might have contributed to a bias. Fourth, the current status of healthcare workers in this study might not be influence by “ten new guideline” only. Although we identified several factors associated with COVID-19 related questions, it was very difficult to consider all other potential factors. Fifth, only 4.7 % infected healthcare workers in this setting which is relatively lower compare to the national experience, this might induce reporting bias and stigma attached to having COVID-19. Sixth, allied health clinicians were defined as physiotherapists, occupational therapists, speech pathologists, dieticians and so on (Abery et al., 2018). However, we did not distinguish between allied health clinicians and medical technicians. Bias estimated might be occurred. Seventh, we only used Negative.

Affect subscale of PANAS, like previous studies (He et al., 2019; Sierra et al., 2021), however, this may not only introduce bias towards negative impacts of working under the new COVID-19 conditions, but also not identify potential beneficial effects. Hence, further longitudinal studies regarding the same topic should be conducted to explore an insightful information. Furthermore, qualitative interviews also should be conducted to enrich the clinical application.

6. Conclusion

In addition to negative affect was the most significant factor, several personal, family, and working situations were also found to independently affected COVID-19 related questions among healthcare workers under “Ten new guidelines” during COVID-19 pandemic.

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CRediT authorship contribution statement

Yu-Pei Yang: Writing – original draft, Methodology, Formal

analysis, Conceptualization. **Shuang-Jun Pan:** Writing – original draft, Methodology, Investigation. **Mei-Xian Zhang:** Methodology, Investigation, Conceptualization. **Hai-Xiao Chen:** Methodology, Conceptualization. **Tao-Hsin Tung:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

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