Risk and Protective Factors for Anxiety Disorder During COVID-19 Pandemic

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Abstract

Background: COVID-19 is a global pandemic and an anxiety-provoking event. Therefore, a study was conducted to identify potential risk and protective factors related to anxiety during COVID-19 pandemic.

Methods: We collected information on demographic data and lifestyles by conducting a web-based survey of 19,802 participants from 34 provinces in China during COVID-19 pandemic. Level of anxiety was evaluated using the Self-Rating Anxiety Scale. We used ordinal multivariable logistic regression to estimate the associations of anxiety level with potential risk and protective factors, and further developed a new score to simplify the assessment of anxiety disorder during COVID-19 crisis.

Results: Among 19,802 participants (mean [SD] age, 25.3 [8.1], years; 10,121 [51.1%] men), we found that those who were front-line medical personnel, suffered from chronic diseases, with present symptom of SARS-CoV-2 infection or contact history had 112%, 93%, 40% and 15% increase risk of higher anxiety level; while those with knowledge about personal protective measures or wore masks had 75% and 29% lower risk of higher anxiety level respectively. We developed a risk score by calculating the sum of single score of 17 factors. Each one increase of the risk score was associated with a 297% increase in anxiety index score. In categorical analysis, low risk (the risk score between 1 to 2), the moderate risk group (the risk score of 3) and high risk group (the risk score ≥4) had a -0.40 (95% CI: -1.55, 0.76), 1.44 (95% CI: 0.27, 2.61) and 9.18 (95% CI: 8.04, 10.33) increase in anxiety index score, and a 26% (95% CI: -7%, 72%), 172% (95% CI: 100%, 270%), and 733% (95% CI: 516%, 1026%) higher risk of anxiety disorder respectively, when compared with the very low risk group (the risk score of 0). The AUC was 0.73 (95% CI: 0.72, 0.74) for the model fitted the developed risk score, with the cut-off point of 3.5.

Conclusions: These findings revealed protective and risk factors associated with anxiety disorder, and propose a practical and simple method of identifying people who are at an increased risk of anxiety disorder during COVID-19 pandemic.

Background

COVID-19 outbreak that occurred since December 2019 has become one of the greatest threats to global public health. According to the report from the World Health Organization (WHO), more than 98 million people across the globe have been infected, causing 2 million deaths until January 28, 2021 [1]. The COVID-19 pandemic and resulting economic downturn have negatively affected mental health. In a recent Kaiser Family Foundation (KFF) poll, 45% of US adults reported mental health problems due to worry and stress during the COVID-19 crisis [2].

Anxiety disorder is the main mental health problem occurred in disaster events. Compared to natural disaster and welfare event (i.e., earthquake or 911), disaster events from emerging infectious diseases might cause anxiety disorders not only due to the extremely high morbidity and mortality, but also the measures that taken to public health. For example, isolation, quarantine, social distancing and community containment may lead to negative social and economic consequences on communities as

well as public health worries [3]. Persistently mental disorders may cause post traumatic stress disorder (PTSD) or acute stress reaction (also known as acute stress disorder) after life-threatening events, or adjustment disorder triggered by an identifiable and stressful life change [4]. Therefore, protective interventions on anxiety disorder are necessary during the COVID-19 crisis when we focus on the treatment and control of physical damage caused by SARS-CoV-2. Assessing the risk and protective factors that contribute to anxiety helps practitioners select appropriate interventions. Previous studies have reported that front-line medical personnel, chronic disease, and contact history were associated with increased risk of anxiety disorder during the epidemic [5–7], but limited evidence for COVID-19 to date.

Therefore, we conducted a web-based study to collect information on demographic data and lifestyles, and to assess the levels of anxiety among 19,802 participants in China during the early outbreak of COVID-19. Associations between potential factors and mental health were estimated to identify the risk and protective factors. We further calculated a score of multivariate factors to assess the effect of combinations of multivariate factors on anxiety disorder.

Methods

Study Population

This study was conducted among 20,102 participants from 34 provinces in China during January, 2020 by a web-based investigation. All participants included in this analysis were all recruited according to the following inclusion criteria: 1) residents aged 14–55 years, who can fully understand the questions; 2) those can use smartphone to complete the standardized questionnaire. After excluding those reported invalid information on date ($n = 180$) and whose data was unable to ensure its authenticity ($n = 120$), there were 19,802 participants included in the final analysis. All participants have provided written informed consent.

Variates

Variates were collected by a web-based investigation, covering information on demographic and socioeconomics, lifestyles including age, sex, body mass index (BMI), race, smoking status, drinking status, chronic diseases (including hypertension, hyperlipidemia, diabetes, asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, heart disease, gout, thyroid nodules, thyroid cancer, and lung cancer), and present symptom of SARS-CoV-2 infection (including fever, cough, runny nose, sore throat, shortness of breath, fatigue, nasal congestion, headache, vomiting and diarrhea), and regular physical activity, etc. Regular physical activity was defined as exercise regularly within the recent six months. Current smoker was defined as an adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes, and former smoker was defined as an adult who has smoked at least 100 cigarettes in his or her lifetime but who had quit smoking at the time of interview. Individual who had never smoked, or who had smoked less than 100 cigarettes in his or her lifetime was defined as never smoker [8]. Current drinker was defined as at least 12 drinks in past year; former drinking was defined as any one year in lifetime but no drinks in past year; while never drinker was defined as fewer

than 12 drinks in lifetime [9]. BMI was calculated by dividing self-reported weight in kilograms by height in meters squared. Each participant was collected information on chronic disease history by asking the question “Have you ever been diagnosed as any diseases including hypertension, hyperlipidemia, diabetes, asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, heart disease, gout, thyroid nodules, thyroid cancer and lung cancer”.

Anxiety Status Assessment

Anxiety disorder was estimated by the Zung Self-Rating Anxiety Scale (SAS). The scale consists of 20 questions with 15 increasing and 5 decreasing anxiety questions. Based on the response by using a 4-point scale, we calculated the anxiety index score and then defined “normal”, “mild anxiety”, “moderate anxiety” and “severe anxiety” according to the cut-off scores of 50, 60 and 70.

Statistical Analysis

We applied summary statistics to describe baseline characteristics and anxiety level of all participants. Ordinal multivariable logistic regression analyses were performed to estimate various risk and protective factors. We entered all variables in the first logistic regression model. Odds ratio (OR) and 95% confidence interval (CI) of anxiety level associated with significant factors in the first model were estimated in the second logistic regression model. Points were attributed to the variables in the second model. The risk score was calculated by summing up the single score of each factor, which can also present the number of anxiety disorder related factors for each participant (i.e. one who had the risk score of three means that he/she had three anxiety-related factors). The risk scores were grouped into scores of 0 (very low risk), 1–2 (low risk), 3 (moderate risk), and ≥ 4 (high risk).

Analysis of variance (ANOVA) and chi-square test were used to compare the average anxiety index score and percentage of anxiety disorder of the four groups. Both linear regression models and logistic regression models were used to estimate the association of developed risk score with anxiety index score and the risk of anxiety disorder, respectively. To further investigate whether the developed risk score can predict the anxiety disorder, we calculated the area under curve (AUC). P values were 2-sided and considered statistically significant at less than 0.05. Analyses were performed by SPSS version 22.0 (https://www.ibm.com/products/software, RRID:SCR_002865), and image analysis was conducted with R Project for Statistical Computing version 3.6.0 (http://www.r-project.org/, RRID:SCR_001905), RStudio version 4.0.2 (http://www.rstudio.com/, RRID:SCR_000432), Microsoft Excel version 2019 (https://www.microsoft.com/en-gb/, RRID:SCR_016137) and ArcMap version 10.2 (https://desktop.arcgis.com/zh-cn/arcmap/).

Patient and Public Involvement

Because this study used existing epidemiological data, it was not appropriate to involve patients or the public in the research.

Results

Participant Characteristics

All participants were from 34 provinces and approximately a half (*n* = 10,459) were from Guangdong Province, Hebei Province, and Shanxi Province (Fig. 1). The mean (SD) age of the 19,802 participants were 25.3 (8.1) years, ranging from 14 to 55, including 51.1% (*n* = 10,121) men. Characteristics and anxiety levels of the participants were summarized in Table 1 and Table 2. Overall, 15,277 (77.1%) participants were without anxiety disorder, while 2157 (10.9%), 1268 (6.4%) and 1100 (5.6%) participants had mild, moderate, and severe levels of anxiety disorder. Characteristics of participants with different levels of anxiety were also presented in Supplemental Table S1.

Table 1
Characteristics of participants (n = 19,802)

Characteristics, *n* (%)	**All participants (*n* = 19,802)**
Age, year	
14–24	11630 (58.7)
25–35	5746 (29.0)
36–55	2426 (12.3)
Male	10121 (51.1)
Body mass index, kg/m^2	
< 18.5	4232 (21.4)
18.5–23.9	11553 (58.3)
> 23.9	4017 (20.3)
Race	
The Hans	19075 (96.3)
Other	727 (3.7)
Smoking status[a]	
Current smoker	1704 (8.6)
Former smoker	764 (3.9)
Never smoker	17334 (87.5)
Drinking status[b]	
Current drinker	3057 (15.4)
Former drinker	2116 (10.7)
Never drinker	14629 (73.9)
Job	
Student or employee	16648 (84.1)
Self-employed	2096 (10.6)
Retired and unemployed	1058 (5.3)
Front-line medical personnel	964 (4.9)

Characteristics, *n* (%)	All participants (*n* = 19,802)
In Hubei Province in the past month	1016 (5.1)
Meeting relatives or friends coming from Hubei in the past month	1159 (5.9)
Quarantine[c]	1175 (5.9)
Exposure to wild animals	436 (2.2)
Gatherings & meetings[d]	6027 (30.4)
Wearing masks	17621 (89.0)
Regular physical activity[e]	10952 (55.3)
Suspicion of SARS-CoV-2 infection	571 (2.9)
Contact history[f]	3004 (15.2)
Knowledge about personal protective measures	15418 (77.9)
Present symptom of SARS-CoV-2 infection[g]	827 (4.2)
Chronic disease[h]	558 (2.8)

[a]Current smoker was defined as an adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes; former smoker was defined as an adult who has smoked at least 100 cigarettes in his or her lifetime but who had quit smoking at the time of interview; while never smoker was defined as an adult who has never smoked, or who has smoked less than 100 cigarettes in his or her lifetime.

[b]Current drinker was defined as at least 12 drinks in the past year; former drinker was defined as at least 12 drinks in any one year in lifetime but no drinks in past year; while never drinker was defined as fewer than 12 drinks in lifetime.

[c]Been or are in quarantine for this outbreak, including mandatory isolation and self isolation at home/hotel.

[d]Been to a company meeting or a family dinner in the last two weeks.

[e]Regular physical activity was defined as regular exercise within the recent six months.

[f]Close contact with a confirmed or suspected case of COVID-19 without taking precautions.

[g]Including fever, cough, runny nose, sore throat, shortness of breath, fatigue, nasal congestion, headache, vomiting and diarrhea.

[h]Including hypertension, hyperlipidemia, diabetes, asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, heart disease, gout, thyroid nodules, thyroid cancer, and lung cancer.

Table 2
Anxiety Level of All Participants (*n* = 19,802)

Self-Rating anxiety scale	**All participants (*n* = 19,802)**
Anxiety index score, mean (SD)	39.60 (14.78)
Classification (anxiety index score), *n* (%)	
Normal (< 50)	15,277 (77.1)
Mild (50–59)	2157 (10.9)
Moderate (60–69)	1268 (6.4)
Severe (≥ 70)	1100 (5.6)

Risk and Protective Factors Associated with Anxiety Level

There are 17 factors with significance in the first multivariate logistic regression model (Supplemental Table S2). In the second multivariate logistic regression analysis, we found that participants aged 25–35 years, males, former smokers or drinkers, or those who were front-line medical personnel, self-employed, exposed to wild animals, or had chronic diseases, suspicion of SARS-CoV-2 infection, present symptom of SARS-CoV-2 infection, regular physical activity, contact history, or met relatives or friends coming from Hubei in the past month were significantly associated with 48%, 40%, 21%, 17%, 112%, 62%, 31%, 93%, 66%, 40%, 37%, 15%, 23% increased risk of anxiety disorder, while those aged 14–24, wore masks or had knowledge about personal protective measures were associated with 33%, 29%, 75% decline in risk of anxiety disorder (Table 3).

Table 3
Analyses of the Association Between Characteristic and Anxiety Level (n = 19,802)

Variable	*t*-value	*df*	Adjusted odds ratio (95% CI)[a]
Age, year			
14–24	46.64	1	0.67 (0.59, 0.75)**
25–35	47.49	1	1.48 (1.33, 1.66)**
36–55	-	-	1.00
Sex			
Male	70.81	1	1.40 (1.29, 1.51)**
Female	-	-	1.00
Race			
The Hans	19.55	1	0.69 (0.59, 0.82)**
Other	-	-	1.00
Job			
Student, employee	0.60	1	1.07 (0.91, 1.25)
Self-employed	27.83	1	1.62 (1.35, 1.93)**
Retired and unemployed	-	-	1.00
Body mass index, kg/m^2			
< 18.5	2.11	1	1.09 (0.97, 1.22)
18.5–23.9	0.51	1	0.97 (0.89, 1.06)
> 23.9	-	-	1.00
Chronic disease[b]			
Yes	51.58	1	1.93 (1.61, 2.31)**
No	-	-	1.00
Regular physical activity[c]			
Yes	61.54	1	1.37 (1.26, 1.48)**
No	-	-	1.00

Variable	*t*-value	*df*	Adjusted odds ratio (95% CI)[a]
Smoking status[d]			
Current smoker	1.41	1	1.08 (0.95, 1.23)
Former smoker	5.16	1	1.21 (1.03, 1.43)*
Never smoker	-	-	1.00
Drinking status[e]			
Current drinker	0.01	1	1.00 (0.89, 1.11)
Former drinker	7.14	1	1.17 (1.04, 1.31)*
Never drinker	-	-	1.00
Contact history[f]			
Yes	7.022	1	1.15 (1.04, 1.28)*
No	-	-	1.00
Suspicion of SARS-CoV-2 infection			
Yes	22.64	1	1.66 (1.35, 2.04)**
No	-	-	1.00
Front-line medical personnel			
Yes	111.09	1	2.12 (1.85, 2.44)**
No	-	-	1.00
Gatherings & meetings[g]			
Yes	18.26	1	0.83 (0.76, 0.90)**
No	-	-	1.00
Meeting relatives or friends coming from Hubei in the past month			
Yes	7.45	1	1.23 (1.06, 1.43)*
No	-	-	1.00
Exposure to wild animals			
Yes	5.61	1	1.31 (1.05, 1.63)*

Variable	*t*-value	*df*	Adjusted odds ratio (95% CI)[a]
No	-	-	1.00
Wearing masks			
Yes	40.16	1	0.71 (0.64, 0.79)**
No	-	-	1.00
Knowledge about personal protective measures			
Yes	1272.24	1	0.25 (0.23, 0.27)**
No	-	-	1.00
Present symptom of SARS-CoV-2 infection[h]			
Yes	12.63	1	1.40 (1.16, 1.68)**
No	-	-	1.00

Abbreviations: CI, confidence interval.

[a]All variables were used in the ordinal multivariate logistic regression. The participants with severe anxiety was selected as the reference frame.

[b]Including hypertension, hyperlipidemia, diabetes, asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, heart disease, gout, thyroid nodules, thyroid cancer, and lung cancer.

[c]Regular physical activity was defined as regular exercise within the recent six months.

[d]Current smoker was defined as an adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes; former smoker was defined as an adult who has smoked at least 100 cigarettes in his or her lifetime but who had quit smoking at the time of interview; while never smoker was defined as an adult who has never smoked, or who has smoked less than 100 cigarettes in his or her lifetime.

[e]Current drinker was defined as at least 12 drinks in the past year; former drinker was defined as at least 12 drinks in any one year in lifetime but no drinks in past year; while never drinker was defined as fewer than 12 drinks in lifetime.

[f]Close contact with a confirmed or suspected case of COVID-19 without taking precautions.

[g]Been to a company meeting or a family dinner in the last two weeks.

[h]Including fever, cough, runny nose, sore throat, shortness of breath, fatigue, nasal congestion, headache, vomiting and diarrhea.

*$p < .05$

Variable	*t*-value	*df*	Adjusted odds ratio (95% CI)[a]
**p < .001			

We evaluated the contribution of each factor to the model by calculating the standardized coefficients, which can make the effect of factors on anxiety disorder comparable (Fig. 2). Knowledge about personal protective measures (β = -1.38) contributed most to the risk of anxiety disorder, following by front-line medical personnel (β = 0.75), chronic disease (β = 0.66), suspicion of SARS-CoV-2 infection (β = 0.51), self-employed (β = 0.48), age (14–24: β = -0.40; 25–35: β = 0.39), race (β = -0.37), wearing masks (β = -0.37), sex (β = 0.34), present symptom of SARS-CoV-2 infection (β = 0.33), regular physical activity (β = 0.31), exposure of wild animals (β = 0.27), meeting relatives or friends coming from Hubei in the past month (β = 0.21), former smoking (β = 0.19), gatherings & meetings (β = -0.19), drinking (β = 0.15), contact history (β = 0.14).

Risk Score Development

The risk score was created using the single score from the statistically significant 17 factors in the final model (Supplemental Table S3). All participants were further divided into four groups by the risk score of 0, 1–2, 3, and ≥ 4. Anxiety index score and the percentage of anxiety disorder was significantly increased with the risk score group of 0 (very low risk), 1–2 (low risk), 3 (moderate risk), and ≥ 4 (high risk)(average anxiety index score: 35.8, 35.4, 37.3, and 45.0 respectively; percentage of anxiety disorder: 7.6%, 9.3%, 17.9% and 38.9%, respectively) (Supplemental Figure S1 and Supplemental Figure S2).

Continuous analysis by linear regression models showed that each one-point increase in risk score was associated with a 2.97 (95% CI: 2.86, 3.09) increase in anxiety index score. In categorical analysis, we also found the moderate risk group and high risk group had a 1.44 (95% CI: 0.27, 2.61) and 9.18 (95% CI: 8.04, 10.33) increase in anxiety index score, when compared with the very low risk group.

Compared with those in very low risk, participants in low risk, moderate risk, and high risk group had 26% (95% CI: -7.4%, 72%), 172% (95% CI: 100%, 270%), and 733% (95% CI: 516%, 1026%) higher risk of higher anxiety level respectively (Table 4). We further attempt to develop risk score as a potential predictor of anxiety disorder by generating ROC (Fig. 3). We found that the AUC was 0.73 (95% CI: 0.72, 0.74) for model with the developed risk score, with the cut-off point of 3.5.

Table 4
Analyses of the Association Between Anxiety Level and Risk Score Group (n = 19,802)

Risk score	Number of participants (%)					Odds ratio
	All participants (n = 19,802)	Normal (n = 15,277)	Mild anxiety (n = 2157)	Moderate anxiety (n = 1268)	Severe anxiety (n = 1100)	(95% CI)[a]
0	632 (3.2)	584 (2.9)	46 (0.2)	2 (0.0)	0 (0.0)	1.00
1–2	6493 (32.8)	5889 (29.7)	451 (2.3)	109 (0.6)	44 (0.2)	1.26 (0.93, 1.72)
3	5030 (25.4)	4130 (20.9)	507 (2.6)	218 (1.1)	175 (0.9)	2.72 (2.00, 3.70)*
≥ 4	7647 (38.6)	4674 (23.6)	1153(5.8)	939 (4.7)	881 (4.4)	8.33 (6.16, 11.26)*

Abbreviations: CI, confidence interval.

[a]Ordinal multivariate logistic regression was used and the participants with severe anxiety was selected as the reference frame.

*p < .001

Discussion

In this study, we found that those who were front-line medical personnel, suffered from chronic diseases, with present symptom of SARS-CoV-2 infection or contact history had 112%, 93%, 40% and 15% increase risk of higher anxiety level; while those with knowledge about personal protective measures or wore masks had 75% and 29% lower risk of higher anxiety level respectively. We developed a risk score to assess the total effect of observed significant factors on anxiety disorder, and found that each one increase of the risk score was associated with increase in anxiety index score, as well as increased risk of anxiety disorder.

Compared with previous studies, similar information may be derived by previous experiences with corona virus infections. Front-line medical personnel may develop psychiatric disorders after coping with stressful community events [7, 10–13]. This fact could be attributed to medical workers have been facing enormous pressure, including a high risk of infection and inadequate protection from contamination, overwork, frustration, discrimination, isolation, patients with negative emotions, a lack of contact with their families, and exhaustion [14]. Some demographic factors may also influence mental health during the COVID-19 pandemic. Individuals with contact history had an increased risk of anxiety disorder for the reason that they not only had to undergo the high possibility of being infectious, but also had to

experience alienation in their neighborhood resulting in a hardened mental impact. Particular precautionary measures (e.g., wearing masks) were associated with a lower psychological impact of the outbreak and lower levels of stress, and anxiety [15]. Because the adoption of self-protective measures can effectively reduce the risk of infection.

We developed a risk score to assess the total effect of factors on anxiety disorder. The results from linear regression models and logistic models consistently showed the significant association between the developed risk score and anxiety index score/disorder. The AUC of 0.73 confirmed the risk score on prediction of anxiety disorder. In addition, the cut-off point of 3.5 indicated that individual who was with more than three observed significant related factors had higher risk of suffering from anxiety disorder during the COVID-19 pandemic. The risk factors (e.g., front-line medical personnel, exposure of wild animals, contact history, and chronic disease) are related with elevated risk scores (Supplemental Figure S3). Particular precautionary measures (e.g., wearing masks) and knowledge about personal protective measures may have a protective effect on risk scores (Supplemental Figure S3). This suggests a worldwide response should focus on the mental health impacts of the specific population and strengthen the publicity of self-protection.

We observed several notable risk factors associated with elevated anxiety in the Chinese population during the COVID-19 outbreak. For example, those with chronic diseases were observed to have higher risk for anxiety disorder, which were similar with those reported in the previous studies [6, 16]. One possible reason is individuals with chronic diseases are more likely to activate psychological stress reactions including hypochondriasis and somatization when faced with external threats. This might play an important role in the development of anxiety disorder. Moreover, the general public with game exposure had a greater likelihood of anxiety during the pandemic. Exposure to live commercial and private poultry is a potential risk factor for infection with novel influenza viruses [17].

There are over 92 million confirmed cases of COVID-19 across the globe. In addition to physical injuries caused by SARS-CoV-2 infections, psychological injuries should also be concerned. Our finding observed the anxiety disorder in Chinese population during the COVID-19 pandemic, and helped to reveal anxiety-related factors. It emphasized the importance of psychosocial intervention to reduce the anxiety during the COVID-19, especially among individuals with chronic diseases and front-line medical staff. The risk score we developed can help to easily screen out individuals with high risk of anxiety disorder through simple questions, in order to take reasonable psychological interventions in time.

Strengths and Limitations

This study has several strengths. First, the sample size of our cross-sectional study was considerably large, which enabled us to estimate the association between uncommon risks and anxiety disorder with sufficient statistical power. Second, we performed multiple methods to identify and confirm the anxiety-related risks, and developed a simple way to assess anxiety disorder during the special period.

There are also some limitations. Similar with most previous psychological studies, data we collected is based on self-reported online questionnaires, which can cause response bias although it was easy to obtain. However, we have carried out quality control including setting up similar questions in the questionnaire and performing logical checks to ensure the reliability of the data. Although we observed the significant associations between some risks and anxiety, we should also note that the data cannot be used to infer causality due to the cross-sectional design.

Conclusions

The findings revealed protective and risk factors associated with anxiety disorder, and developed a practical and simple score to identify individuals who are at risk of anxiety disorder. This research offered preliminary support for relieving anxiety as an acceptable selective preventive intervention for people during COVID-19 pandemic.

Abbreviations

COVID-19: Corona Virus Disease 2019; OR: Odds radio; CI: Confidence interval; SAS: Self-Rating Anxiety Scale; SD: Standard deviation; AUC: Area under curve

Supplementary Information

Additional file 1: Supplemental Table S1. Characteristics of Participants with Different Levels of Anxiety (n = 19,802). **Table S2.** The First Ordinal Multivariable Logistic Regression Analyses of the Association Between Characteristic and Anxiety Level (n = 19,802). **Table S3.** Scoring of the Variables in the Anxiety Disorder Scoring System. **Figure S1.** Anxiety Index Score in Four Risk Score Groups. **Figure S2.** Anxiety Level of Participants in Different Risk Score Groups. **Figure S3.** Percentages of Each Risk Factor Among High Risk Group (Participants with the Risk Score $\geq$ 4).

Declarations

Ethics approval and consent to participate

The study was approved by the ethics committee of the School of Public Health, Guangzhou Medical University (reference no.: 2020010002). All of the participants were informed of the background and aims of the study and the anonymous nature and length of the survey. The participants were also well informed that completion of the questionnaire signified their informed consent. We confirmed that the study protocol followed the STROBE guidelines and were submitted before recruitment completes.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due legal restriction but are available from the corresponding author on reasonable request.

Competing interests

The authors declare they have no competing interests.

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Authors' contributions

YZ designed the study. JYZ and CHZ drafted the manuscript. YZ, JYL (Jiayi Li), WFL, SGW, JCZ and JZ contributed the collection of data. YZ, JYZ, CHZ, LQ and JYL (Jiayi Lai) contributed the analysis and interpretation of data. YZ contributed to critical revision of the manuscript. All the authors revised the manuscript, read the submitted manuscript and approved the final submission.

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Figures

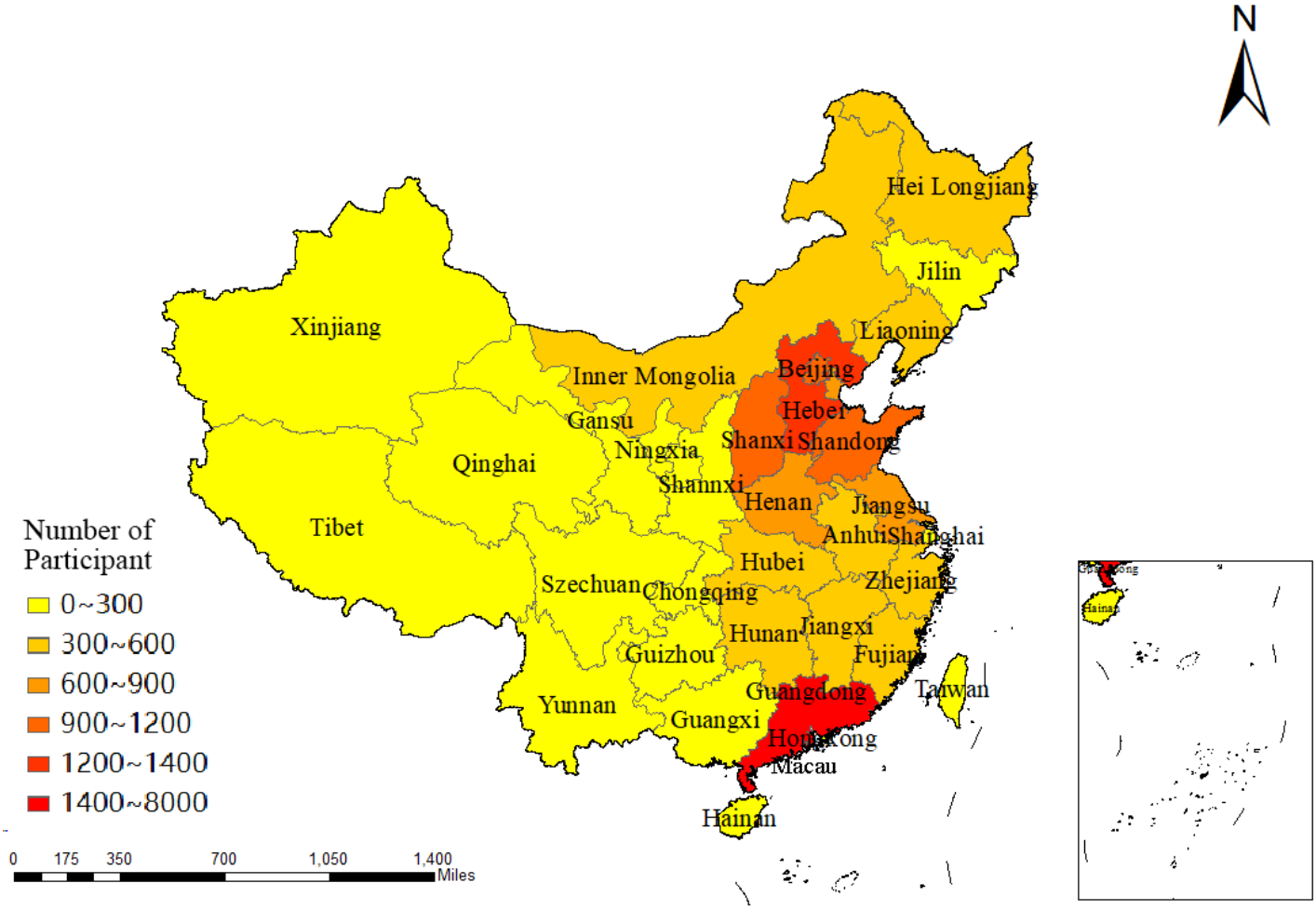

Figure 1

Distribution of Participants. The map was plotted using ArcMap 10.2 (https://desktop.arcgis.com/zh-cn/arcmap/). Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

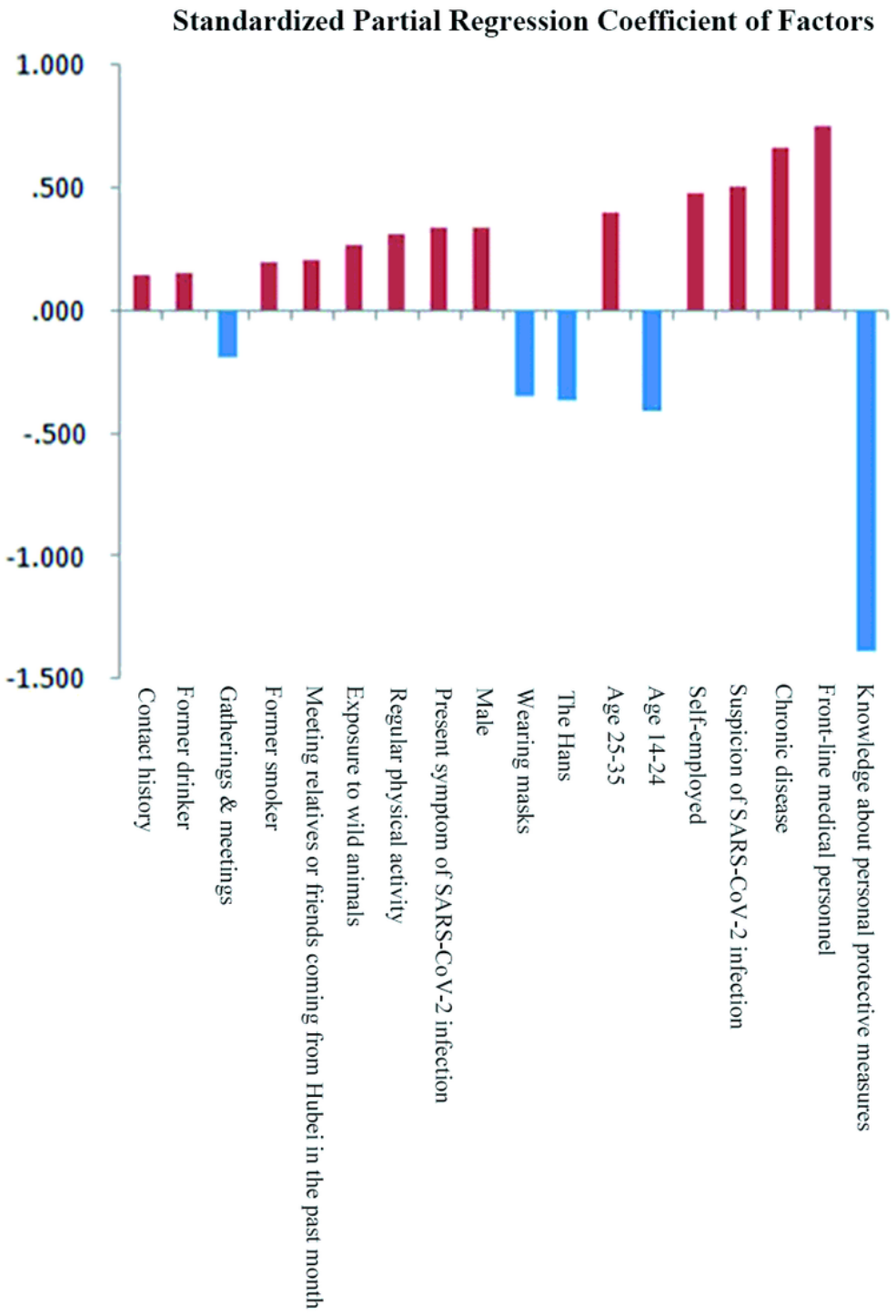

Figure 2

Standardized Partial Regression Coefficient of Factors. Chronic disease included hypertension, hyperlipidemia, diabetes, asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, heart disease, gout, thyroid nodules, thyroid cancer, and lung cancer. Regular physical activity was defined as regular exercise within the recent six months. Current smoker was defined as an adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes; former smoker was

defined as an adult who has smoked at least 100 cigarettes in his or her lifetime but who had quit smoking at the time of interview; while never smoker was defined as an adult who has never smoked, or who has smoked less than 100 cigarettes in his or her lifetime. Current drinker was defined as at least 12 drinks in the past year; former drinker was defined as at least 12 drinks in any one year in lifetime but no drinks in past year; while never drinker was defined as fewer than 12 drinks in lifetime. Contact history was defined as close contact with a confirmed or suspected case of COVID-19 without taking precautions. Gatherings & meetings were defined as been to a company meeting or a family dinner in the last two weeks. Present symptom of SARS-CoV-2 infection included fever, cough, runny nose, sore throat, shortness of breath, fatigue, nasal congestion, headache, vomiting and diarrhea. The figure was plotted using Microsoft Excel version 2019 (https://www.microsoft.com/en-gb/, RRID:SCR_016137)

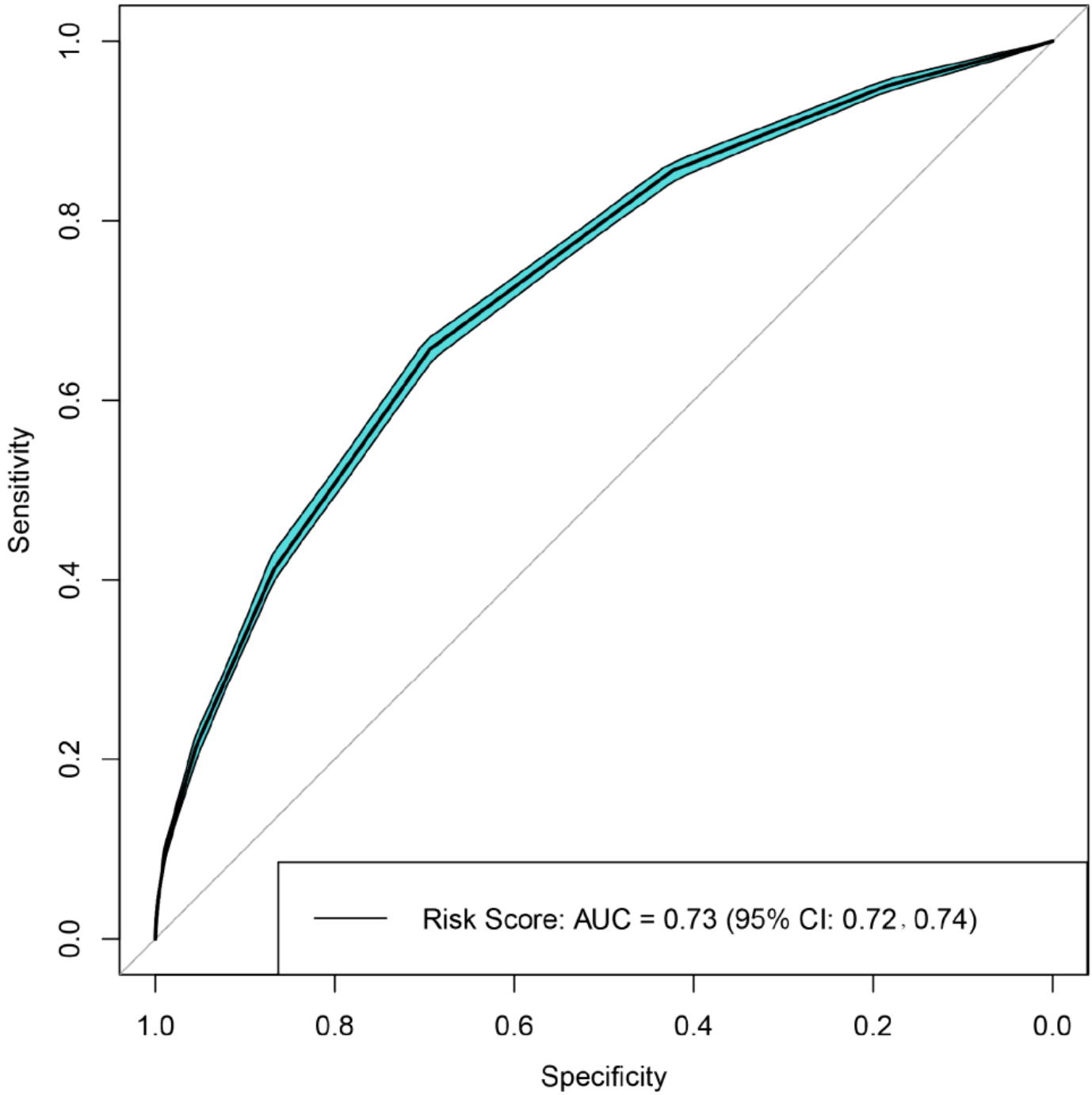

Figure 3

Description of the Developed Risk Score Prediction Performance for Anxiety Disorder by AUC. Abbreviations: AUC, area under the Receive Operating Characteristic Curve. Solid black line represents results for model including risk score, with light green area indicating the 95% CIs. Image analysis was conducted with RStudio version 4.0.2 (https://rstudio.com/)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

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