

Psychological Characteristics of Lung Cancer Patients During the 2019 Novel Coronavirus Outbreak: A Cross-Sectional and Longitudinal Study Based on a Propensity Score-Matched Population

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Abstract

Objective: This study sought to reveal the psychological characteristics of lung cancer patients at different time points of the COVID-19 epidemic.

Methods: This cross-sectional study used data from two different regional medical centers. 128 pairs of lung cancer (LC) patients and non-lung cancer subjects (NLC) were selected through propensity score matching (PSM) analysis. For the longitudinal study, the anxiety and distress state before and during the COVID-19 pandemic were surveyed through a dedicated questionnaire.

Results: A total of 135 LC patients and 165 healthy individuals were included in this cross-sectional study. After PSM analysis, 128 pairs of LC patients and NLC were matched and compared in this analysis. During the uptrend period of COVID-19 epidemic, there were significant differences in anxiety between LC patients and NLC ($P=0.005$). For LC patients, the proportions of severe distress differed significantly between the uptrend and the decline period (22.05% vs 11.90%, $P=0.032$). In two-way repeated ANOVA analysis, no significant main effect for group or group \times condition interaction effect has been founded. The distress of LC patients is mainly manifested as worry. Logistic regression showed that gender (OR=41.48, 95% CI: 9.74-17.97), age (OR=0.20, 95% CI: 0.08-0.50), and education level (OR=4.82, 95% CI: 1.98-11.69) were correlated with "worry" and contributed significantly to the model.

Conclusions: This study revealed that lung cancer patients had significant anxiety and distress during the uptrend period of the COVID-19 epidemic. The distress states of LC patients mainly manifested as worry, which was associated with age, gender, and education level.

Background

In December, 2019, a novel coronavirus (2019-nCoV) outbreak of pneumonia emerged in Wuhan, China, and has subsequently garnered attention around the world[1]. On February 11, 2020, the WHO formally named the disease triggered by 2019-nCoV as Corona Virus Disease 2019 (COVID-19)[2]. Public health emergencies have an impact on public mental health[3]. This impact might evolve to include a broad range of public mental health concerns, including distress reactions (insomnia, anger, extreme fear of illness even in those not exposed), health risk behaviors (increased use of alcohol and tobacco, social isolation), mental health disorders (posttraumatic stress disorder, anxiety disorders, distress, somatization), and lowered perceived health[4]. Additionally, people's emotional responses to an epidemic are likely to include extreme fear and uncertainty[5]. Among these mental health problems, psychological distress and anxiety are the most common, and effective interventions might be an important approach to improve outcomes for large numbers of people[6].

Compared with healthy populations, LC patients have reported higher levels of anxiety and distress[7]. It has been demonstrated that a quick identification of distress and anxiety may lead to prompt treatment and consequently to better adherence to the oncologic plan[8, 9]. Therefore, scholars have recommended paying attention to the anxiety and distress status of lung cancer patients[10]. Additionally, understanding the

mental health response after a public health emergency might help medical workers and communities prepare for a population's response to a disaster[11].

One of the barriers to the widespread adoption of psychological intervention is the current lack of knowledge regarding the potential adverse psychological impact of the COVID-19 outbreak on lung cancer patients. Therefore, the anxiety and distress status of lung cancer patients at different time points of COVID-19 should be evaluated.

Although most lung cancer patients in China are not infected with COVID-19, the epidemic situation may have a particular impact on the psychology of these patients. In this cross-sectional study, we used LC patients' data from two clinical centers to conduct a propensity matching analysis with NLC to identify the anxiety and distress changes of cancer patients during the COVID-19 epidemic.

Methods

Study overview and setting

We conducted a population-based, propensity score-matched cross-sectional and longitudinal study. For recruitment for the cross-sectional study, information was advertised online and through a dedicated questionnaire. For the longitudinal study, the anxiety and distress state before and during the COVID-19 pandemic were surveyed. As of February 24, 2020, a total of 135 LC patients and 165 non-lung cancer controls from two independent medical centers were included in the study. The study protocol was reviewed and approved by the Research Ethics Board of the First People's Hospital of Yunnan Province [reference no. 20200009], and written informed consent was obtained from all participants. The reporting of this study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (eTable 1).

Subjects and recruitment

The baseline data of primary LC patients were collected from November 2019 to December 2019 at the First People's Hospital of Yunnan Province (Kunming City, China) and Daping Hospital (Chongqing City, China) for another study (data not shown). Inclusion criteria were 1) lung cancer diagnosis (all kinds of pathological types); 2) no psychological illness or family history of it; 3) age ≥ 20 years; and 4) ability to complete the questionnaire independently. The non-lung cancer subjects (NLC) were recruited from volunteers, and the exclusion criteria were 1) posttraumatic stress disorder, obsessive-compulsive disorder, or major depression; 2) current treatment with psychotropic medication; 3) age < 20 years; 4) multiple chronic difficulties associated with learning and/or conduct problems; 5) any concurrent psychotherapy[12]. When COVID-19 has broken out in China, all of the participants were recruited again through email or phone for the present study.

Propensity score matching analysis

PSM analysis was used to minimize selection bias and balance variables. Propensity scores for all patients were estimated by a logistic regression model using age, gender, religion, income, and education level as

covariates, since these factors may affect the psychological characteristics of LC patients[13-15]. A one-to-one nearest-neighbor matching algorithm with a caliper of 0.2 and without replacement was used^[16, 17]. PSM analysis was performed using SPSS software (v24.0).

Instruments and measures

State Anxiety Inventory (SAI). State anxiety is the temporary and changeable feeling induced by the arousal of the autonomic nervous system (e.g., how a person is feeling at the time of a perceived threat)[18]; the SAI measures this feeling using 20 items rated on a 4-point scale (1, “none”; 2, “mild”; 3, “moderate”; 4, “severe”) [19]. Total SAI scores can range from 20 to 80. SAI scores ≥ 44 were considered severe anxiety[20]. Both LC patients and NLC completed the SAI.

Chinese Distress Thermometer and problem list. The distress thermometer (DT) is a screening tool recommended by the National Comprehensive Cancer Network (NCCN)[21]. Since there are racial differences in responses to the DT[22], the validated Chinese version of the DT (CDT) was used to screen patients’ levels of distress ranging from 0 (no distress) to 10 (extreme distress)[23]. Patients were instructed to circle the number (0-10) that best described how much distress they had been experiencing recently. A score of 4/10 indicates clinically significant distress and warrants additional evaluation (NCCN, 2017). Analysis of the Chinese version indicated that a cut-off score of 4/10 has a sensitivity rate of 0.80 and specificity of 0.70[24]. Unlike the SAI, the CDT was used to evaluate distress status for LC patients only[25].

The original problem list was developed by a Distress Management Guideline Panel of the NCCN and consists of 39 problems commonly experienced by cancer patients[26]. The Chinese version of the problem list was adapted from the NCCN and includes the original 39 problems plus 1 item, relationship with healthcare providers[27, 28]. Patients were asked to mark “yes” or “no” to indicate whether they had experienced each problem in the past week.

Assessment schedule

According to the epidemic data released by the Chinese Center for Disease Control and Prevention (<http://www.chinacdc.cn/>), the initial 23 days was the rapid uptrend period of the COVID-19 epidemic (cohort effects peaked around February 9); then the epidemic entered the decline period (Figure 1). Therefore, we conducted assessments on participants who were included in this study during the uptrend and decline periods (Figure 2).

Statistical analysis

The demographic and clinical characteristics, CDT score, SAI scores, and problems were described using frequencies, percentages, and measures of central tendency and dispersion. Problem totals were calculated by creating frequency scores for the number of items checked in each category. The SAI score was modeled as a count variable (ranging from 20 to 80). For within-group differences, a group \times time interaction was assessed using two-way repeated measures ANOVA with the outcome as dependent variable and group (LC and NLC) and time (Baseline, Uptrend period and Decline period) as independent variables (fixed effects) [29]. Bonferroni post hoc tests were used if interactions were detected. ESs were calculated using

Hedge's *g* for repeated measures. Effect size (ES) of 0.00–0.19, 0.20–0.49, 0.50–0.79, and ≥ 0.80 represented trivial, small, moderate, and large effects, respectively. Mean differences and their 95% confidence intervals were also calculated. Besides, we used Student's *t*-test to assess the difference in SAI scores between LC patients and NLC, and a Mann-Whitney *U* test was performed for skew distribution. Pearson's chi-squared test was used to determine the proportion of severe anxiety (SAI scores ≥ 44) and severe distress (CDT score ≥ 33) at different time points of the COVID-19 outbreak.

Based on the frequency results, worry (yes vs no) was the most commonly endorsed emotional problem on the problem list in the uptrend and decline periods of COVID-19; logistic regression analyses with worry as the dependent variable were performed to test whether any demographic or clinical variables were the best predictors of worry.

Statistical analyses were performed with SPSS (version 23.4, IBM Corp., Armonk, NY) and GraphPad (version 8.3), with a two-sided $P < 0.05$ considered statistically significant for all reports.

Results

Demographic characteristics

A total of 135 LC patients and 165 NLC were included in this cross-sectional study. The baseline characteristics of these demographics before and after PSM analysis are listed in Table 1. After PSM analysis, 128 pairs of LC patients and NLC were matched and compared in the subsequent analysis. The median age of the LC patients and NLC was 59.3 years (range, 29-77 years) and 59.7 years (range, 27-77 years), respectively. There were more males (60.9%) than females (39.1%) among the LC patients after PSM, while the NLC group had a slightly higher proportion of female patients. All variables were balanced between two groups after PSM analysis (Table 1).

Anxiety at different time points of the COVID-19 outbreak

Descriptive statistics for the anxiety of LC and NLC in the uptrend period are listed in Table 2. In the uptrend period of COVID-19, there were significant differences in SAI scores between LC patients and NLC ($P = 0.000$), while in the baseline and decline periods, there were no significant differences ($P = 0.731$ and $P = 0.102$, respectively) (Table 2). There was a significant difference in the prevalence of severe anxiety between LC patients and NLC in the uptrend period only (23.62% vs 10.32%, $P = 0.005$, eTable 1). However, there was no significant difference in the proportion of severe anxiety (SAI scores ≥ 44) between the uptrend period and the decline period (23.62% vs 16.67%, $P = 0.168$, eTable 2).

In two-way repeated ANOVA analysis (table 3), we did not find a significant main effect for the group ($p = 0.356$) or group \times condition interaction effect ($p = 0.151$). There was a significant main effect for condition ($p = 0.013$; ES = 0.15). We did not find a significant correlation coefficient ($p = 0.378$; $r = -0.18$) between diagnosis and the absolute change in anxiety. (Figure 3)

Distress at different time points of the COVID-19 outbreak

The distress of LC patients was significantly higher than the baseline in the uptrend period and the decline period. The proportions of severe distress (CTD ≥ 4) differed significantly between the uptrend period and the decline period (22.05% vs 11.90%, $P=0.032$) (eTable 2).

In two-way repeated ANOVA analysis (table 3), we did not find a significant main effect for group ($p=0.757$) or group \times condition interaction effect ($p>0.842$) in any of the analyzed outcomes for distress. For all outcomes, there was not a significant main effect for condition ($p>0.05$, $ES=0.28$) (Figure 3)

The problem list for LC patients in different periods of COVID-19

All patients who completed the questionnaire survey ($n=127$) reported at least one problem on the problem list. Different categories of problems were reported in different periods of COVID-19. During the uptrend period of COVID-19, the top five most frequent problems reported by all participants were worry ($n=51$, 40.2%), nervousness ($n=21$, 16.5%), and sleep ($n=18$, 14.2%), financial ($n=12$, 9.4%), and breathing ($n=9$, 7.1%) problems. In the decline period of COVID-19, the top five most frequent problems reported by all participants were worry ($n=49$, 38.9%), sleep ($n=22$, 17.5%), nervousness ($n=17$, 13.5%), financial problems ($n=11$, 8.7%), and constipation ($n=10$, 7.9%). (eTable 3 and Figure 2)

Logistic regression analysis

With “worry” (yes vs no) as the dependent variable, age, gender, religion, education, income, and LC stage were entered into the analysis. The model predicted the correct value in 54.3% of cases. Gender (OR=41.48, 95% CI: 9.74-17.97), age (OR=0.20, 95% CI: 0.08-0.50), and education level (OR= 4.82, 95% CI: 1.98-11.69) were correlated with worry indicated on the emotional problem list and contributed significantly to the model. (Table 4).

Discussion

To the best of our knowledge, the present study is the first to examine the psychological characteristics of lung cancer patients during the COVID-19 outbreak. COVID-19 is causing mental health problems such as stress, anxiety, depressive symptoms, insomnia, denial, anger, and fear[1]. These mental health problems not only affect healthy people but could also affect lung cancer patients, who have been found to be more vulnerable than healthy populations[10, 30]. Lung cancer survivors have been shown to experience elevated distress compared with survivors of other cancer types[31], and emotional difficulties in cancer survivors are directly associated with lower QoL and greater symptom burden[32]. Although psychologists and the government have called for more psychological counseling during the epidemic, insufficient psychological attention has been paid to patients with lung cancer. The prerequisite for this psychological counseling is to clarify the psychological characteristics of lung cancer patients during this epidemic.

We found that there was a difference in distress levels between NLC and LC patients. The distress level among the patients in our study was comparable with other studies on lung cancer patients[33, 34]. Distress reflects the spectrum of psychological problems (i.e., cognitive, emotional, social, and spiritual) associated with a diagnosis and treatment of cancer and can be measured by the CDT[35]. The NCCN published the

first distress screening guidelines in the United States in 1999 (updated in 2017), recommending distress screening as a part of routine cancer care. According to previous reports, distress has prognostic value for lung cancer patients[36]. Our study further confirmed that the distress level of LC patients was higher than baseline during the COVID-19 epidemic, although this cross-sectional study could not reveal the long-term impacts on these patients. An explanation for this observation could be that lung cancer patients suffer from dual psychological distress from lung cancer and the COVID-19 epidemic.

With an improved understanding of the impact of demographic or disease characteristics on distress, the psychological intervention can be executed for LC patients in the COVID-19 outbreak period. Logistic regression showed that gender, age, and education level were correlated with “worry,” which may be the main source of distress during the outbreak. In general, older people and males constitute a large proportion of lung cancer patients, which may explain the relationship between age and gender with worry. Additionally, LC patients with a higher education level usually have a better understanding of lung cancer and COVID-19, which may explain the negative correlation of education level with worry.

During different periods of the epidemic, the lung cancer patients had different CTD scores. In the uptrend period of COVID-19, overwhelming and sensational news headlines and images added anxiety and fear about this situation as well as fostering rumors and hype to fill in the absence of information[4]. By contrast, in the decline period of the epidemic, LC patients’ worries about the epidemic gradually diminished, while their concern about lung cancer may not be alleviated. Therefore, the DS showed a significant decrease in the decline period compared with the uptrend period of COVID-19, but it was still higher than at baseline.

Two validated anxiety measures are commonly used for lung cancer patients, the SAI and the Medical Outcomes Study Short-Form 36-item survey (SF-36)[37]. Since LC patients were matched with NLC in this study, the SAI was used to evaluate anxiety. There was a significant difference between LC and NLC during the uptrend period of COVID-19, while there was no difference between LC and NLC at baseline or in the decline period. We believe that the difference in the anxiety of lung cancer patients in the uptrend period was mainly due to the impact of the epidemic situation. Due to the gradual mitigation of the epidemic in the decline period, there was no significant difference in SAI scores between LC patients and NLC.

Some limitations of this study should be noted. First, as we write this paper, the COVID-19 epidemic is slowly evolving in China. Although this cross-sectional study included the uptrend and decline periods, the design and results did not capture the changing patterns of psychosocial distress over the entire COVID-19 outbreak. Nevertheless, we can more or less predict the expected mental/physical health consequences and most vulnerable populations. Second, given the use of previous baseline data, the included patients represent a population with lung cancer only. This selection bias likely contributed to the limitations of tumor type selection of this study. For future studies, it might be of interest to include a broader sample and other types of tumor patients. Third, PSM accounts only for observed covariates. Factors that affect assignment to treatment and outcome but that cannot be observed cannot be accounted for in the matching procedure. As the procedure only controls for observed variables, any hidden bias due to latent variables may remain after matching. Moreover, the longitudinal study has a limited sample size. Finally, the Chongqing and

Yunnan was not the central area of the COVID-19 outbreak; nevertheless, as of February 20, 2020, 567 and 236 patients in Chongqing and Yunnan were diagnosed with COVID-19 respectively.

Conclusions

As far as we knew, this is the first study reveals that compared with non-lung cancer people, lung cancer patients experienced significantly higher anxiety and distress during the uptrend period of the COVID-19 epidemic. In addition, during the uptrend period of COVID-19, LC patients showed more obvious distress than NLC, and this distress mainly manifested as worry, which was associated with age, gender, and education level. Further study of efficacy and underlying mechanisms is warranted.

Abbreviations

COVID-19: Corona Virus Disease 2019; 2019-nCoV: 2019 novel coronavirus; LC: lung cancer; NLC: Non-lung cancer subjects; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology; PSM: Propensity score matching; DT: distress thermometer score; DS: distress scores; SAI: State Anxiety Inventory; CDT: Chinese Distress Thermometer score; NCCN: National Comprehensive Cancer Network; SAI: State Anxiety Inventory, CI: confidence interval, ES: effect size

Declarations

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Authors' contributions

Conception and design: LHJ, KQ, YD; Administrative support: HP; Data extraction: YD, YC, KQ; Collection and assembly of data: KQ, YC, YD; Data analysis and interpretation: YC, HP, YD; Manuscript writing: All authors; Final approval of manuscript: All authors.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available because the file contains personal or clinical details of participants that compromise anonymity, but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was reviewed and approved by the ethics committee of The First People's Hospital of Yunnan Province [reference no. 20200009]

Consent for publication

All authors and patients involved in this article agree to publish this article on *BMC Psychiatry*. (consent form can be provided at any time if needed.)

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1 Demographic characteristics

Characteristics	Before PSM, <i>n</i>			<i>P</i> value	After PSM, <i>n</i>			<i>P</i> -value
	LC	NLC	Total number		LC	NLC	Total number	
Total number	135	165	300		128	128	256	
Age (years)								
<30	4	13	17	0.017	4	5	12	0.898
30–49	28	30	58		27	24	47	
50–69	73	66	139		70	68	122	
≥70	30	56	86		27	31	75	
Gender								
Male	85	78	172	0.007	78	75	153	0.702
Female	50	87	128		50	53	103	
Religion								
Buddhism	27	32	59	0.107	24	26	50	0.744
Christianity	11	19	30		10	11	24	
Catholicism	14	6	20		14	9	17	
Other	83	108	191		80	82	165	
Education								
Elementary school	65	54	144	0.008	62	60	122	0.860
High school	42	79	96		42	46	88	
University	28	32	60		24	22	46	
Income (RMB)				0.003				
<5,000	54	94	125		54	53	107	0.899
≥5,000	81	71	175		74	75	149	

Table 2 Descriptive statistics for anxiety measures at each time point

Time Point and Subscale	Score Range of SAI	LC			NLC			Difference in Mean	P-value
		N	Mean/Median	SD/Quartiles	N	Mean/Median	SD/Quartiles		
Baseline	20–80	128	28.51 [#]	8.27 [#]	128	24.95 [#]	5.30 [#]	3.56	0.731*
Uptrend period	20–80	127	40.97 [#]	8.78 [#]	126	35.86 [#]	5.19 [#]	5.11	0.000*
Decline period	20–80	126	34.18	7.26	126	32.79	6.12	1.39	0.102

Note: SAI: State Anxiety Inventory, *Mann–Whitney U test, [#]SAI has a skew distribution median and quartiles instead.

Table 3 Results on the effects of time on the psychological characteristics

Variable	Main effect for Group p-value	Main effect for condition p-value	Group×condition interaction effect p-value	ES for condition and 95% CI	Mean diff and 95% CI*	Correlation p-value
SAI score	0.356	0.013	0.151	0.15 (0.03-0.25)	25.8 (22.3-35.9)	0.387
CDT score	0.757	0.821	0.842	0.28 (0.09-0.36)	2.7(1.2-4.3)	0.452

Note: SAI: State Anxiety Inventory, CI: confidence interval, CDT: the validated Chinese version of the distress thermometer, ES: effect size, *: mean difference between lung cancer patients and non-lung cancer people for the whole sample;

Table 4 Logistic regression of LC patients with dichotomized worry outcome in uptrend period of COVID-19

Variables	P-value	Exp(B)	95% CI for Exp(B)	
			Lower	Upper
Gender	0.000	41.481	9.674	177.861
Religion	0.908	0.973	0.608	1.556
Age	0.001	0.201	0.080	0.501
Education	0.001	4.816	1.984	11.691
Income	0.247	1.970	0.624	6.213
Lung cancer stage*	0.589	1.362	0.444	4.174
Age by gender	0.060	0.874	0.759	1.006
Age by education	0.335	0.934	0.813	1.073
Gender by education	0.268	1.129	0.911	1.399
Constant	0.099	0.025		

Note: *: Staging according to NCCN guidelines of lung cancer.

Figures

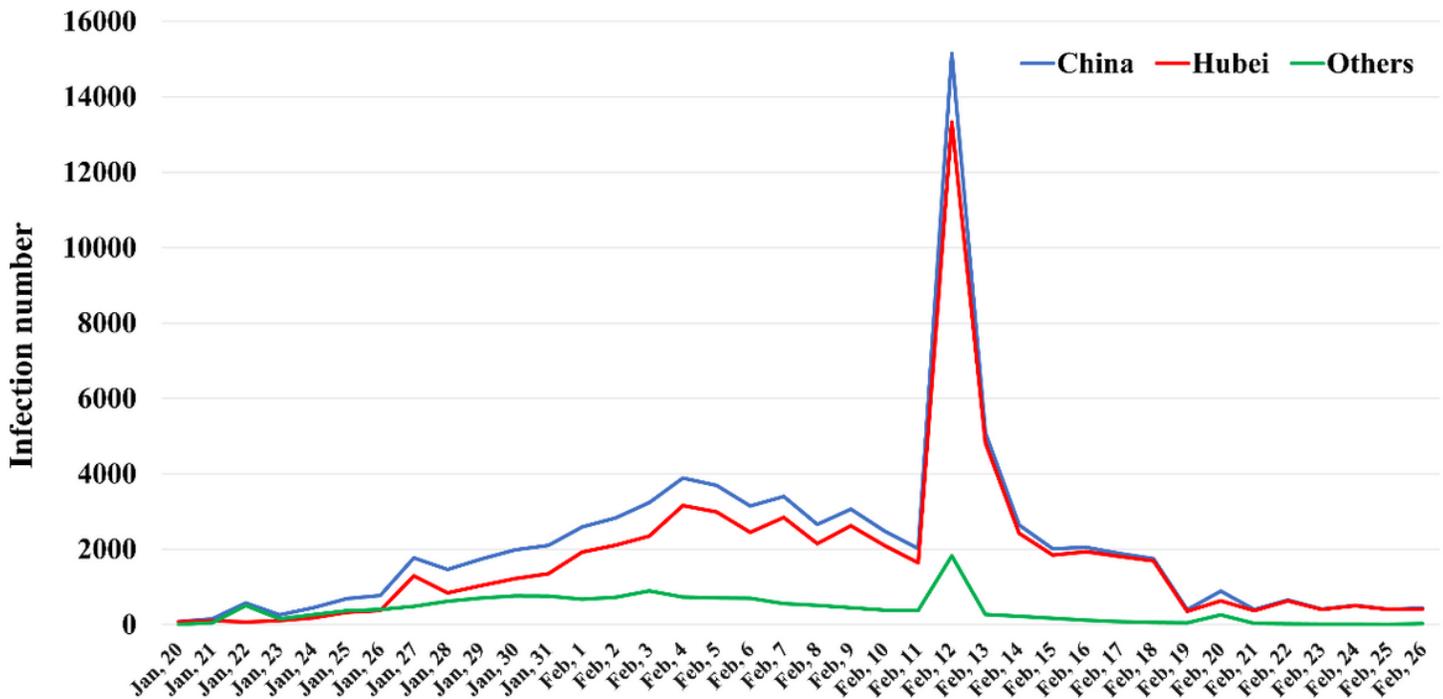


Figure 1

COVID-19 trend chart in China. Blue line: The reported cases in China; red line: the reported cases in Hubei; green line: reported cases in other regions of China.

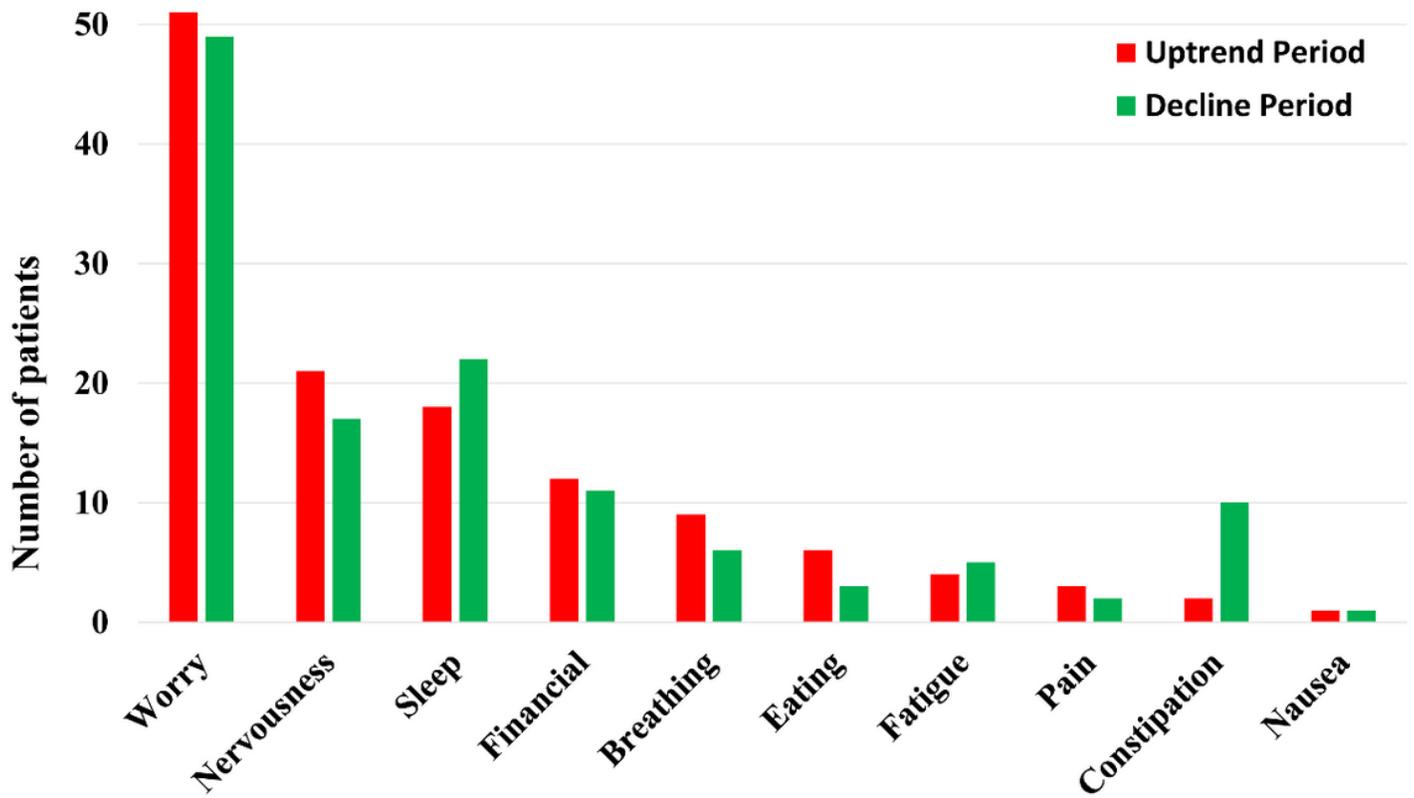


Figure 2

Patients' report of the top 10 problems from the CDT problem list during the uptrend and decline periods.

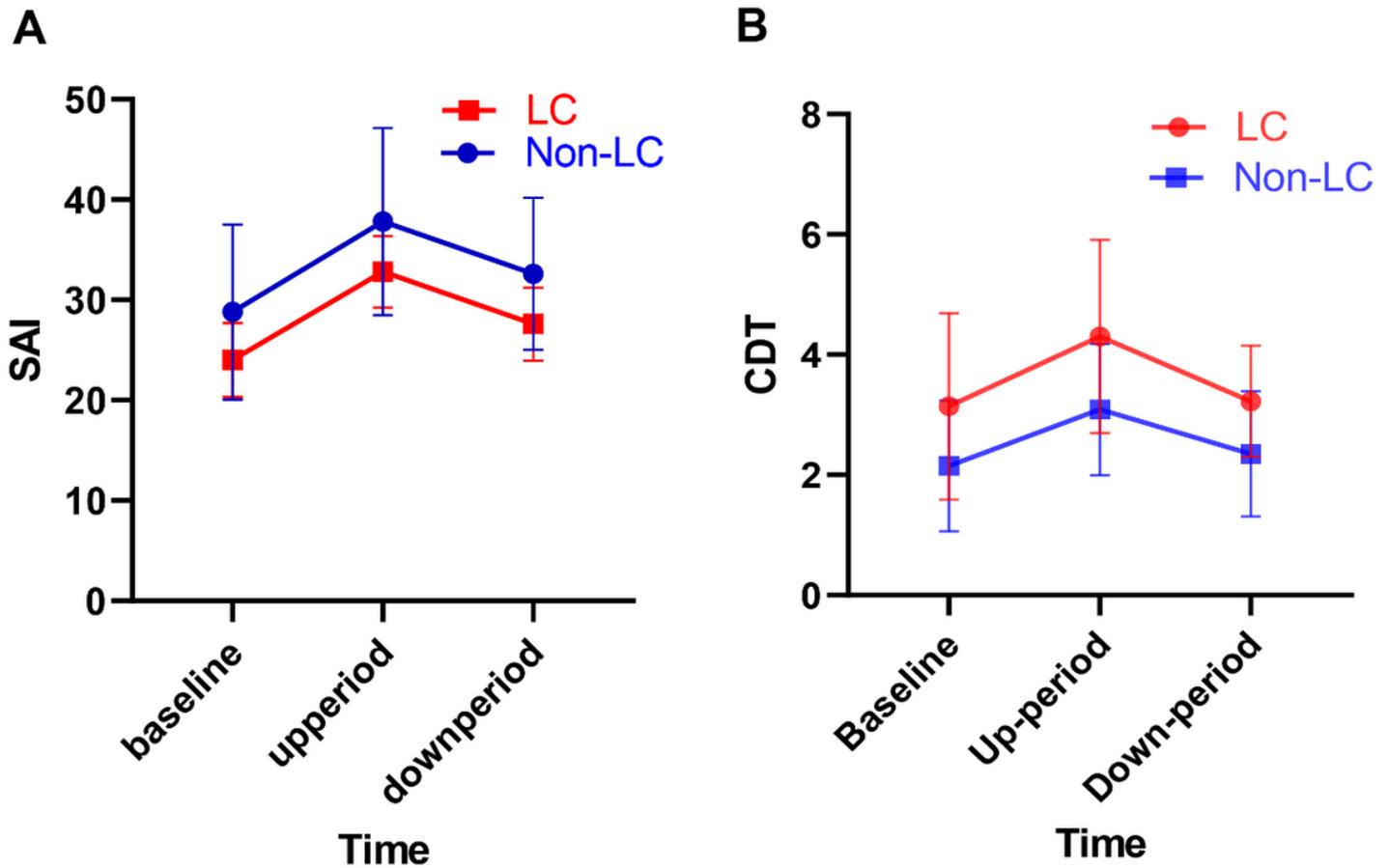


Figure 3

Psychological characteristics of LC and NLC during the COVID-19. A. SAI score of LC and NLC during the COVID-19 at baseline, uptrend period and downtrend period. B. CDT score of LC and NLC during the COVID-19 at baseline, uptrend period and downtrend period. For detailed statistical analysis, see text and Table 3.

Supplementary Files

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

- [eTable1.docx](#)
- [eTable2.docx](#)
- [eTable3.docx](#)