



# A cross-sectional study on the mental health of patients with COVID-19 1 year after discharge in Huanggang, China

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## Abstract

**Objective** This study is aimed to investigate the mental health status of COVID-19 survivors 1 year after discharge from hospital and reveal the related risk factors.

**Methods** From April 11 to May 11, 2021, 566 COVID-19 survivors in Huanggang city were recruited through their primary doctors. A total of 535 participants (94.5%) admitted to participate in the survey and completed the questionnaires. Five scales were applied including 7-Items Generalized Anxiety Disorder Scale, Patient Health Questionnaire-9, Impact of Event Scale-Revised, Pittsburgh Sleep Quality Index, and Fatigue Scale-14. The chi-square and the Fisher's exact test were used to evaluate the classification data, multivariate logistic regression was used to explore the related factors of sleep quality, fatigue, anxiety, depression, and post-traumatic stress disorder (PTSD).

**Results** One year after being discharged, of the 535 COVID-19 survivors, 252 (47.1%) had poor sleep quality; 157 (29.3%) had the symptoms of fatigue; 84 (15.7%), 112 (20.9%), and 130 (24.3%) suffered from symptoms of anxiety, depression, and PTSD, respectively. The logistic regression analysis showed that history of chronic disease was risk factor for poor sleep quality (OR 2.501; 95% CI, 1.618–3.866), fatigue (OR 3.284; 95% CI 2.143–5.033), PTSD (OR 2.323; 95% CI 1.431–3.773) and depression (OR 1.950; 95% CI 1.106–3.436) in COVID-19 survivors. Smoking contributed to the poor sleep quality (OR 2.005; 95% CI 1.044–3.850), anxiety (OR 4.491; 95% CI 2.276–8.861) and depression (OR 5.459; 95% CI 2.651–11.239) in survivors. Drinking influenced fatigue (OR 2.783; 95% CI 1.331–5.819) and PTSD (OR 4.419; 95% CI 1.990–9.814) in survivors. Compared with college-educated survivors, survivors with high school education were at higher risk for poor sleep quality (OR 1.828; 95% CI 1.050–3.181) and PTSD (OR 2.521; 95% CI 1.316–4.830), and survivors with junior high school education were at higher risk for PTSD (OR 2.078; 95% CI 1.039–4.155). Compared with overweight survivors (BMI  $\geq$  23.0), survivors with normal BMI (18.5–22.9) (OR 0.600; 95% CI 0.405–0.889) were at lower risk for fatigue. While being housewife (OR 0.390; 95% CI 0.189–0.803) was protective factor for fatigue and having more family members was protective factor for PTSD (OR 0.404 95% CI 0.250–0.653) in survivors.

**Conclusions** One year after infection, poor sleep quality, fatigue, anxiety, depression, and PTSD, still existed in a relatively high proportion of COVID-19 survivors. Chronic disease history was an independent risk factor for poor sleep quality, fatigue, depression, and PTSD. Participants with low education levels were more likely to have mental problems than the others. We should focus on the long-term psychological impact of COVID-19 on survivors, and the government should apply appropriate mental health services to offer psychiatric support.

**Keywords** COVID-19 · One year after discharge · Fatigue · Sleep quality · PTSD · Depression · Anxiety · Related factors

## Introduction

Following the severe acute respiratory syndrome (SARS) and Middle East Respiratory Syndrome, 2019 coronavirus disease (COVID-19) is the third disease causing by cross-species new coronavirus in the past 18 years and has been declared as a pandemic by World Health Organization [1–3].

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As of middle April, 2022, more than 500 million COVID-19 cases have been confirmed, and more than 6.1 million people have died globally [4]. In the general population, between 13 and 60% of COVID-19 survivors are at risk of developing post COVID-19 symptoms [5]. A wide variety of COVID-19 sequelae have been described, including respiratory symptoms, gastrointestinal sequelae, functional impairment, neuro-cognitive changes and urological symptoms [5–12]. The patients with SARS suffer from many physical and psychological problems even after 1–3 years of being discharged from the hospital [13–18]. In COVID-19 survivors, many mental health issues also existed after hospital discharge, such as fatigue, insomnia, decreased quality of life, anxiety, depression, and PTSD [19–21].

However, few studies have been conducted on COVID-19 survivors 1 year after hospital discharge, and mainly focused on physical health [11, 12, 22]. Only one study at Jinyintan Hospital reported that after 12 months of discharge, anxiety and depression scores in 1,276 survivors were significantly higher than these in general population [8]. As a result, the long-term impact of COVID-19 on mental health of survivors still need to be further investigated. Therefore, this study applied accepted scales to reveal the long-term psychological impact of COVID-19 on survivors 1 year after hospital discharge, and attempted to explore the related factors. This study will provide evidence for the long-term psychological effects of COVID-19 and ultimately inform government policies to support COVID-19 survivors.

## Methods

### Study design and participants

This cross-sectional study was conducted from April 11 to May 11, 2021. All the COVID-19 survivors discharged from the Huanggang Central Hospital from April to May 2020 were recruited through their primary doctors. The diagnosis of COVID-19 was based on the Chinese standard [23]. Excluded patients were (1) those who declined to participate and (2) those who could not be contacted. Participants were recruited from different communities by primary doctors. The purpose and benefits of the study were notified. After obtaining consent, the questionnaire was distributed to participant for data collection. For participants under the age of 18, the survey was carried out with the consent of parents.

In accordance with the Declaration of Helsinki, this study was approved by the Institutional Review Board of the Ethics Committee of Beijing University of Traditional Chinese Medicine (2020BZHYYL0111), and informed consent

was obtained from all the participants. The trial was registered in the Chinese Clinical Trial Registration Center (ChiCTR2000031955).

### Questionnaires

The survey included five self-reported scales and some sociodemographic data, including sex, age, BMI (measured by primary doctors, categorized as < 18.5, 18.5–22.9,  $\geq$  23.0), education (none, primary school, junior high school, high school, university and above), family member ( $\leq$  3 or > 3), residence (urban, rural and urban–rural fringe), income (categorized as none, RMB1 to 2999, RMB3000 to 7999, RMB8000 to 19 999, and  $\geq$  RMB200 000), work (full time, part time, student, housewife, unemployed and retire) drinking (drinker or never drinker), smoking (smoker or never-smoker), chronic diseases history (chronic conditions from 13 disease categories, including infectious diseases other than COVID-19, musculoskeletal, respiratory, cardiovascular, endocrine-metabolic, neurological, gastrointestinal, genitourinary, ophthalmologic, blood, skin, renal, and cancer) and severity of COVID-19 (mild, moderate, severe, and critical). 7-Items Generalized Anxiety Disorder Scale (GAD-7) was used to screen the anxiety [24, 25]. The Patient Health Questionnaire-9 (PHQ-9) was used to assess depression status [24, 26]. Symptoms of PTSD among survivors after the event were evaluated by the Impact of Event Scale-Revised (IES-R) [27]. The Fatigue Scale-14 (FS-14) was used to assess fatigue [28]. The Pittsburgh Sleep Quality Index (PSQI) was used to estimate sleep quality [29].

### Statistical analysis

All data were analyzed using the IBM SPSS Statistics (version 20.0, SPSS Inc, USA) software. The sociodemographic characteristics and health status of subjects were presented using frequency statistics and composition ratios. Age, BMI, education, and family members were described using average and standard deviation. The chi-square test was used to evaluate the classification data, and the Fisher's exact test was used whenever the *P* value calculation did not meet the chi-square test conditions. In addition, the correlation between related factors and sleep quality, fatigue, anxiety, depression, and PTSD were determined using the multifactor binary logistic regression. All tests were two-tailed, and the level of significance level was set as *p* value < 0.05.

## Results

### Demographics and characteristics

Among 566 COVID-19 survivors one year after hospital discharge, 535 participants (94.5%) admitted to participate in the survey and completed the questionnaires.

Among the 535 patients, 216 (40.4%) were males, and 319 (59.6%) were females. The average age was  $50.80 \pm 14.44$  years. Among the survivors, 84 (15.7%), 358 (66.9%), 92 (17.2%), and 1 (0.2%) had mild, moderate, severe, and critical COVID-19, respectively. The demographic and clinical characteristics of the participants are shown in Table 1.

### Mental Health Outcomes

The mental health outcomes of COVID-19 survivors 1 year after hospital discharge are shown in Table 2. Except anxiety (15.7%), the prevalence of poor sleep quality, fatigue, PTSD and depression were all over 20%, and the rate of self-reporting poor sleep quality reached 47%.

The status of poor sleep quality, fatigue, anxiety, depression and PTSD among different demographic and clinical characteristics groups are presented in Table 1. These mental outcomes were statistically significant across six subgroups of family members, income, work, smoking, drinking, and history of chronic diseases (all  $P < 0.01$ ).

### Risk Factors for Mental Health Outcomes

After adjusting age, sex, severity of COVID-19, residence and income, the multivariate logistic regression was performed to explore the related factors of the mental health outcomes (Table 3). The history of chronic disease was risk factor for poor sleep quality (OR 2.501; 95% CI 1.618–3.866), fatigue (OR 3.284; 95% CI 2.143–5.033), PTSD (OR 2.323; 95% CI 1.431–3.773) and depression (OR 1.950; 95% CI 1.106–3.436). Smoking contributed to the poor sleep quality (OR 2.005; 95% CI 1.044–3.850), anxiety (OR 4.491; 95% CI 2.276–8.861) and depression (OR 5.459; 95% CI 2.651–11.239). Drinking negatively influenced fatigue (OR 2.783; 95% CI 1.331–5.819), and PTSD (OR 4.419; 95% CI 1.990–9.814) in survivors. Compared with college-educated survivors, survivors with high school education were at higher risk for poor sleep quality (OR 1.828; 95% CI 1.050–3.181) and PTSD (OR 2.521; 95% CI 1.316–4.830), survivors with junior high school education had more risk for PTSD (OR 2.078; 95% CI 1.039–4.155). Compared with overweight survivors (BMI  $\geq 23.0$ ), survivors with normal BMI (18.5–22.9) (OR 0.600; 95% CI

0.405–0.889) were at lower risk for fatigue. While being housewife (OR 0.390; 95% CI 0.189–0.803) was protective factor for fatigue and having more family members was protective factor for PTSD (OR 0.404 95% CI 0.250–0.653) in survivors.

## Discussion

We found that most COVID-19 survivors still had some mental health problems 1 year after discharge. Poor sleep quality was the most common symptom, fatigue, anxiety, depression, and PTSD still existed. The history of chronic diseases was an independent risk factor for poor sleep quality, fatigue, depression, and PTSD. Smoking was associated with poor sleep quality, anxiety and depression, while drinking contributed to fatigue and PTSD. Additionally, we found that lower educated survivors were more likely to suffer from mental problems than higher educated survivors.

In our study, 52.9% of survivors suffered from sleep problems one year after hospital discharge. Sleep problems have also been reported in SARS survivors [16]. The cause and pathogenesis of poor sleep quality after COVID-19 are still unclear, but on the basis of previous evidence from SARS, the long-term effects of coronavirus damage to the nervous system leading to impaired respiratory regulation could have contributed to the condition, since there is a close relationship between breathing disorders and sleep [30]. The sleep has been proved able to affect the immune function by regulating immune pathways and cells [31], therefore, poor sleep quality is not only detrimental to the recovery of immune system function of COVID-19 survivors, but also may induce serious psychological problems and ultimately become a risk factor for suicide [32].

For the risk factors of poor sleep quality in COVID-19 survivors, we revealed that risk factors might be smoking, lower school education, and history of chronic diseases. Studies have shown that 30.1% of smokers in China have increased their smoking since the outbreak of COVID-19 [33], and the pharmacological effects of nicotine exacerbate sleep problems [34]. The low educational levels have also been reported to be associated with poor sleep quality [35], which is consistent with our findings. Previous studies have shown that higher education level is one of the strong mediators in alleviating the psychological responses caused by traumatic events [36]. Chronic diseases can certainly affect the physical and psychical health of COVID-19 survivors [37]. Our study found that chronic disease was an independent risk factor for poor sleep quality, fatigue, PTSD, and depression. A world mental health survey from 17 countries suggested that a wide range of chronic physical conditions was associated with increased risk of all kinds of mental disorders. The mechanisms have

**Table 1** Characteristics of COVID-19 survivors and differences in the mental health outcomes among/between various demographic and clinical characteristics

Characteristics	Total(%)	Poor sleep quality		Fatigue		PTSD		Depression		Anxiety	
		n	P value	n	P value	n	P value	n	P value	n	P value
<b>Sex</b>											
Male	216(40.4)	96	0.311	68	0.372	79	0.000*	67	0.000*	35	0.793
Female	319(59.6)	156		89		51		45		49	
<b>Age (years)</b>											
10–19	5(0.9)	2	0.019 <sup>a*</sup>	1	0.180 <sup>a</sup>	1	0.187 <sup>a</sup>	1	0.240 <sup>a</sup>	1	0.000 <sup>a*</sup>
20–39	115(21.5)	44		33		26		18		12	
40–59	281(52.5)	122		71		61		52		42	
60–79	124(23.2)	78		48		39		38		27	
80–99	10(1.9)	6		4		3		3		2	
<b>BMI</b>											
< 18.5	19(3.6)	11	0.018*	3	0.001 <sup>a*</sup>	2	0.025 <sup>a*</sup>	8	0.052	7	0.000*
18.5–22.9	295(55.1)	128		70		62		56		41	
≥ 23.0	221(41.3)	113		84		66		48		36	
<b>Education (years)</b>											
None	18(3.4)	11	0.011*	7	0.794	6	0.037*	7	0.002 <sup>a*</sup>	4	0.000 <sup>a*</sup>
Primary school	66(12.3)	38		18		13		14		10	
Junior high school	157(29.3)	80		49		45		46		31	
High school	141(26.4)	68		42		41		26		22	
University and above	153(28.6)	55		41		25		19		17	
<b>Family member</b>											
≤ 3	320(59.8)	153	0.000*	94	0.000*	95	0.000*	68	0.000*	48	0.587
> 3	215(40.2)	99		63		35		44		36	
<b>Residence</b>											
Urban	433(80.9)	208	0.309	132	0.335	108	0.596	88	0.068	69	0.000 <sup>a*</sup>
Rural	53(9.9)	26		15		13		17		11	
Urban–rural fringe	49(9.2)	18		10		9		7		4	
<b>Income (month/yuan)</b>											
0	247(46.2)	141	0.000 <sup>a*</sup>	92	0.001 <sup>a*</sup>	78	0.003 <sup>a*</sup>	62	0.001 <sup>a*</sup>	43	0.000 <sup>a*</sup>
1–2999	99(18.5)	52		31		21		28		23	
3000–7999	164(30.7)	49		28		25		18		14	
8000–19,999	21(3.9)	9		5		5		3		3	
≥ 20,000	4(0.7)	1		1		1		1		1	
<b>Work</b>											
Full time	256(47.9)	95	0.000*	61	0.000 <sup>a*</sup>	47	0.003 <sup>a*</sup>	38	0.004 <sup>a*</sup>	30	0.000 <sup>a*</sup>
Part time	38(7.1)	19		6		6		14		13	
Student	11(2.0)	5		3		4		2		2	
housewife	57(10.7)	24		11		14		10		6	
Unemployed	58(10.8)	39		26		23		18		11	
Retire	115(21.5)	70		50		36		30		22	
<b>Smoking</b>											
Yes	65(12.1)	44	0.000*	16	0.000*	16	0.000*	28	0.000*	28	0.000*
No	470(87.9)	208		141		114		84		56	
<b>Drinking</b>											
Yes	45(8.4)	28	0.000*	22	0.000*	20	0.000*	14	0.000*	10	0.209
No	490(91.6)	224		135		110		98		74	
<b>Chronic diseases history</b>											

**Table 1** (continued)

Characteristics	Total(%)	Poor sleep quality		Fatigue		PTSD		Depression		Anxiety	
		n	P value	n	P value	n	P value	n	P value	n	P value
<b>Sex</b>											
Yes	188(35.1)	124	0.000*	85	0.000*	65	0.000*	60	0.000*	47	0.000*
No	347(64.9)	128		72		65		52		37	
<b>Severity of COVID-19</b>											
Mild	84(15.7)	40	0.955a	28	0.667a	22	0.742a	11	0.226a	10	0.000**
Moderate	358(66.9)	167		10		89		80		59	
Severe	92(17.2)	45		29		19		21		15	
Critical	1(0.2)	0		0		0		0		0	

\*Statistically significant ( $P < 0.05$ ). a = Fisher's exact test

**Table 2** Mental health outcomes of 1 year discharged patients with COVID-19

Variables	Mean	Standard deviation	n	Percentage (%)
Sleep quality (PSQI) (0–21)	6.20	3.99		
High ( $\geq 6$ )			252	47.1
Low ( $< 6$ )			283	52.9
Fatigue (FS-14) (0–14)	4.66	3.71		
Yes ( $\geq 6.5$ )			157	29.3
No ( $< 6.5$ )			378	70.6
PTSD (IES-R) (0–100)	22.19	14.91		
Yes ( $< 33$ )			130	24.3
No ( $\geq 33$ )			405	75.7
Depression (PHQ-9) (0–27)	5.92	6.73		
Yes ( $\geq 10$ )			112	20.9
No ( $< 10$ )			423	79.1
Anxiety (GAD-7) (0–21)	3.98	5.31		
Yes ( $\geq 10$ )			84	15.7
No ( $< 10$ )			451	84.3

been proved on the basis of biological, behavioral, and psychological researches [38]. Therefore, having chronic disease is detrimental to the recovery of physical and mental health of COVID-19 survivors even one year after hospital discharge.

In our study, 29.3% of survivors reported fatigue, which is consistent with previous studies that showed a fatigue rate of 27.7% among COVID-19 survivors one year after discharge from Wuhan hospital [8]. Survivors of SARS also developed chronic fatigue symptoms after the first year of recovery, 40% of survivors reported chronic fatigue syndrome [39, 40]. Fatigue is common after acute lung injury in COVID-19 infection and is associated with substantial impairments in physical function and quality of life [41].

Our study also explored the related factors of fatigue, and found that having normal BMI (18.5–22.9) and being housewife were protective factors for fatigue among survivors, whereas drinking and chronic disease were risk factors. A study of COVID-19 survivors one month after hospital discharge found that increased BMI was associated with higher odds of persistence of fatigue [42]. Fatigue is associated with greater fat mass [43], both overweight and obese subjects showed higher fatigue scores compared to normal weight participants, and might be related to systemic inflammation [44]. Housewives are less affected by pandemic compared to the working population. As housewives, they may spend more time at home with family members, it reduces loneliness and social stress, which have been proved to be risk factors for fatigue [45]. On the other hand, alcohol affects neurological function, metabolism, cardiovascular physiology, thermoregulation, and skeletal myopathy [46]. Thus, drinking strains the body, and hangovers can significantly increase fatigue next day. The chronic disease has been discussed in sleep quality part.

In our study, the prevalence of PTSD, anxiety, and depression among COVID-19 survivors were 24.3%, 15.7%, and 20.9%, respectively, these results are approximately consistent with previous study of SARS survivors (28%, 19%, and 20%, respectively) [47]. The prevalence of PTSD was significantly higher than anxiety and depression in COVID-19 survivors one year after hospital discharge. The influence of the virus on nervous system, the discomfort experience after infection, the side effect of treatment drugs, and the loneliness caused by separation from relatives and friends all can be the causes of PTSD, depression and anxiety [48]. In addition, the current epidemic situation is still not resolved, and multiple infections frequently reoccur, these may all increase the fear, anxiety and PTSD in COVID-19 survivors [49].

Among these survivors, junior high school and high school education, drinking, and chronic illness were risk

**Table 3** The multiple logistic regression analysis of factors related to the mental health of patients with COVID-19

Outcomes	Variables	OR (95% CI)	P value
Poor sleep quality	Education (High school)	1.828(1.050–3.181)	0.033*
	Smoking	2.005(1.044–3.850)	0.037*
	Chronic diseases history	2.501(1.618–3.866)	0.000***
Fatigue	BMI (18.5–22.9)	0.600(0.405–0.889)	0.011*
	Work (Housewife)	0.390(0.189–0.803)	0.011*
	Drinking	2.783(1.331–5.819)	0.007**
	Chronic diseases history	3.284(2.143–5.033)	0.000***
PTSD	Education(Junior high school)	2.078(1.039–4.155)	0.039*
	Education(High school)	2.521(1.316–4.830)	0.005**
	Family member (> 3)	0.404(0.250–0.653)	0.000***
	Drinking	4.419(1.990–9.814)	0.000***
	Chronic diseases history	2.323(1.431–3.773)	0.001**
Depression	Smoking	5.459(2.651–11.239)	0.000***
	Chronic diseases history	1.950(1.106–3.436)	0.021*
Anxiety	Smoking	4.491(2.276–8.861)	0.000***

\**P* value < 0.05, \*\**P* value < 0.01, \*\*\**P* value < 0.001

factors for PTSD, whereas having family members was protective factors for PTSD. The lower education was also associated with PTSD in previous study [50], and low IQ has been shown to be a risk factor for PTSD, while education is highly correlated with IQ, thus education is inversely associated with the risk of PTSD and other psychiatric disorders [36]. For drinking, there are many evidences suggesting that alcohol use increases vulnerability to the development of PTSD, exacerbates existing posttraumatic stress symptoms, and contributes to the maintenance of posttraumatic stress symptoms [51, 52]. On the contrary, spending time with the family members provided improving support, relieved destructive emotions, and ultimately minimized PTSD [21]. These are all consistent with our findings. The chronic disease has been discussed in sleep quality part.

Our research found that 20.9% COVID-19 survivors had depression, and 15.7% survivors had anxiety after one year of discharge. Immune system disorders caused by infection might induce psychopathology, leading to depression and anxiety in COVID-19 survivors [53]. Our study revealed that smoking was an independent risk factor of depression and anxiety whereas chronic diseases negatively influenced depression. Smoking is associated with several mental health disorders, including anxiety and depression [54, 55]. The specific mechanisms range from the effect of smoking on neurotransmission, which in turn increases the susceptibility to environmental stressors, to psychological explanations that smoking leads to feeling out of control and thus leads to mental symptoms [56, 57]. Therefore, reducing smoking behavior in COVID-19 survivor will be beneficial to recovery. The chronic disease has been discussed in sleep quality part.

At present, the mechanism of long-term symptoms after COVID-19 infection is still unclear, and further research is required. Many exploratory discussions on the long-term symptoms and potential mechanism after COVID-19 infection have been conducted, and believe that the related sequelae may be due to the joint effect of virus infection, host immune response and psychological stress [58–62]. For example, persistent hypoxia after infection can lead to fatigue, and the immune system disturbance caused by infection may induce psychopathological processes. Meanwhile, patients will suffer psychological stress from potentially fatal diseases, resulting in stress-related inflammation [63]. The interaction between the inflammation and neurotransmitters has been shown to be the underlying mechanism of mood disorders, psychosis and anxiety disorders [64]. Unlike SARS and MERS, T-helper cell-2 secretes elevated levels of cytokines in COVID-19-infected patients [60]. Emily A. Troyer et al. also suggested that the dysregulation of cytokine network after COVID-19 infection is one of the potential mechanisms for the occurrence of neurological and psychiatric symptoms, and mentioned five other possible mechanisms, including virus penetration into the central nervous system, peripheral immune cell transport, autoimmune disorders after infection, effects of immunoregulatory therapy, and intestinal microbial translocation [62]. These are to be further confirmed in future research.

The present study had several limitations. First, this work is a cross-sectional study, so there are limited causal links between the findings. Second, most of the survey samples were recruited in Huangzhou District, which could not represent the whole city. Third, there was a lack of baseline data on participants' mental status. As a result, it is not possible to

determine whether mental health symptoms are pre-existing, or due to COVID-19 infection.

## Conclusion

One year after acute infection, poor sleep quality, fatigue, anxiety, depression, and PTSD, still existed in a relatively high proportion of COVID-19 survivors. Chronic disease history was an independent risk factor for poor sleep quality, fatigue, depression, and PTSD. Survivors with low education levels were more likely to have mental problems than the others. We should focus on the long-term psychological impact of COVID-19 on survivors, and to consider to developing and implementing effective intervention and management approaches to address persistent negative mental status among COVID-19 survivors.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s00406-022-01484-8>.

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## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical standards** The authors assert that all procedures contributing to this work have been approved by the Ethics Committee of Beijing University of Traditional Chinese Medicine (2020BZHYLL0111) and have, therefore, been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

**Consent to participate** Informed consent was obtained from all participants included in the study. For participants under the age of 18, the survey was carried out with the consent of their parents.

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