

Psychological factors and oral health during initial outbreak of COVID-19 in China: A cross-sectional study

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Qiang Sun¹, Honglin Ren^{2,*} , Yueran Bian³,
Yesi Xie¹ and Hui Shi⁴ 

Abstract

Objectives: To investigate associations between oral health and psychological factors (i.e., depression, anxiety, and resilience) in a group of Chinese individuals who had sought an intervention online during the COVID-19 pandemic.

Methods: For this cross-sectional study, online questionnaires were created using online survey software from set items of instruments commonly used to assess depression, anxiety, and resilience combined with an oral health survey. The study was conducted from March 13 to 16, 2020.

Results: 568 participants (188 men and 380 women) with a mean \pm SD age of 41.7 ± 10.2 years were included in the analyses. In total, 152 (27%) participants were from Beijing, 149 (26%) from Wuhan, 110 (19%) from Shenyang, and 157 (28%) from other Chinese cities. Halitosis and bleeding gums were the most common reasons for individuals to seek an intervention. Compared with other cities, participants from Wuhan showed higher anxiety and depression and worse previous oral health. Resilience mediated the relationship between depression and oral health, but not between anxiety and oral health.

Conclusion: We hope that the data from this study will inform clinical practitioners and demonstrate that mental health awareness and resilience training are important strategies that may mitigate the negative impact of lockdown and isolation on oral health.

⁴Department of Clinical Psychology, Beijing Chao-Yang Hospital, Capital Medical University, Beijing, China

*These authors share first authorship. They made equal contributions to the article.

Corresponding author:

Qiang Sun, Centre of Dental Medicine, China-Japan Friendship Hospital, Beijing 100029, China.
Email: superqiangcjf@163.com

¹Centre of Dental Medicine, China-Japan Friendship Hospital, Beijing, China

²Department of General Education, Wuhan Vocational College of Software and Engineering, Wuhan, China

³School of Educational Science, Huazhong University of Science and Technology, Wuhan, China



Keywords

COVID-19, oral health, anxiety, depression, resilience

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that was responsible for coronavirus disease 2019 (COVID-19) was first detected in Wuhan, China in early December 2019, and quickly spread globally, proving to be one of the most challenging tests faced by humanity in modern history.^{1,2} According to current data from Centre for Systems Science and Engineering (CSSE) at Johns Hopkins University, worldwide, COVID-19 has infected over 664 million individuals and caused nearly 7 million deaths.³ The COVID-19 virus is highly contagious and spreads from person to person by inhalation of respiratory droplets.⁴ Data also showed that the virus could persist on surfaces from a few hours to several days, depending on the type of surface, temperature, and environment.⁵

During the pandemic, infection control was the cornerstone of safe dental practice.⁶ However, many dental procedures produce aerosols and droplets contaminated with bacteria, viruses, and blood and so the risk of cross-infection between patients and dentists was high.⁷ Moreover, according to records, when the COVID-19 virus was first identified, many dental practices were closed or suspended and despite dental emergencies, people were reluctant to go and seek treatment.^{7,8} Interestingly, one study showed that increased levels of anxiety, depression, and stress lead to increased levels of oral parafunctional habits during the COVID-19 pandemic, and the authors suggested that this may result in an increased prevalence of orofacial pain and temporomandibular disorders

in the future.⁹ While the comprehensive and long-lasting psychological consequences of COVID-19 have been highlighted in several studies,^{10,11} little data are available on how the virus affects oral behaviour. Indeed, to-date, no empirical study has examined the psychological impacts of COVID-19 on oral and dental health.^{7,12} The aim of this present was to investigate associations between oral health and psychological factors (i.e., depression, anxiety, and resilience) in a group of Chinese individuals who had sought an intervention online during the COVID-19 pandemic.

Methods

Study procedures

For this cross-sectional study, online questionnaires were created using online survey software (Questionnaire Star software, <https://www.wjx.cn/>) from set items of instruments commonly used to assess depression, anxiety, and resilience¹⁴⁻¹⁶ and an oral health survey. Demographic data included: sex; age; district; medical history (suffering from two or more chronic diseases was considered as severe). Participants were encouraged to complete the e-questionnaires by phone, email, or instant messaging software. The questionnaire was accessible online across 29 cities in China.

Study population

The participants in this cross-sectional study had oral symptoms and had chosen to seek medical intervention online because of lockdown during the COVID-19 epidemic. The study took place from March 13–16,

2020. The participants had used a nucleic acid amplification test to confirm that they were negative for COVID-19.

Two investigators [QS; YX] from the Centre of Dental Medicine, China-Japan Friendship Hospital, Beijing, China, reviewed the responses to the questionnaires retrieved from the website administrator and enrolled individuals who met the inclusion and exclusion criteria. Inclusion criteria were as follows: oral symptoms; aged between 20 and 75 years; able to complete the questionnaires. Exclusions were as follows: resided outside China; a response time to the questionnaire of ≤ 3 min or ≥ 30 min; an oral emergency (e.g., maxillofacial trauma); presence of a severe concomitant disease; history of psychotic symptoms (e.g., schizophrenia).

The study followed the STROBE statement guidelines¹³ and was approved by the Institutional Research Ethics Committee of the Institute of Psychology, the Chinese Academy of Sciences (Approval number: CAS-20200221; Date: February 21, 2020). Written informed consent was obtained from each patient and data were anonymized prior to analysis.

Instruments

The following instruments and an oral health survey were used to construct the online questionnaire.

The 9-item Patient Health Questionnaire (PHQ-9) was used to assess the participants' depression.¹⁴ The questionnaire consists of 9 items that represent the 9 diagnostic criteria for major depression. The items are rated on a 4-point ordinal scale indicating how frequently the symptom has been present over the past two weeks. Recommended severity score ranges are as follows: 0–4, none; 5–9 mild; 10–14 moderate; 15–19 moderately severe; 20–27, severe. The Chinese version of PHQ has been shown to have outstanding reliability and validity.¹⁵

To assess the participants' anxiety and symptom severity, the Chinese version of the 7-item Generalized Anxiety Disorder (GAD-7) scale was used.¹⁶ According to severity scores, anxiety was graded as: 0–4, none; 5–9, mild; 10–13, moderate; 14–18, moderate; 19–21, severe. This instrument has been shown to have outstanding reliability and validity.¹⁶

Resilience is the ability of individuals to adapt to difficult situations and helps protect them from various mental health conditions, such as depression and anxiety.¹⁷ To assess participants' resilience, the Chinese version of the Connor-Davidson Resilience Scale-10 (CD-RISC-10) was used in this study.¹⁸ The scale has 10 items each scored 0–4 (i.e., score range 0–40). The Chinese version of CD-RISC-10 has been shown to have high reliability and validity.¹⁹ This scale has been shown to be sensitive to changes in response to interventions in psychiatric patients and so was suitable for this study.²⁰

The oral health survey had five questions: (1) professional teeth cleaning (i.e., none; once/year; twice or more/year); (2) treatment desire (i.e., none; needed but not available; needed but feared consequences of the pandemic); (3) latest treatment (i.e., emergency department; stayed home; telehealth visit); (4) previous oral health (i.e., *good*: no decay or repair; *medium*: oral problems that did not affect the quality of life; *poor*: required oral care and had an impact on quality of life); (5) occurrence of specific oral symptoms (i.e., tooth pain; sleep bruxism; bleeding gums; halitosis; oral ulcers; uncomfortable feelings; third molar problems).

Statistical analyses

According to sample size calculations using G-power 3.1 software,¹⁵ an effect size of 0.25 in the χ^2 test, with a probability of type I error of $\leq 5\%$, and power $(1-\beta)$ of

0.95, required a minimum sample size of 220. Statistical analysis was performed using SPSS software (version 20.0 for Windows®; IBM Corp, Armonk, NY, USA). A *P*-value <0.05 was considered to indicate statistical significance.

Classification data were expressed as percentages and compared using χ^2 test. For psychological symptoms (i.e., anxiety, depression, resilience), the student's *t*-test was used and bootstrap 95% Confidence Intervals (CIs) established. Pearson's correlation test was used to analyse the correlation between anxiety and depression scores. Mediation and Path analyses were used to evaluate the direct and indirect effects of anxiety, depression, and resilience on oral health.²¹

Results

Of the initial 680 questionnaires that were collected, 112 were excluded (47, incomplete data; 43, response time ≤ 3 min; 8, outside China; 6, severe disease; 5, mental illness; 3, <20 years. Therefore, 568 valid questionnaires were analysed. The population consisted of 188 men and 380 women with a mean \pm SD age of 41.7 ± 10.2 years.

Across the population, 152 (27%) participants were from Beijing, 149 (26%) from Wuhan, 110 (19%) from Shenyang, and 157 (28%) from other cities in China.

Across the population (*n* = 568), the results of oral health survey were as follows: (1) For professional teeth cleaning, none (252), once (290), or twice or more/year (26); (2) For treatment desire, none (371), needed but not available (63), needed but feared consequences of the pandemic (134); (3) For latest treatment, emergency department (144), stayed home (299), telehealth visit (125) (4) For previous oral health, *good* (65), *medium* (347), *poor* (156); (5) For specific oral symptoms, seven oral symptoms troubled the participants enough for them to seek advice online, these were: halitosis (27%); bleeding gums (24%); ulcers (16%); tooth pain (14%); third molar problems (9%); sleep bruxism (6%); uncomfortable feelings (4%).

Across the population, PHQ-9 scores for depression were as follows: none (0–4), 350 (62%); mild (5–9), 140 (25%); moderate (10–14), 60 (11%); moderately severe (15–19), 18 (3%); severe (20–27), 0 (0%) (Table 1). The GAD-7 scores for anxiety were as follows: none (0–4), 396 (70%);

Table 1. Depression and anxiety scores from Wuhan and other Chinese cities.

	Wuhan n = 149	Other Cities n = 419	Total n = 568	Statistical significance
Depression				
none	51 (34)	299 (71)	350 (62)	
mild	50 (34)	90 (22)	140 (25)	
moderate	34 (23)	26 (6)	60 (11)	
moderately/severe	14 (9)	4 (0)	18 (3)	
severe	0 (0)	0 (0)	0 (0)	<i>P</i> < 0.001
Anxiety				
none	61 (41)	335 (80)	396 (70)	
mild	56 (38)	76 (18)	132 (23)	
moderate	14 (9)	4 (1)	18 (3)	
moderately/severe	11 (7)	3 (1)	14 (3)	
severe	7 (5)	1 (0)	8 (1)	<i>P</i> < 0.001

Data are expressed as *n* (%).

mild (5–9), 132 (23%); moderate (10–13), 18 (3%); moderately severe (14–18), 14 (3%); severe (19–21), 8 (1%) (Table 1).

We compared differences between Wuhan and other cities combined. In terms of oral symptoms there was no difference between Wuhan and other cities combined, the largest χ^2 test = 2.98, $P = 0.085$ (bootstrap test; bootstrap 95%CI, -0.008 – 0.104). However, for their previous oral health assessment, compared with other cities combined, fewer participants from Wuhan reported ‘good’ (χ^2 test = 31.2, $P < 0.001$), and more from Wuhan reported ‘poor’ (χ^2 test, 24.6, $P < 0.001$). Wuhan ($n = 149$): good, 10 (7%); medium, 92 (62%); poor, 47 (32%). Other cities combined ($n = 419$): good, 55 (13%); medium, 255 (61%); poor, 109 (26%). As a consequence, more participants in Wuhan than other cities sought an intervention: Wuhan: yes, 92 (62%), no, 57 (38%); other cities: yes, 140 (33%), no, 279 (67%).

In terms of mental health, participants from Wuhan were more vulnerable than those in other cities, which was supported by the difference in resilience scores, Wuhan: mean \pm SD, 21.7 ± 6.8 ; other cities: 24.5 ± 6.2 ; $P < 0.001$; bootstrap 95% CI, 1.6–4.1). Compared with participants from other cities, those from Wuhan had

a higher level of anxiety ($P < 0.001$; bootstrap 95%CI, 3.1–4.9), and depression ($P < 0.001$; bootstrap 95%CI: 3.1–4.9) (Table 1).

There was a statistically significant correlation between anxiety and depression scores ($r = 0.76$, $P < 0.001$) (Figure 1a). Interindividual differences in resilience scores were observed. Scores ranged from 2–32 and the median scores was 24.0 (mean \pm SD, 23.8 ± 6.4); (Figure 1b). Further analysis showed that resilience scores negatively correlated with anxiety and depression scores, and the correlations were statistically significant (anxiety, $r = -0.43$, $P < 0.001$; depression, $r = -0.50$, $P < 0.001$).

Using mediation and path analyses, we investigated the relationship between psychological factors (anxiety, depression, resilience) and oral health (Figures 2a and 2b). The depression or anxiety scores were independent variables (IVs), resilience was a mediator, and oral health was a dependent variable (DV). Estimated path coefficients represent the strength of connections or the strength of the influence conveyed through that pathway. A bias-corrected bootstrap 95% CI for the indirect effect (estimated path coefficient [$a * b$], 0.008) based on bootstrap sampled 10,000 times was above zero (0.0007–0.0175), such that the effect

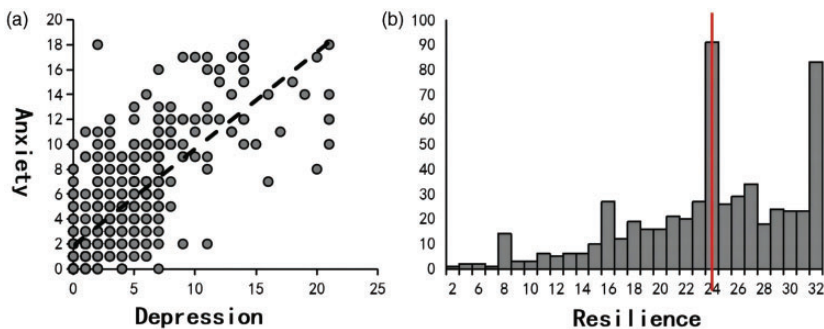


Figure 1. (a) Correlation between depression and anxiety scores for the whole population ($n = 568$). The correlation was statistically significant ($r = 0.76$, $P < 0.001$) and (b) Distribution of resilience scores for the whole population ($n = 568$); median 24.0 (red line) range 2–32.

between depression and the oral health depended partially on resilience ($c' = 0.0175$ $P = 0.0208$; Figure 2a). However, the mediation model for the effect between anxiety, resilience and oral health was nonsignificant. A bias-corrected bootstrap 95% CI for the indirect effect (estimated path coefficient [$a * b$], 0.0067) was below zero (-0.0002 – 0.0141) (Figure 2b).

Discussion

COVID-19 outbreaks disrupted basic life activities and elicited acute and long-term effects on individuals' well-being and health, including psychological distress, anxiety, and depression.²² In China, severe measures that included massive lockdowns and electronic surveillance of millions of people, were taken.²³ Indeed, COVID-19 has created an uncertain world, and its severe psychological consequences for individuals and societies are perhaps long-lasting.²⁴

Oral health can be regarded as a window to our overall health, but the influence of the COVID-19 crisis on patients' dental and oral health and their quality of life has been

largely ignored.^{7,25} In this present study we analysed data collected in March 2020 and investigated the impact of COVID-19 on oral and dental care and explored the relationship between anxiety, depression, and resilience on oral health in a sample of individuals with negative COVID-19 tests. Oral health affects people physically and psychologically.²⁴ We found that the most frequently reported oral symptoms reported by our participants were halitosis, bleeding gums, ulcers and tooth pain. These findings are consistent with those from another study conducted in India, that found aphthous stomatitis, facial pain, periodontitis, and gingivitis were commonly reported during the COVID epidemic.²⁶

Compared with participants from other Chinese cities, we observed that individuals from Wuhan showed higher anxiety and depression, lower resilience and worse previous oral health assessments. Our results are consistent with those from a previous study that showed participants in Wuhan were more psychologically affected during the epidemic, and had more oral health problems than individuals from other

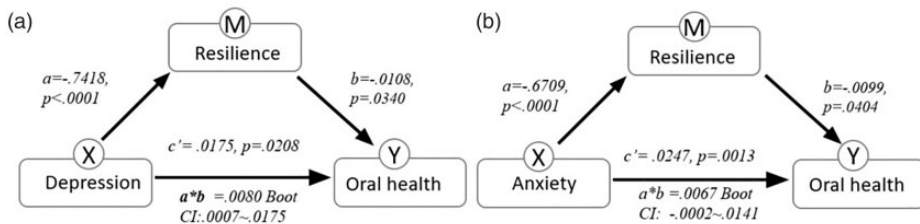


Figure 2. (a) Mediation model using depression-resilience-oral health symptom counts. A bias-corrected bootstrap 95% CI for the indirect effect (estimated path coefficient [$a * b$], 0.008) based on bootstrap sampled 10,000 times was above zero (0.0007–0.0175), such that the effect between depression and the oral health depended on resilience ($P < 0.05$) and (b) Mediation model using anxiety-resilience-oral health symptom counts. The mediation model for the effect between anxiety, resilience and oral health was nonsignificant. A bias-corrected bootstrap 95% CI for the indirect effect (estimated path coefficient [$a * b$], 0.0067) was below zero (-0.0002 – 0.0141).

a , b , $a * b$, and c' refer to estimated path coefficients.

Oral health = specific oral symptom counts (i.e., tooth pain; sleep bruxism; bleeding gums; halitosis; oral ulcers; uncomfortable feelings; third molar problems).

Boot CI = bootstrap 95% Confidence Interval.

cities in China.²⁷ Psychological stress associated with the COVID-19 outbreak in Wuhan was significant and induced the feelings of fear, anxiety, distress, and isolation in the population.²²

Previous studies have shown that poor oral health was associated with poor emotional health and well-being as assessed by psychological factors such as anxiety, depression and resilience.²⁸ A study from China in patients with oral cancer showed that improving their resilience helped relieve anxiety symptoms.²⁹ Our analysis across all participants found that the while the mediating effect of resilience on the relationship between depression and oral symptoms was significant, the mediating effect of resilience on the relationship between anxiety and oral symptoms was not. Despite their close association in many cases, depression and anxiety have distinct causes and consequences. Importantly, improving emotional regulation and resilience is critical for coping with catastrophic events. We suggest that remote psychological support and online oral health counselling should be recommended to improve resilience and support the mental health of those in isolation or lockdown.

The study had several limitations. For instance, the survey was administered in March 2020 when COVID-19 was initially spreading across Wuhan and a few cities in China. This may have reduced the number of potential responders and so limited the scope of the study. However, the data we retrieved may assist in providing an insight into the COVID-19 situation at that time. In addition, our study did not include a survey of oral healthcare professionals, who would probably be particularly at risk from psychological symptoms. Further research is warranted to confirm our findings and construct relevant sub-sets of participants. Nevertheless, we hope that the data from this study will inform clinical practitioners and demonstrate that mental health

awareness and resilience training are important strategies that may mitigate the negative impact of lockdown and isolation on oral health.

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Declaration of conflicting interests


The authors declare that there are no conflicts of interest.

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ORCID iDs

Honglin Ren  <https://orcid.org/0000-0003-4878-0360>

Hui Shi  <https://orcid.org/0000-0002-3304-9316>

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