Research article

Mental health and psychosocial problems among laboratory technicians in response to the COVID-19 pandemic in Hebei, China

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ABSTRACT

Objective: During the coronavirus disease 2019 (COVID-19) pandemic, an increased mental burden has been widely reported among medical health workers such as physicians and nurses. However, data on laboratory technicians exposed to COVID-19 have rarely been published. The aim of this study was to assess the magnitude of psychological symptoms among laboratory technicians and analyze potential risk factors associated with these symptoms.

Methods: A cross-sectional online survey was performed via the Wenjuanxing platform (a professional online questionnaire platform) (https://www.wjx.cn/mobile/statnew.aspx) to investigate the mental health of laboratory technicians during the COVID-19 pandemic in Hebei, China from October 4, 2021, to November 3, 2021. The online questionnaire included demographic and occupational characteristics data of responders, and the Symptom Check List-90-Revised (SCL90-R) was used to quantify the magnitude of psychological symptoms among laboratory technicians. Participants' demographic and occupational characteristics were analyzed using descriptive statistical analyses. Chi-square tests were applied to compare the severity of each symptom between two or more groups. A binary logistic regression model was developed to identify the predictors of laboratory technicians' mental health in response to the COVID-19 pandemic, and outcomes are presented as odds ratios and 95% confidence interval. Statistical analysis was performed using SPSS version 21 (SPSS, New Orchard Road, Armonk, New York, USA).

Results: A total of 3081 valid questionnaires were collected. Of these 3081 participants, 338 (11.0%) reported a total SCL90-R score >160, which indicated positive psychological symptoms. Among the 338 participants who reported psychological problems, most of them were mild

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symptoms. Several factors associated with mental health problems in laboratory technicians during COVID-19 were found, which include a history of physical and/or psychological problems (all 10 symptoms $p < 0.001$), more than 10 years of work experience (depression symptoms: OR = 2.350, $p = 0.024$; anxiety symptoms: OR = 2.642, $p = 0.038$), frontline work (depression symptoms: OR = 1.761, $p = 0.001$; anxiety symptoms: OR = 2.619, $p < 0.001$; hostility symptoms: OR = 1.913, $p = 0.001$), participant in more than 3 times large-scale SARS-CoV-2 screenings and more than 36 h per week in SARS-CoV-2 nucleic acid testing.

Conclusion: A portion of laboratory technicians reported experiencing varying levels of psychological burden. During the COVID-19 pandemic, multiple interventions should be developed and implemented to address existing psychosocial challenges and promote the mental health of laboratory technicians.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has been spreading globally for more than two years, causing hundreds of millions of infections and deaths [1]. Despite extensive public health measures, the number of infected cases and deaths continues to rise owing to the variability, high transmission rate and serious pathogenicity of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [2].

Healthcare providers play an important role in the battle against COVID-19. Meanwhile, they are also victims of the pandemic. Medical health workers are at a high risk of being infected [3]. In the early stages of the COVID-19 epidemic, more than 3000 medical staff were infected in Hubei, of whom 40% were infected in hospitals because of insufficient understanding of the virus and prevention strategies[4,5]. Obviously, the dangerous and heavy work may put medical staff under tremendous physical and psychological pressure. A recent study reported that a considerable proportion of physicians in Hubei, China reported symptoms of depression (225 [45.6%]), anxiety (200 [40.6%]), insomnia (135 [27.4%]), and distress (330 [66.9%]) [6]. Moreover, a study by Baraka et al. [7] revealed that 38.5% and 62.0% of nurses had severe stress and anxiety, respectively. Notably, compared with healthcare workers working at the frontline such as doctors and nurses who directly contact patients, few studies have reported the mental health status of laboratory technician, those who conduct SARS-CoV-2 nucleic acid testing and on high risk of exposure to SARS-CoV-2 virus in laboratory samples. During the COVID-19 pandemic, mental health and psychosocial problems of laboratory technicians in response to the sudden increase in workload and high risk of being infected need to be studied.

Factors associated with mental health outcomes among physicians and nurses exposed to COVID-19 have been widely studied and well recognized [6]. According to a meta-analyses, existing mental disorders, female sex, and concerns about getting infected were repeatedly reported as risk factors for developing mental disorder, and a good economic situation was considered a protective factor [8]. In a study by Galanis et al. [9], younger age, increased perceived threat of COVID-19, longer working time in quarantine areas, working in a high-risk environment, increased workload and lower level of specialized training regarding COVID-19 were the main risk factors that increased burnout in nurses during the COVID-19 pandemic. Unlike doctors and nurses, laboratory technicians need to handle a large number of samples that could be infectious. Moreover, they may also be deployed to support areas with severe outbreaks at any time. Whether discomfort caused by heavy medical protective equipment and masks, circadian disruption due to intensive work, long-term workload, risk of occupational toxicant exposure and fear of the virus will contribute to the physical and mental burden of these laboratory technicians remains to be investigated.

To assess the magnitude of psychological symptoms among laboratory technicians and analyze potential risk factors associated with these symptoms, and provide a reference for social support to decrease adverse mental health consequences during the COVID-19 pandemic, we conducted a mental-health survey among laboratory technicians. We hypothesize that a proportion of laboratory technicians will develop psychological symptoms such as depression, anxiety and hostility in response to the pandemic. According to relevant research, female sex, increased age and history of physiological and/or physical problem were reported as risk factors for developing mental disorder, we hypothesis that these factors will also adversely affect the mental health of laboratory technicians. Given the way laboratory technicians work, we hypothesize that occupational related factors such as working in the frontline for a long time, frequently participating in large-scale coronavirus screening, more than 36 h spent in coronavirus nucleic acid detection peer week and increasing times of quarantined are also detrimental to their mental health.

2. Method

2.1. Study design and participants

This study followed the American Association for Public Opinion Research reporting guideline. Approval from the clinical research ethics committee of The Second Hospital of Hebei Medical University (Approval No. 2022-R311) was received before the initiation of this study. A cross-sectional online survey was conducted in Hebei, China to investigate the mental health of laboratory technicians during the COVID-19 pandemic from October 4, 2021, to November 3, 2021. The survey was anonymous, and confidentiality of information was assured. All the laboratory technicians who work in Hebei Province, are over 18 years old and able to fill out and submit the questionnaire independently were invited to participate in this study.

2.2. Questionnaire design, scales and measurement

An electronic questionnaire designed on the Wenjuanxing platform (a professional online questionnaire platform) (https://www. wjx.cn/mobile/statnew.aspx) was used in this study. The questionnaire was composed of three parts. Part one collected the demographic characteristics of responders, which included gender (male or female), age ($\leq$25, 26–30, 31–40, or >40), marital status (unmarried, married, or widowed/divorced), education level ($\leq$undergraduate, undergraduate, or $\geq$postgraduate), actively share feelings (yes or no), contact with COVID 19 patient samples (yes or no), and history of physiological and psychological problems (yes, no, or uncertain).

Part two assessed work-related variables, which included type of hospital (primary, secondary, or tertiary), years of work experience (<1, 1–5, 6–10, >10), education and training on SARS-CoV-2 nucleic acid detection (yes or no), working on the front line (yes or no), duration spent in frontline work (months) (<3, 3–6, 6–9, or >9), hours spent in SARS-CoV-2 nucleic acid detection/week ($\leq$36 h or > 36 h), number of times performing large-scale SARS-CoV-2 screening (0, 1, 2, or $\geq$3), having been quarantined (yes or no) and number of times quarantined (1, 2, or $\geq$3), and family or colleagues infected with COVID-19 (yes or no).

Part three was the 90-item Symptom Checklist-90 (SCL-90) developed by Derogatis, Lipman, and Covi [11]. It is a 90-item self-rating inventory with ten clinical scales (somatization, obsessive–compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism and others [e.g., foraging status and sleep]). Each dimension consists of 6–13 questions. The score on each dimension represents the average score for that dimension and directly reflects the severity of mental health problems. A subscale score $\geq$2 indicates underlying mental health problems [12]. Items are rated on a 5-point Likert scale (from 0 "not at all" to 4 "extremely likely"). The scores of the measurement tool were interpreted as follows: not at all (<2), mild (2–2.9), moderate (3–3.8), and extremely likely ($\geq$3.9).

2.3. Sampling procedure

After the questionnaire was designed on the Wenjuanxing platform (https://www.wjx.cn/mobile/statnew.aspx), we sent the questionnaire to the WeChat (an extremely popular social application in China) working groups in each laboratory. All laboratory technicians who met the above criteria were invited to fill in the questionnaire. Participants can decide whether to fill in and submit the questionnaire according to their own circumstances and willingness. After the investigation deadline, we sorted out and analyzed the collected questionnaires. According to the process shown in Fig. 1, we eliminated those questionnaires with incorrect information filling and inconsistent answers to some coherent questions. Subsequently, all eligible data after screening were included in subsequent analyses.

2.4. Statistical analysis

Statistical analysis was performed using SPSS version 21 (SPSS, New Orchard Road, Armonk, New York, USA). We used descriptive statistical analyses to assess the demographic and occupational characteristics and variations among the participants. Number and percentage were used to report demographic and main research variables. Chi-square tests were applied to compare the severity of each symptom between two or more groups. A binary logistic regression model was developed to identify the impactors of laboratory technicians' mental health in response to the COVID-19 pandemic and outcomes are presented as odds ratios (ORs) and 95% CIs. p-
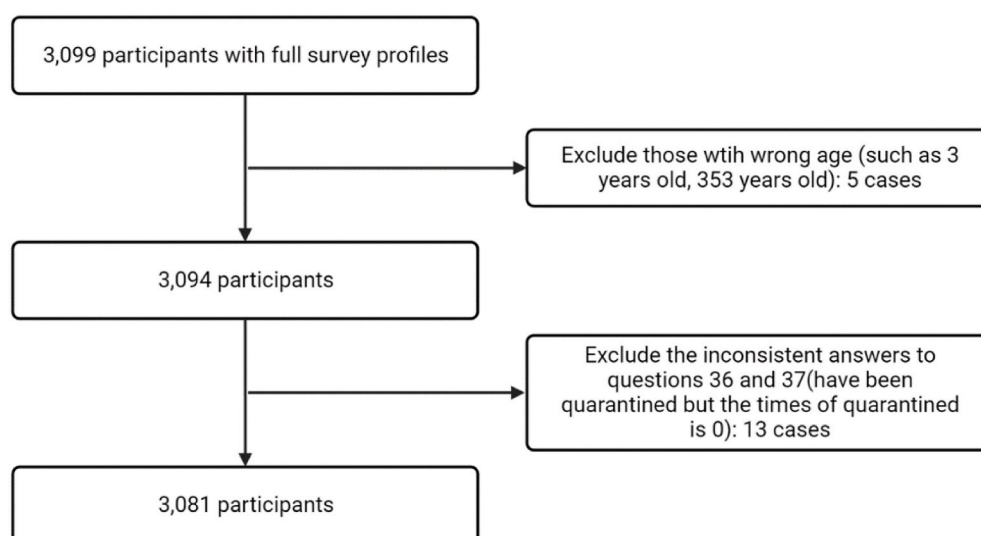

Fig. 1. Data filtering process.

values <0.05 were considered statistically significant.

3. Results

3.1. Demographic characteristics

The frequency description of participants' demographic characteristics is illustrated in Table 1. A total of 3081 laboratory technicians were included in this study. The majority of participants were female (2055 [66.7%]), were aged 31–40 years (1256 [40.8%]), and were married (2207 [71.6%]). Of all the participants, 1962 (63.7%) and 374 (12.1%) had undergraduate and postgraduate degrees, respectively. Most people (2622 [84.7%]) actively shared their feelings with family and friends. Only 131 (4.3%) of participants had a history of physiological problems, and 38 (1.2%) had a history of psychological problems.

3.2. Occupational characteristics

The frequency description of participants' occupational characteristics is illustrated in Table 2. Regarding work-related data, 1329 (43.1%) worked in a tertiary hospital, 1502 (48.8%) worked in a secondary hospital, and only 250 (8.1%) worked in a primary hospital. Among the laboratory technicians, 619 (20.1%) reported having between 6 and 10 years of work experience, and 1475 (47.9%) had more than 10 years of work experience. The percentage of laboratory technicians who had received education and training on SARS-CoV-2 nucleic acid detection was 2969 (96.4%). In addition, 2359 (76.6%) of the respondents worked on the front line during the study, and more than half (1624 [52.7%]) of them had been engaged in this work for more than 9 months. Frontline laboratory technicians who had spent more than 2 months in the current round of work accounted for 47.9% (1131/2359) (eTable S1 in the Supplement) of the total respondents. Of these, 24.8% had been quarantined and a small percentage of them (41/765, 5.4%) had been quarantined more than three times (eTable S2 in the Supplement). Nearly one-third (1110 [36.0%]) had participated in three or more large-scale SARS-CoV-2 screening programs. Laboratory technicians who spent 36 h or more on SARS-CoV-2 nucleic acid detection per week accounted for 34.5% (1063/3081) of the total sample. The percentage who reported having colleagues infected with COVID-19 was 0.7% (22/3081).

3.3. Severity of psychological manifestations and associated factors

The frequency description of responders' psychological manifestations is illustrated in eTable S3 in the Supplement. As we predicted, due to the impact of the COVID-19 pandemic, a portion of the laboratory technicians reported psychological symptoms of varying degrees. Of these 3081 participants, 338 (11.0%) reported a total score ≥160, 263 (15.5%) had obsessive–compulsive symptoms, and 444 (14.4%) had foraging and sleep disorders. Moreover, 324 (10.5%) and 254 (8.2%) of the participants had symptoms of depression and anxiety, respectively. Fortunately, only a small proportion (9 [0.3%]) had severe depression and anxiety.

Table 3 shows the severity categories of laboratory technicians' psychological manifestations related to demographic characteristics. People who were reluctant to share their feelings ($p < 0.001$), had contact with COVID 19 patient samples ($p < 0.001$), or had a

Table 1
Demographic characteristics of responders (N = 3081).

Variables		N	%
Gender	Male	1026	33.3
	Female	2055	66.7
Age (years)	≤25	490	15.9
	26–30	621	20.2
	31–40	1256	40.8
	>40	714	23.2
Marital status	Unmarried	831	27.0
	Married	2207	71.6
	Widowed/Divorced	43	1.4
Education level	≤Undergraduate	745	24.2
	Undergraduate	1962	63.7
	≥Postgraduate	374	12.1
Actively share feelings	Yes	2611	84.7
	No	470	15.3
Contacted with COVID-19 patients' sample	Yes	921	29.9
	No	2160	70.1
History of physiological problem	Yes	131	4.3
	No	2738	88.9
	Uncertain	212	6.9
History of psychological problem	Yes	38	1.2
	No	2806	91.1
	Uncertain	237	7.7

N, number.

Table 2
Occupational characteristics of responders (N = 3081).

Variables		N	%
Type of hospital	Primary	250	8.1
	Secondary	1502	48.8
	Tertiary	1329	43.1
Years of work experiences	<1	162	5.3
	1–5	825	26.8
	6–10	619	20.1
	>10	1475	47.9
Education and training on coronavirus nucleic acid detection	Yes	2969	96.4
	No	112	3.6
Working in the frontline	Yes	2359	76.6
	No	722	23.4
Duration spent in frontline work (months)	<3	1104	35.8
	3–6	199	6.5
	6–9	154	5.0
	>9	1624	52.7
Hours spent in coronavirus nucleic acid detection/week	≤36 h	2018	65.5
	>36 h	1063	34.5
Times of large-scale coronavirus screening	0	639	20.7
	1	853	27.7
	2	479	15.5
	≥3	1110	36.0
Have been quarantined	Yes	765	24.8
	No	2316	75.2
Infected colleagues with COVID 19	Yes	22	0.7
	No	3059	99.3

N, number.

history of physiological or psychological problems ($p < 0.001$) were significantly more likely to have high total scores and all psychiatric symptoms. Respondents' psychological status was less affected by marital status and education level (eTable S4 and eTable S5 in the Supplement).

Table 4 shows the severity categories of laboratory technicians' psychological manifestations related to occupational characteristics. Among the laboratory technicians, in pairwise comparisons, participants who had more than 10 years of work experience were significantly more likely to report symptoms of somatization ($p = 0.001$), obsessive–compulsive behavior ($p = 0.021$), hostility ($p = 0.011$) and foraging and sleep disorder ($p = 0.002$) when compared with those with less than five year of work experience. Among frontline laboratory technicians, increased time spent in the current round of work was associated with all psychiatric symptoms except phobic anxiety and psychoticism (eTable S6 in the Supplement). In addition, increased hours working on SARS-CoV-2 nucleic acid detection and number of times quarantined were associated with high total scores and psychiatric symptoms (eTable S7 and eTable S8 in the Supplement). No difference in symptoms was found between different types of hospital (eTable S9 in the Supplement).

3.4. Risk factors for mental health outcomes

The binary logistic regression analyses (Table 5) showed that a history of physiological and psychological problems was a significant risk factor for all psychiatric symptoms among laboratory technicians (all ten psychiatric symptoms involved, $p < 0.001$). Notably, actively sharing feelings was associated with a lower risk of reporting all psychiatric symptoms (all ten psychiatric symptoms involved, $p < 0.001$). Working on the frontline was a risk factor for somatization ($p < 0.001$), obsessive–compulsive behaviors ($p = 0.103$), depression ($p = 0.001$), anxiety ($p < 0.001$), hostility ($p = 0.001$), paranoid ideation ($p = 0.003$), psychoticism symptoms ($p = 0.001$), and foraging and sleep disorder ($p < 0.001$). Among frontline laboratory technicians, increased time spent in the current round of work was a predictor for somatization, obsessive–compulsive behaviors, interpersonal sensitivity, depression, anxiety and paranoid ideation, and foraging and sleep disorder (eTable S10 in the Supplement). Increasing years of work experience was a predictor for all psychiatric symptoms, especially in those with more than 10 years of working experience (Table 5). Working on large-scale SARS-CoV-2 screening more than three times was a predictor for somatization ($p = 0.009$), interpersonal sensitivity ($p = 0.007$), anxiety ($p = 0.008$), hostility ($p = 0.001$), phobic anxiety ($p = 0.025$), paranoid ideation ($p = 0.014$), and psychoticism symptoms ($p = 0.015$), as well as foraging and sleep disorder ($p = 0.009$). Moreover, increased hours working on SARS-CoV-2 nucleic acid detection and number of times quarantined were risk factors for most psychoticism symptoms (eTable S11 and eTable S12 in the Supplement). Above results confirmed our hypothesis that high-intensity frontline work during the COVID-19 pandemic has indeed negatively affected the mental health of laboratory technicians.

4. Discussion

The prolonged COVID-19 pandemic has brought adverse effects on the mental health of many healthcare workers. In this study, we evaluated the psychological status of laboratory technicians, a medical group that is easy to be ignored. Relying on cut-offs in the SCL-

Table 3

Distribution of demographic characteristics and their association with mental health problems. (N = 3081).

	Psychological symptoms																					
	Total scores (>160)		Somatization1		Obsessive–compulsive2		Interpersonal sensitivity3		Depression4		Anxiety5		Hostility6		Phobic anxiety7		Paranoid ideation8		Psychoticism9		Foraging and sleep disorder	
	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p
Gender																						
Male	115 (11.2)	0.765	72 (7.0)	0.009	159 (15.5)	0.985	96 (9.4)	0.940	104 (10.1)	0.627	89 (8.7)	0.539	101 (9.8%)	0.281	49 (4.8)	0.820	86 (8.4)	0.046	60 (5.8)	0.650	163 (15.9)	0.099
Female	223 (10.9)		203 (9.9)		319 (15.5)		194 (9.4)		220 (10.7)		165 (8.0)		178 (8.7)		102 (5.0)		132 (6.4)		112 (5.5)		281 (13.7)	
Age (years)																						
≤30	105 (9.5%)	0.125	74 (6.7)	0.002	145 (13.1)	0.017	92 (8.3)	0.269	96 (8.6)	0.039	76 (6.8)	0.101	76 (6.8)	0.006	51 (4.6)	0.089	66 (5.9)	0.122	52 (4.7)	0.202	127 (11.4)	0.001
31–40	147 (11.7)		121 (9.6)		210 (16.7)		127 (10.1)		145 (11.5)		115 (9.2)		128 (10.2)		54 (4.3)		92 (7.3)		73 (5.8)		196 (15.6)	
>40	86 (12.0)		80 (11.2)		123 (17.2)		71 (9.9)		83 (11.6)		63 (8.8)		75 (10.5)		46 (6.4)		60 (8.4)		47 (6.6)		121 (16.9)	
Actively share feelings																						
No	107 (22.8)	<0.001	79 (16.8)	<0.001	121 (25.7)	<0.001	86 (18.3)	<0.001	104 (22.1)	<0.001	77 (16.4)	<0.001	82 (17.4)	<0.001	45 (9.6)	<0.001	71 (15.1)	<0.001	55 (11.7)	<0.001	123 (26.2)	<0.001
Yes	231 (8.8)		196 (7.5)		357 (13.7)		204 (7.8)		220 (8.4)		177 (6.8)		197 (7.5)		106 (4.1)		147 (5.6)		117 (4.5)		321 (12.3)	
Contacted with COVID-19 patients' sample																						
No	177 (8.2)	0.029	177 (8.2)	0.029	308 (14.3)	0.003	189 (8.8)	0.054	200 (9.3)	<0.001	161 (7.5)	0.015	172 (8.0)	0.001	98 (4.5)	0.152	138 (6.4)	0.023	110 (5.1)	0.07	274 (12.7)	<0.001
Yes	98 (10.6)		98 (10.6)		170 (18.5)		101 (11.0)		124 (13.5)		93 (10.1)		107 (11.6)		53 (5.8)		80 (8.7)		62 (6.7)		170 (18.5)	
History of physiological problem																						
No	182 (6.6)	<0.001	182 (6.6)	<0.001	346 (12.6)	<0.001	203 (7.4)	<0.001	227 (8.3)	<0.001	172 (6.3)	<0.001	205 (7.5)	<0.001	102 (3.7)	<0.001	153 (5.6)	<0.001	120 (4.4)	<0.001	326 (11.9)	<0.001
Yes	38 (29.0)		38 (29.0)		50 (38.2)		35 (26.7)		36 (27.5)		33 (25.2)		29 (22.1)		20 (15.3)		27 (20.6)		23 (17.6)		45 (34.4)	
Uncertain	55 (25.9)		55 (25.9)		82 (38.7)		52 (24.5)		61 (28.8)		49 (23.1)		45 (21.2)		29 (13.7)		38 (17.9)		29 (13.7)		73 (34.4)	
History of psychological problem																						
No	174 (6.2)	<0.001	174 (6.2)	<0.001	328 (11.7)	<0.001	184 (6.6)	<0.001	202 (7.2)	<0.001	152 (5.4)	<0.001	186 (6.6)	<0.001	94 (3.3)	<0.001	126 (4.5)	<0.001	99 (3.5)	<0.001	311 (11.1)	<0.001
Yes	15 (39.5)		15 (39.5)		25 (65.8)		19 (50.0)		23 (60.5)		17 (44.7)		15 (39.5)		10 (26.3)		20 (52.6)		17 (44.7)		22 (57.9)	
Uncertain	86 (36.3)		86 (36.3)		125 (52.7)		87 (36.7)		99 (41.8)		85 (35.9)		78 (32.9)		47 (19.8)		72 (30.4)		56 (23.6)		111 (46.8)	

N, number.

Table 4

Distribution of occupational characteristics and their association with mental health problems. (N = 3081).

	Total scores (>160)		Psychological symptoms															
			Somatization1		Obsessive–compulsive2		Interpersonal sensitivity3		Depression4		Anxiety5		Hostility6		Phobic anxiety7		Paranoid ideation8		Psychoticism9		Foraging and sleep disorder
	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p	N (%)	p
Years of work experiences																						
<5	97 (9.8)	0.307	66 (6.7)	0.001	132 (13.4)	0.021	86 (8.7)	0.514	89 (9.0)	0.090	68 (6.9)	0.162	68 (6.9)	0.011	46 (4.7)	0.825	58 (5.9)	0.198	48 (4.9)	0.421	113 (11.4)	0.002
5–10	67 (10.8)		49 (7.9)		90 (14.5)		56 (9.0)		62 (10.0)		53 (8.6)		57 (9.2)		29 (4.7)		46 (7.4)		34 (5.5)		88 (14.2)	
>10	174 (11.8		160 (10.80		256 (17.4)		148 (10.0)		173 (11.7)		133 (9.0)		154 (10.4)		76 (5.2)		114 (7.7)		90 (6.1)		243 (16.5)	
Working in the frontline																						
No	46 (6.4)	<0.001	27 (3.7)	<0.001	84 (11.6)	0.001	47 (6.5)	0.002	46 (6.4)	<0.001	25 (3.5)	<0.001	38 (5.9)	<0.001	22 (3.0)	0.008	28 (3.9)	<0.001	18 (2.5)	<0.001	53 (7.3)	<0.001
Yes	292 (12.4)		248 (10.5)		394 (16.7)		243 (10.3)		278 (11.8)		229 (9.7)		108 (8.1)		129 (5.5)		190 (8.1)		154 (6.5)		391 (16.6)	
Duration spent in frontline work (months)																						
<3	59 (7.7)	<0.001	36 (4.7)	<0.001	96 (12.6)	0.001	58 (7.6)	0.018	58 (7.6)	<0.001	35 (4.6)	<0.001	54 (7.1)	0.001	29 (3.8)	0.120	40 (5.2)	0.006	29 (3.8)	0.015	68 (8.9)	<0.001
3–9	95 (9.9)		70 (7.3)		136 (14.2)		82 (8.6)		85 (8.9)		73 (7.6)		73 (7.6)		44 (4.6)		60 (6.3)		51 (5.3)		131 (13.7)	
>9	184 (13.5)		169 (12.4)		246 (18.1)		150 (11.0)		181 (13.3)		146 (10.7)		152 (11.2		78 (5.7)		118 (8.7)		92 (6.8)		245 (18.0)	
Times of large-scale coronavirus screening																						
0	50 (7.8)	0.003	39 (6.1)	<0.001	85 (13.3)	0.007	39 (6.1)	0.004	52 (8.1)	0.055	32 (5.0)	0.001	38 (5.9)	<0.001	18 (2.8)	0.019	29 (4.5)	0.005	22 (3.4)	0.002	66 (10.3)	<0.001
<3	143 (10.7)		106 (8.0)		191 (14.3)		130 (9.8)		141 (10.6)		111 (8.3)		108 (8.1)		69 (5.2)		93 (7.0)		69 (5.2)		187 (14.0)	
≥3	145 (13.1)		130 (11.7)		202 (18.2)		121 (10.9)		131 (11.8)		111 (10.0)		133 (12.0)		64 (5.8)		96 (8.6)		81 (7.3)		191 (17.2)	

N, number.

Table 5
Risk factors for mental health outcomes.

Variable		Somatization symptoms		Obsessive–compulsive symptoms		Interpersonal symptoms		Depression symptoms	
		OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Actively share feelings	No	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
	Yes	0.352 (0.262–0.474)	<0.001	0.440 (0.344–0.561)	<0.001	0.369 (0.277–0.491)	<0.001	0.301 (0.230–0.395)	<0.001
History of physiological problem	No[a]	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
	Yes	3.967 (2.599–6.056)	<0.001	3.033 (2.059–4.469)	<0.001	3.240 (2.094–5.011)	<0.001	2.835 (1.831–4.391)	<0.001
History of psychological problem	No[a]	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
	Yes	4.886 (2.400–9.943)	<0.001	8.684 (4.312–17.487)	<0.001	8.129 (4.109–16.079)	<0.001	11.584 (5.799–23.141)	<0.001
Years of work experiences	<1 years	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
	1–5 years	2.487 (0.883–6.999)	0.084	1.816 (0.969–3.403)	0.063	2.326 (0.987–5.481)	0.054	1.701 (0.797–3.630)	0.170
	6–10 years	2.769 (0.975–7.865)	0.056	1.845 (0.975–3.493)	0.060	2.197 (0.920–5.245)	0.076	1.782 (0.826–3.844)	0.141
	>10 years	4.227 (1.532–11.664)	0.005	2.427 (1.316–4.478)	0.005	2.706 (1.165–6.287)	0.021	2.350 (1.122–4.923)	0.024
Times of large-scale coronavirus screening	0	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
	1	0.985 (0.642–1.511)	0.945	0.960 (0.704–1.311)	0.799	1.576 (1.051–2.364)	0.028	1.136 (0.782–1.651)	0.502
	2	1.278 (0.806–2.026)	0.297	1.013 (0.712–1.442)	0.941	1.363 (0.858–2.164)	0.189	1.180 (0.776–1.793)	0.438
	≥3	1.673 (1.138–2.458)	0.009	1.320 (0.991–1.759)	0.058	1.704 (1.156–2.511)	0.007	1.307 (0.920–1.858)	0.135
Working in the frontline	No	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
	Yes	2.674 (1.762–4.056)	<0.001	1.398 (1.074–1.819)	0.013	1.393 (0.995–1.949)	0.054	1.761 (1.257–2.465)	0.001

aNo category included, uncertain. Abbreviations: OR, odds ratio; CI, confidence interval; Ref, reference; NA, not applicable.

90, we found that 11.0% of laboratory technicians reported a total score >160, and were considered to have positive psychological symptoms, and this is consistent with our hypothesis that a proportion of laboratory technicians developed psychological symptoms. Among the 10 psychological symptom assessments, only a small proportion (less than 5%) reported moderate to severe symptoms. This ratio is lower than the findings of Teo et al. [13], who reported that more than half of the laboratory technicians experienced mild to severe fear, anxiety and depression. Probably, epidemic situation of different magnitude caused this difference.

To our knowledge, this cross-sectional survey enrolling 3081 respondents is one of the few mental health studies of laboratory technicians during COVID-19 pandemic in China and provides initial evidence of their mental health status. The large population and active epidemic prevention policies created a huge workload for laboratory technicians, especially those working in the frontline against COVID-19. Our research timely provides valuable insights for the employer and relevant departments to formulate policies to improve the psychological symptoms of laboratory technicians. Additionally, compared with other similar studies, the sample size of this study is larger, which can better reflect the average status of mental health of laboratory technicians. Moreover, using the SCL-90R scale to evaluate the 10 psychological symptoms of laboratory technicians allows us to have a deeper and more comprehensive understanding of the mental health of them.

According to our research, participants aged more than 40 years reported more somatization, hostility, phobic anxiety symptoms and foraging and sleep disorder. These results are consistent with those of Rossi et al. [15], who showed that older age was associated with insomnia among health-care workers during the COVID-19 pandemic. Moreover, this result echoes the finding that increasing years of work experience was associated with most psychiatric symptoms, especially in those with more than 10 years of work experience. The reason might be that older participants have poorer physical fitness than younger colleagues, and are prone to some psychiatric discomfort under continuous high-intensity coronavirus nucleic acid detection work. Consequently, when assigning work to older medical workers, their physical condition should be taken into consideration.

Baraka et al. [7] assessed critical care nurses' stress, anxiety, and depression in response to the COVID-19 pandemic and suggested that a history of physical and psychological problems was a significant predictor of depression. Our study came to the same conclusion. Although only 4.3% and 1.3% of participants had a history of physiological and psychological problems in our study, high prevalence rates of severe psychiatric symptoms were found among them. Among those with a history of psychological problems, 28.9% (11/38) reported moderate or severe symptoms of depression. They also had risk factors for developing all psychiatric symptoms (p < 0.001). This was also in line with the findings of Zhang et al. [14], who revealed that having organic disease was an independent risk factor for insomnia, anxiety, depression, somatization and obsessive–compulsive symptoms. Notably, participants who actively shared their feelings with family and friends were less likely to suffer from various mental problems than those who were reluctant to share their feelings with others. Thus, we suggest that particular attention should be paid to the mental health of the latter individuals. Effective

Anxiety symptoms		Hostility symptoms		Phobic anxiety symptoms		Paranoid ideation symptoms		Psychoticism symptoms		Foraging and sleep disorder	
OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
0.356 (0.264–0.481)	<0.001	0.363 (0.272–0.485)	<0.001	0.398 (0.273–0.581)	<0.001	0.316 (0.230–0.434)	<0.001	0.344 (0.241–0.490)	<0.001	0.375 (0.293–0.479)	<0.001
1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
3.493 (2.237–5.454)	<0.001	2.507 (1.588–3.958)	<0.001	3.188 (1.864–5.452)	<0.001	2.948 (1.805–4.816)	<0.001	3.014 (1.787–5.082)	<0.001	2.764 (1.855–4.118)	<0.001
1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
7.504 (3.753–15.004)	<0.001	5.452 (2.721–10.923)	<0.001	5.109 (2.321–11.249)	<0.001	13.662 (6.836–27.305)	<0.001	11.950 (5.948–24.011)	<0.001	6.841 (3.465–13.505)	<0.001
1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
1.985 (0.777–5.071)	0.152	1.652 (0.695–3.929)	0.256	1.063 (0.438–2.579)	0.893	2.988 (0.915–9.753)	0.070	2.313 (0.703–7.612)	0.168	1.730 (0.874–3.425)	0.116
2.339 (0.909–6.019)	0.078	2.162 (0.905–5.162)	0.083	1.054 (0.425–2.612)	0.910	3.461 (1.053–11.373)	0.041	2.414 (0.725–8.045)	0.151	2.103 (1.055–4.189)	0.035
2.642 (1.054–6.623)	0.038	2.662 (1.146–6.184)	0.023	1.290 (0.546–3.047)	0.562	3.856 (1.201–12.382)	0.023	2.897 (0.897–9.353)	0.075	2.736 (1.407–5.321)	0.003
1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
1.439 (0.924–2.242)	0.108	1.294 (0.852–1.967)	0.227	1.842 (1.050–3.234)	0.033	1.434 (0.899–2.286)	0.130	1.402 (0.827–2.377)	0.209	1.205 (0.865–1.681)	0.271
1.374 (0.837–2.256)	0.209	1.036 (0.636–1.689)	0.887	1.352 (0.704–2.597)	0.366	1.205 (0.705–2.059)	0.495	1.017 (0.545–1.899)	0.957	1.178 (0.809–1.715)	0.392
1.758 (1.156–2.674)	0.008	1.880 (1.276–2.770)	0.001	1.863 (1.081–3.210)	0.025	1.738 (1.118–2.701)	0.014	1.848 (1.127–3.031)	0.015	1.514 (1.109–2.067)	0.009
1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA	1 [Ref]	NA
2.619 (1.700–4.035)	<0.001	1.913 (1.318–2.775)	0.001	1.553 (0.969–2.491)	0.068	1.870 (1.231–2.841)	0.003	2.348 (1.414–3.900)	0.001	2.258 (1.656–3.078)	<0.001

communication and listening to patients may help to prevent psychological problems.

According to our findings, physical exhaustion due to high-intensity works is an important risk factor for the development of mental disease in laboratory technicians. Compared with non-frontline workers, frontline laboratory technicians expressed more severe psychological symptoms. Among frontline laboratory technicians, 47.9% (1131/2359) had worked continuously on the front-line for more than 2 months; as a result, their risk of developing psychological symptoms was significantly higher than those who had worked on the front line for less than 2 weeks. Otherwise, 34.5% (1063/3081) of them spent more than 36 h per week on SARS-CoV-2 nucleic acid detection, and they also reported more somatization, obsessive–compulsive symptoms, depression, anxiety, hostility, paranoid ideation, symptoms of psychoticism, and foraging and sleep disorder. This is consistent with two similar studies: longer time spent caring for patients with COVID-19 per week were significantly associated with high anxiety scores of nurses [7]; longer working time in quarantine increases nurses' burnout [9]. Consequently, during the COVID-19 pandemic, we appeal to the government and hospital management to pay more attention to the health of laboratory technicians, especially their mental health, and take active measures, such as increasing job control and reward, and formulating scientific work schedules to reduce workload and ensure staff have ample time to recover from exhaustion. This may help to maintain the mental health of laboratory technicians and create favorable conditions for them to work efficiently.

Laboratory technicians who have contact with COVID-19 patient samples with a high risk for acquiring COVID-19 infection were also likely to report more severe psychiatric symptoms. This may be due to their fear of these specimens and the potential risk of infection. Another interesting finding was that being quarantined more than three times was significantly associated with psychological symptoms in laboratory technicians. During quarantine, laboratory technicians are separated from their families and stay at designated hospitals or hotels, which greatly increases their loneliness. Galanis et al. [9] found that longer working time in quarantine increases burnout among nurses. In fact, loneliness while working in quarantine has been recognized as a significant stressor for nurses during epidemics [16], and the restrictions taken during the COVID-19 pandemic have been shown to affect the practice of physical activity levels and sleep quality in migraine [17]. However, it is obviously unwise to remove the quarantine measure, because it would greatly increase the risk of laboratory technicians transmitting the virus to others. Therefore, we recommend providing necessary social support from families, friends, colleagues and health-care organizations for laboratory technicians during the quarantine period to alleviate their uncomfortable psychological symptoms, rather than simply providing them with food and shelter.

Another significant finding in our study was that an increased number of times performing large-scale SARS-CoV-2 screening, especially more than three times, was a significant predictor for somatization, interpersonal sensitivity, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism symptoms and foraging and sleep disorder among laboratory technicians. When large-scale screening is carried out, laboratory technicians have to work for a long time to test a tremendous number of specimens every day. Laboratory technicians have to sit in a relatively narrow and closed laboratory for continuous mechanical operation for 3–4 h. In

addition, they needed to wear heavy medical protective equipment and masks, which makes it difficult to breathe. Moreover, the mental stress caused by the potential contagiousness of positive samples increases the mental pressure. We suggest that this issue should be taken seriously, and the working conditions of laboratory technicians should be improved.

5. Limitations

The present study has limitations. First, we conducted a cross-sectional study rather than longitudinal follow-up, which means we cannot track the dynamic changes in the psychological status of the participants with the progression of the COVID-19 epidemic. Second, this study is limited to Hebei province, and only a sample of laboratory technicians participated. The overall psychological status of laboratory technicians in the whole province and even the whole country still needs further research. Third, there may have been systematic bias due to the differences in willingness among laboratory technicians to participate and complete the survey.

6. Conclusions

Collectively, the presence of psychological symptoms was high among laboratory technicians during COVID-19, especially among women, frontline workers, and those with a history of physical and psychological problems. To prevent further deterioration of psychological symptoms among laboratory technicians, mental problems need to be addressed, and early monitoring, arrangement of adequate rest, and improvement of the working environment are essential.

Author contribution statement

Zi-rou Ouyang; Zhi-rong Li: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Pu Qin; Yu-lian Zhang; Min Zhao; Jia-yiren Li; Chao He; Ning Dong; Hai-qi Li; Hao-dong Wang: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Wei-na Chen; Ji-hong Hao; Jian-hong Zhao: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of interest's statement

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.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.heliyon.2023.e13090.

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