Predictors of stress among nucleic acid sampling support nurses (NASSNs) during the COVID-19 pandemic

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Abstract

Background The COVID-19 pandemic has forced nucleic acid detection to be essential for prevention and control. The psychological and physical health of healthcare staff who conducted nucleic acid sampling (NAS) should be paid attention to. This study aims to investigate the status and explore the predictors of stress among nucleic acid sampling support nurses (NASSNs) by an online survey.

Material and methods Totally 388 NASSNs were recruited through cluster random sampling for the research. An online cross-sectional survey with structured questionnaires was used, including socio-demographic information, the stressor scale of nucleic acid sampling nurses (SSNASN), and the challenge–hindrance stress scale (CHSS). T-tests, ANOVA, and multivariable linear regression model were used to analyze data.

Results A total of 324 NASSNs filled out questionnaires online with a response rate of 83.51%. NASSNs had an overall mean score of (2.199±0.917) for challenge stress and (2.014±0.805) for hindrance stress. The item "the amount of responsibility I have" scored highest in the challenge stress dimension, while "the lack of job security I have" scored highest in the hindrance stress dimension. The predictors of challenge and hindrance stress include concern about the preparedness of NASSNs and their families, working environment, and competence of emergency disposal. An additional socio-demographic predictor of challenge stress was motivation, while that of hindrance stress was longer nursing experiences.

Conclusions During the COVID-19 pandemic, stress among NASSNs was moderately low. The factors detected to be predictors of stress include motivation, nursing experiences, concern about the preparedness of NASSNs and their families, working environment, and competence in emergency disposal. Therefore, in advance of responding to a public health event, we recommend that subsequent short-term psychological counseling be given to healthcare workers and accompanying psychological counseling be provided to prevent the emergence of mental health problems thereafter.

Keywords COVID-19 pandemic, Nucleic acid sampling, Nurses, Stress, Predictor

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Introduction

Since March 2022, the novel coronavirus with Omicron variant has been spreading in Shanghai [1]. More than 220,000 confirmed cases have been reported nationally by the end of June [2]. Nucleic acid tests are essential in preventing and controlling the COVID-19 pandemic to achieve the goal of "early detection, early reporting, early isolation, and early treatment"[3]. In order to ensure the quality and quantity of large-scale nucleic acid testing and screening within designated sites like communities and schools, nucleic acid sampling support nurses (NASSNs) from various medical institutions were sent to strengthen personnel.

NASSNs refer to nurses who are not full-timely dedicated to nucleic acid sampling (NAS) and who are temporarily deployed from different medical institutions to support the frontline NAS teams during the pandemic. Their work contents list as follows: (a) preparation of sampling consumables and personnel to conduct NAS in the designated communities, universities and other sites; (b) NAS of positive patients individually at home; (c) health education to the public on sampling norms, cooperation, wearing masks, and lining up in an orderly manner and keeping a distance; (d) standardized disposal of sampling waste.

Stress is a response mode when the body breaks its balance and load capacity to external stimuli, with the work-related stress as the most common and typical type [4]. Some scholars divide stress into positive stress (eustress) and negative stress (distress) [5–7]. Cavanaugh et al. [8] propose the challenge–hindrance stress on this basis. Challenge stress is the stress that individuals can overcome and brings a sense of accomplishment, and motivation, facilitating performance and career development [9]. Challenge stress usually includes appropriate workload, time urgency, job responsibilities, and complexity of work [10]. Stress that individuals find difficult to overcome is defined as hindrance stress, including role conflicts, responsibility ambiguity, bureaucratic procedures, organizational politics, and job insecurity [11]. Researchers have identified hindrance stress as a barrier to the achievement of goals [12]. Interestingly, Tong believed that there was a critical point below and above which indicated challenge stress and hindrance stress, respectively [13].

Healthcare staff has been bearing much stress since the outbreak of the COVID-19 pandemic, as reported in prior studies [14–16]. Their stress might stem from the high risk of infection, overwork, lack of a safe work environment, increased number of confirmed and suspected cases, negative patient emotions, and lack of contact with family members [17–19]. Thus, NASSNs under the threat of occupational exposure of the COVID-19 could experience stress and have short- and long-term psychological outcomes. Evidence implies that frequent night shifts, fatigue, fear of infection, overwork, burnout, and self-blame for the adverse outcomes of patients are predictors of stress among frontline healthcare staff [18, 19]. In addition, some studies have highlighted the need to focus on the occupational pressure of frontline healthcare staff during the COVID-19 pandemic [20].

The pandemic has highlighted the vulnerability of healthcare workers to psychological distress. While numerous studies have focused on the general healthcare workforce, there is a gap in research specifically addressing NASSNs. These nurses are at the forefront of pandemic response, conducting critical tasks such as testing and contact tracing, which exposes them to unique stressors not experienced by other healthcare professionals. The existing literature on stress predictors among NASSNs is limited, but suggests that resilience, coping strategies, personality traits, and social support are critical factors influencing their psychological well-being during the COVID-19 pandemic [16–18]. More research is needed to explore these predictors within the specific context of NASSNs to inform tailored support strategies.

According to the person–environment fit theory, what causes stress is not the result of individual and environmental characteristics acting alone but rather a mismatch between the two [21]. The individual part represents motivation, personality characteristics, knowledge, ability, values and other factors that can form differences, and the environment part represents the internal and external environment of the organization [22]. Furthermore, the person–environment fit theory suggests that the congruence between an individual's personal attributes and the work environment's demands and resources is crucial for psychological well-being. During the COVID-19 pandemic, NASSNs have faced unique and intense work demands that may disrupt this fit, potentially contributing to increased stress levels. Therefore, guided by the person–environment fit theory, this study aims to investigate the current situation of NASSNs' stress and related influencing factors (predictors). Based on this theory, we chose relevant measurements and possible influencing factors and hoped to provide a basis for developing targeted interventions from the organizational level to relieve their stress and encourage efficiency and confidence in fighting the pandemic.

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Materials and methods

Study design and participants

The current study took a cross-sectional design based on responses to an online survey that comprised three sections. A total of 388 NASSNs from two general tertiary hospitals were recruited for the study using cluster random sampling. The inclusion criteria of our study were participants who were (a) registered nurses; (b) included in the hospital's NAS support team and sent out for the sampling; (c) voluntary. Logistical staff assisting with NAS were excluded from the study. We obtained ethical approval from the Institutional Review Board of Changhai Hospital and informed consent from the participants through the questionnaire link.

Design of the online survey

The online survey consisted of questions related to socio-demographic information, the stressor scale of nucleic acid sampling nurses (SSNASN), and the challenge–hindrance stress scale (CHSS) [8].

Socio-demographic information questionnaire

The socio-demographic information included gender, age, nursing experience, professional title, educational level, marital status, etc.

The stressor scale of nucleic acid sampling nurses (SSNASN)

Referring to the Chinese nurses' work stressors scale developed by Li Xiaomei et al. [23], we designed the SSNASN through brainstorming, expert consultation, and literature review. Six experts in nursing management, statistics, medicine, and infection control were invited to review the dimensions and items of the scale. After two rounds of review, the scale consisted of four dimensions, including preparedness of NASSNs and their families (8 items), working environment of NASSNs (7 items), competence of emergency disposal (4 items), and interpersonal relationships (3 items). A Likert 5-point scale was used, with one point indicating no stress and five points indicating great stress. The total score of the scale was 110 points. Calculated from the data of this study, the Cronbach's alpha coefficient for the total scale was 0.952, and the split-half reliability was 0.877. The Cronbach's alpha coefficients for the four dimensions were 0.923, 0.929, 0.864, and 0.714, indicating that the scale's reliability was sound.

The challenge–hindrance stress scale (CHSS)

Developed by Cavanaugh et al. [8] and translated and modified by Chang Suying [24], the scale was mainly used to measure the level of stress felt by health care staff, including two dimensions, challenge stress (6 items) and hindrance stress (5 items). The CHSS was rated on a 5-point Likert scale (1–5 points), with higher scores indicating more significant stress. The Cronbach's alpha coefficient for the scale was 0.875, while those for challenging and hindrance stress were 0.877 and 0.779, respectively. The variance explained by the questionnaire was 58.429%. The CHSS has been verified to have good reliability and validity among healthcare staff [25, 26].

Data collection

The participants filled out anonymous questionnaires through a two-dimensional code or an internet link based on Wen Juanxing from February 1 to April 30, 2022, in Shanghai. The random number table method was used in the process of cluster random sampling. We numbered 23 medical institutions participating in NAS support sequentially. Six institutions were selected as clusters according to the random numbers generated. Then, we recruited all the 388 NASSNs who met the inclusion criteria from the six institutions. We obtained permission from hospital administrators to conduct the investigation. The recruited 388 NASSNs also signed informed consent digitally before data collection. An online survey was designed to collect data via Wen Juanxing (www.wjx. cn). Through the online survey platform, we limited each participant to one chance to answer questions and only via WeChat to avoid duplication of data collection. Questionnaires with too short answer time (less than 2 min) or obviously unreasonable answers (choosing the same option for all questions) in the output result would be considered invalid and removed from the dataset. Totally, 324 questionnaires were recovered anonymously and met our data requirements. Therefore, the effective response rate of the investigation was 83.51%.

Statistical analysis

Data were analyzed using SPSS 22.0 software. Descriptive statistics (mean, standard deviation, frequency (%)) were conducted for all participant characteristics. Normally and non-normally distributed continuous variables were expressed as mean ± standard deviation and median/quartile. Cross-sectional associations between participant characteristics and challenge/hindrance stress were first analyzed using independent samples t-tests and ANOVA, then modelled using multivariate linear regressions, adjusting for any characteristics that were significant in univariate analysis. Multivariable linear regression was used to determine the predictors that caused challenge–hindrance stress. Differences were considered statistically significant at $P < 0.05$.

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Results

Characteristics of the participants

The 324 NASSNs were mainly female (300, 92.59%) distributed in the age group of 25–35 (139, 42.9%), and most of them were junior nurses (142, 42.83%). More socio-demographic information is shown in Table 1.

Challenge–hindrance stress and SSNASN of NASSNs

NASSNs had an overall mean score of (2.199 ± 0.917) for challenge stress and (2.014 ± 0.805) for hindrance stress. The ranks and scores of each item are shown in Table 2. Meanwhile, the mean score of SSNASN was 2.339 ± 1.085

Table 1 Socio-demographic characteristics of the participants (*N* = 324), February 1 to April 30, 2022, China

Variable	Participants (*N* = 324) [*n* (%)]
Gender	
Male	24 (7.41)
Female	300 (92.59)
Age	
< 25	111 (34.26)
25 ~ 35	139 (42.90)
> 35	74 (22.84)
Professional title	
Junior nurse	142 (43.83)
Senior nurse	115 (35.49)
Supervisor nurse	67 (20.68)
Education	
Junior college	146 (45.06)
Bachelors' degree and above	178 (54.94)
Nursing experience	
< 5	142 (43.83)
5 ~ 10	74 (22.84)
> 10	108 (33.33)
Marital status	
Married	132 (40.74)
Single	192 (59.26)
Maternity status	
Yes	116 (35.80)
No	208 (64.20)
Motivation	
Personal willingness	280 (86.42)
Task assigned	44 (13.58)
Experiences in epidemic prevention	
Yes	190 (58.64)
No	134 (41.36)
Experiences in emergency disposal	
Yes	56 (17.28)
No	268 (82.72)

and the mean scores of each dimension are displayed in Table 3. The item "the amount of responsibility I have" scored highest in the challenge stress dimension, while "the lack of job security I have" scored highest in the hindrance stress dimension.

Univariate analysis of challenge–hindrance stress among NASSNs between different groups

No significant differences in challenge–hindrance stress were found among NASSNs concerning gender, age, professional title, education, marital status, maternity status, experiences in epidemic prevention, and emergency disposal. NASSNs working more than 10 years had higher hindrance stress than those with 5–10 years of nursing experience ($P < 0.05$). Furthermore, challenge and hindrance stress were higher among NASSNs assigned to the NAS task than those who joined in due to personal willingness ($P < 0.05$). More details are displayed in Table 4.

Multivariable linear regression of predictors of challenging–hindrance stress of NASSNs

Multivariable linear regression analyses were conducted using challenging and hindrance stress as dependent variables. Socio-demographic factors found significantly different above, and dimensions of SSNASN were listed as independent variables. As shown in Table 5, verified predictors of challenge stress were motivation, preparedness of NASSNs and their families, working environment, and competence of emergency disposal, accounting for 75% of the variance. As shown in Table 6, verified predictors of hindrance stress were nursing experiences, preparedness of NASSNs and their families, working environment, and competence of emergency disposal, accounting for 72.5% of the variance.

Discussion

Because of 2 years of constant epidemic control, healthcare staff in medical institutions are subjected to suffering from psychological symptoms and are prone to stress [19, 25]. In this study, we investigated the status of challenge–hindrance stress of NASSNs and determined the predictors of stress. Our findings suggest that the overall challenge–hindrance stress of NASSNs is moderately low, and the predictors affecting challenge–hindrance stress contain motivation, nursing experiences, preparedness of NASSNs and their families, working environment, and competence of emergency disposal.

The observed moderately low levels of challenge–hindrance stress among NASSNs can be interpreted through the lens of the person–environment fit theory. This theory posits that when there is a good fit between

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Table 2 Scores and ranks of CHSS (*N* = 324), February 1 to April 30, 2022, China

Dimensions	Rank	Item	Score (mean ± SD)
Challenge stress			2.199 ± 0.917
	1	The amount of responsibility I have	2.333 ± 1.002
	2	Time pressures I experience	2.262 ± 1.039
	3	The scope of responsibility my position entails	2.225 ± 0.990
	4	The volume of work that must be accomplished in the allotted time	2.136 ± 1.002
	5	The number of projects and/or assignments I have	2.130 ± 1.027
	6	The amount of time I spend at work	2.105 ± 1.050
Hindrance stress			2.014 ± 0.805
	1	The lack of job security I have	2.241 ± 1.037
	2	The amount of red tape I need to go through to get my job done	2.028 ± 0.945
	3	The degree to which politics rather than performance affects organizational decisions	1.994 ± 0.928
	4	The degree to which my career seems "stalled"	1.978 ± 0.919
	5	The inability to clearly understand what is expected of me on the job	1.827 ± 0.841

Table 3 Mean scores of the dimensions of SSNASN (*N* = 324), February 1 to April 30, 2022, China

Dimensions	Score (mean ± SD)
Preparedness of NASSNs and their families	2.583 ± 0.879
Working environment of NASSNs	2.567 ± 0.890
Competence of emergency disposal	1.965 ± 0.751
Interpersonal relationships	1.659 ± 0.476

an individual's personal attributes and the demands of their work environment, stress levels are likely to be lower [21]. In our study, the predictors of stress align with the dimensions of this theory, suggesting that a better fit in these areas can contribute to reduced stress levels among NASSNs.

NASSNs in our research reported moderately low challenge and hindrance stress, differing from the findings of other researchers at the beginning of the COVID-19 pandemic [14, 16]. This could be attributed to the consistent training in epidemiological characteristics, prevention, and treatment of the novel coronavirus pneumonia. It has been noted that healthcare staff facing the pandemic are exposed to chronic psychological stress on both themselves and their patients [27]. This difference in stress levels over time may also reflect an improved person–environment fit as NASSNs have adapted to the demands of their roles and as healthcare systems have evolved to better support them. It has also been reported that nurses wearing protective clothing are prone to physiological discomforts such as headaches, nausea, and respiratory distress during high-intensity work; some even become fearful of their work [28]. Hence, administrators should provide a stable and safe working environment for NASSNs from a humanistic perspective and implement early psychological interventions as recommended by Pinho [29]. In line with the person–environment fit theory, creating a supportive work environment and providing psychological interventions can enhance the fit between the personal attributes of NASSNs and their work environment. This, in turn, can lead to reduced stress levels and improved well-being, highlighting the importance of organizational support in the mental health of healthcare workers.

According to our findings, NASSNs' challenge stress scores highest in the following items, amount of responsibility, time pressures, and scope of responsibility. In contrast, their hindrance stress scored highest in the lack of job security, the amount of red tape needed, and the degree to which politics rather than performance affects organizational decisions. Challenge stress is usually considered to have a positive predictive effect on attitudes and behaviors and is beneficial to realizing potential [9, 11]. Contrary to challenge stress, hindrance stress has a negative psychological effect and requires adjustment [12]. Our study showed that challenge stress was higher than hindrance stress, indicating that NASSNs tended to perceive the stress of NAS as a challenge, which could increase their sense of professional benefit and ensure the quality of the sampling task. The highest challenge stress item was the amount of responsibility, implying that NASSNs saw a high social value in the NAS task to detect, diagnose, and treat patients with novel coronaviruses early. The highest hindrance stress score was lack of job security, suggesting nursing administrators must strengthen occupational protection and establish a standardized sampling site and procedure. Similarly, scholars abroad and at home also argued that

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Table 4 Comparisons of challenge–hindrance stress scores between different groups of participants (*N* = 324), February 1 to April 30, 2022, China

Variable	*n* (%)	Challenge stress			Hindrance stress		
		Scores (mean ± SD)	t or *F*	*P*-value	Scores (mean ± SD)	t or *F*	*P*-value
Gender							
Male	24 (7.41)	2.424 ± 1.008	1.250	0.212	2.100 ± 0.877	0.546	0.585
Female	300 (92.59)	2.181 ± 0.909			2.007 ± 0.780		
Age							
< 25	111 (34.26)	2.167 ± 0.882	0.439	0.645	1.971 ± 0.739	2.546	0.080
25 ~ 35	139 (42.90)	2.177 ± 0.953			1.950 ± 0.806		
> 35	74 (22.84)	2.286 ± 0.908			2.197 ± 0.877		
Professional title							
Junior	142 (43.83)	2.138 ± 0.877	0.542	0.582	1.945 ± 0.777	0.925	0.398
Senior	115 (35.49)	2.248 ± 0.939			2.061 ± 0.834		
Supervisor	67 (20.68)	2.241 ± 0.967			2.078 ± 0.812		
Education							
Junior college	146 (45.06)	2.223 ± 0.911	0.427	0.670	1.999 ± 0.824	−0.302	0.763
Bachelors' degree and above	178 (54.94)	2.179 ± 0.924			2.026 ± 0.791		
Nursing experience							
< 5	142 (43.83)	2.216 ± 0.905	1.697	0.185	1.987 ± 0.755	3.111	0.046*
5 ~ 10	74 (22.84)	2.036 ± 0.936			1.859 ± 0.814		
> 10	108 (33.33)	2.287 ± 0.914			2.154 ± 0.845		
Marital status							
Married	132 (40.74)	2.302 ± 0.939	1.684	0.093	2.089 ± 0.840	1.408	0.160
Single	192 (59.26)	2.128 ± 0.897			1.962 ± 0.777		
Maternity status							
Yes	116 (35.80)	2.296 ± 0.957	1.430	0.154	2.129 ± 0.872	1.942	0.053
No	208 (64.20)	2.144 ± 0.892			1.949 ± 0.759		
Motivation							
Personal willingness	280 (86.42)	2.091 ± 0.855	−5.563	0.000**	1.921 ± 0.769	−5.424	0.000**
Task assigned	44 (13.58)	2.883 ± 1.010			2.600 ± 0.789		
Experiences in epidemic prevention							
Yes	190 (58.64)	2.154 ± 0.934	−1.053	0.293	1.992 ± 0.829	−0.585	0.559
No	134 (41.36)	2.262 ± 0.893			2.045 ± 0.771		
Experiences in emergency disposal							
Yes	56 (17.28)	2.321 ± 0.969	1.103	0.271	2.136 ± 0.832	1.250	0.212
No	268 (82.72)	2.173 ± 0.906			1.988 ± 0.798		

* means $P < 0.05$; ** means $P < 0.001$

Table 5 Multivariable linear regression analysis of challenge stress (*N* = 324), February 1 to April 30, 2022, China

Variant	B	SE	β	t	*P*-value	VIF
Constant item	−1.975	0.711	–	−2.778	0.006*	
Motivation	1.116	0.483	0.070	2.312	0.021*	1.170
Preparedness of NASSNs and their families	1.090	0.292	0.174	3.737	< 0.001*	2.802
Working environment of NASSNs	1.829	0.315	0.296	5.813	< 0.001*	3.344
Competence of emergency disposal	3.404	0.313	0.464	10.866	< 0.001*	2.360
Interpersonal relationships	−0.180	0.352	−0.016	−0.511	0.609	1.195

$R = 0.868$, $R^2 = 0.754$, adjusted $R^2 = 0.750$, $F = 194.717$, $P < 0.001$

* means $P < 0.05$, *SE* means standard error, VIF means variance inflation factor

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Table 6 Multivariable linear regression analysis of hindrance stress (*N* = 324), February 1 to April 30, 2022, China

Variant	B	SE	β	t	P-value	VIF
Constant item	−0.759	0.565		−1.343	0.180	
Motivation	0.625	0.370	0.053	1.689	0.092	1.175
Nursing experience (y > 10 as reference)						
< 5	−0.605	0.278	−0.075	−2.174	0.030*	1.393
5 ~ 10	−0.764	0.320	−0.080	−2.386	0.018*	1.322
Preparedness of NASSNs and their families	0.757	0.225	0.165	3.359	0.001*	2.862
Working environment of NASSNs	0.991	0.241	0.219	4.106	<0.001*	3.363
Competence of emergency disposal	2.690	0.244	0.502	11.020	<0.001*	2.450
Interpersonal relationships	0.464	0.273	0.055	1.699	0.090	1.233

$R = 0.856$, $R^2 = 0.732$, adjusted $R^2 = 0.726$, $F = 123.398$, $P < 0.001$

* means $P < 0.05$, *SE* means standard error, VIF means variance inflation factor

the stress of medical staff tended to remain stable over time due to fear of job exposure, working long hours, and barriers from institutional policy provisions [30, 31].

The most exciting finding from our analysis is that motivation, nursing experiences, preparedness of NASSNs and their families, working environment, and emergency disposal competence could predict the challenge–hindrance stress level. This result is particularly significant in the context of the person–environment fit theory, which suggests that an optimal fit between personal attributes and environmental demands can mitigate stress levels [21]. Our findings indicate that when NASSNs perceive a higher level of preparedness and support, both personally and from their families, and when they feel confident in their emergency disposal competence, they experience lower levels of stress. This aligns with the theory's assertion that a good fit can lead to better psychological outcomes. Previous studies have found that risk factors for mental health problems in the face of major health emergencies may include young age/inexperience, negative stress coping styles, exposure to and perceived level of risk associated with the patient in question, past traumatic experiences and a history of psychiatric illness or mood disorders, high levels of stress, and low quality of life ratings. Meanwhile, synthesizing former studies, the following factors are usually seen as protective factors for healthcare workers in the face of major health emergencies: positive coping styles, support from family and society, self-esteem, high job satisfaction, and altruism. Our study builds on this by identifying specific factors that contribute to a better person–environment fit, which in turn, acts as a protective factor against stress.

In our study, NASSNs who were less concerned about preparedness of themselves and families, working environment, and emergency disposal competence

showed less challenge and hindrance stress. NASSNs could develop both positive and negative emotions during NAS. Therefore, nursing administrators should help nurses make psychological adjustments, rationalize the deployment in sampling nurse personnel, clarify the scope of job responsibilities, and strengthen the training of emergency disposal. Furthermore, when dispatching NASSNs, nursing administrators should focus on relief of pressure from their families, and strengthening humanistic care. Moreover, NASSNs motivated by personal willingness to participate in the sampling task experience less challenge stress, accords with earlier observations by Deng et al.[9]. In terms of hindrance stress, NASSNs with longer nursing experiences showed higher hindrance stress. In accordance with the present results, previous studies have also demonstrated that predictors of stress among emergency medical personnel during the COVID-19 pandemic include the fear of contracting COVID-19, a reduction in safety and security while performing emergency medical procedures, and the marginalization of patients who are not infected with COVID-19 [32].

In response to the status and predictors of NASSNs' challenge–hindrance stress reflected by our findings, the following strategies are proposed: (a) establish an emergency response system in hospitals and reserve flexible personnel for emergency disposal. (b) Develop smooth communication channels between frontline NAS teams, regularly summarize and share experiences in prevention and control of COVID-19, and improve NASSNs' adaptability to complex clinical settings. (c) Set up a psychological hotline and provide psychological counseling to staff to reduce negative emotions. (d) Strengthen logistical support and increase humanistic care to alleviate health care workers' concerns about their families.

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Limitations

In our study, several limitations need to be considered. Firstly, due to the limitations of cluster random sampling, sampling errors are unavoidable, such as the low proportion of male NASSNs in the survey population, which may lead to some bias in our findings. Secondly, the cross-sectional investigation and multivariable linear analysis used in our research only reflect the current situation and cannot evaluate the relevant measures and their impact. Thirdly, volunteers with or without medical backgrounds helped NASSNs a lot during the pandemic who could also be surveyed to get a deeper understanding of their support experiences. Further investigation and intervention on relieving NASSNs' stress are recommended.

Conclusions

In the light of our results, the challenge–hindrance stress of NASSNs is moderately low, and predictors of stress include motivation, nursing experiences, preparedness of NASSNs and their families, working environment, and competence of emergency disposal. This research also highlights the importance of the emergency response system, elastic personnel, flexible personnel allocation, occupational environment, logistical support, and humanistic care for the NASSNs during the COVID-19 pandemic.

Abbreviations

COVID-19	Corona virus infectious disease 2019
NASSN	Nucleic acid sampling support nurse
NAS	Nucleic acid sampling
SSNASN	Stressor scale of nucleic acid sampling nurses
CHSS	Challenge–hindrance stress scale
ANOVA	Analysis of variance
SD	Standard deviation

Declarations

Ethics approval and consent to participate
All activities were approved by Institutional Review Board of Changhai Hospital. All participants provided consent before accessing online survey.

Consent for publication
Not applicable.

Competing interests
All authors declare there are no competing interests.

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