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Mental distress in orthodontic patients during the coronavirus disease 2019 pandemic

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Introduction: The ongoing coronavirus disease 2019 (COVID-19) outbreak impacts the mental health of patients, health workers, and the public. The level of impact on the mental health of orthodontic patients in treatment is unknown. The objective of the study was to evaluate the mental health of orthodontic patients in China during the early stage of the pandemic. **Methods:** An online survey was conducted on a convenience sample of anonymous participants. The questionnaire, in Chinese (Mandarin), comprised 5 sections. Sections 1-3 included demographic, epidemical, and orthodontic status of the patients. Section 4 assessed mental health-related to orthodontics. Section 5 was the Kessler-10 Mental Distress Scale. A total of 48 orthodontists were invited to distribute the questionnaires to their patients. Descriptive statistics, principal component analysis, K-means cluster analysis, and bivariate logistics regression analysis were performed with significance set at $P < 0.05$. **Results:** Questionnaires were collected from 558 patients (104 males, 354 females; mean age 24.78 $\pm$ 6.33 years). The prevalence of mental distress was 38% (174/458). Higher odds ratios were associated with female participants, missed appointments, and Hubei residence. The type of orthodontic appliance was associated with the anxiety of prolonged treatment duration. The manner of communication with patients regarding the postponement of appointments was associated with patients' concerns of prolonged treatment duration. The frequency of contact from dentists was associated with patients' independence. **Conclusions:** Over one-third of orthodontic patients experienced mental distress during the pandemic. Multiple factors affected the level of anxiety of orthodontic patients, such as the type of orthodontic appliance, time since last dental visit, manner of communication with the orthodontist, and the localities of the pandemic progression. (Am J Orthod Dentofacial Orthop 2020;158:824-33)

Coronavirus disease 2019 (COVID-19) was first reported in Wuhan, Hubei Province, China, in December 2019. With stunning speed, now it is sweeping across the whole world, causing a global health emergency of international concern. On March 11, 2020, the World Health Organization declared COVID-19 a global pandemic. By May 28, 2020, the disease has been reported in over 210 countries and territories with increasing confirmed patients in Italy, United States, Brazil, Russia, and Spain. With the ongoing outbreak, the mental health of COVID-19 patients, health workers, and the public has become of great concern.[1]

During the pandemic, all the provinces in China, as well as many cities in other countries such as Italy, have raised highest-level health emergency. Cities were locked down with residents staying at home to avoid disease transmission. Because of the prolonged lockdown, subjects are suffering from a feeling of isolation from society, which could further develop into depression and

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anxiety.[2] Among these subjects, a particular focus should be on dental patients.

In a dental clinic setting, the patients, dentists, and dental assistants are exposed to the aerosol mist of saliva or blood droplets generated from high-speed handpiece or ultrasonic instruments to the surroundings. The delivery of orthodontic treatment involves close contact with patients. It was found that droplet and close contact transmission were the main transmission route for COVID-19.[3] It has been previously reported that 9 dental practitioners were infected by the coronavirus in the School and Hospital of Stomatology, Wuhan University.[4] Therefore, many dental hospitals and clinics were advised to provide treatment for dental emergencies only with the shutdown of all other dental departments, especially in the Hubei Province, since January 23, 2020. Thus, routine follow-up visits of orthodontic treatment had been interrupted by the pandemic. Furthermore, some patients suffered from orthodontic emergencies, such as loose brackets and protruding wire, but were unable to get timely and effective help from the specialists. After February 25, 2020, some hospitals and clinics were allowed to open with extra-protective measures such as epidemiologic record evaluation, temperature check, and upgraded personal protective measures during the dental treatment.[4-6] All these factors might lead to an increase in the mental stress of the patients.

The objectives of the present study were to evaluate the mental distress of orthodontic patients and to investigate the level of their anxiety on treatment duration and outcome during the early stage of the pandemic.

MATERIAL AND METHODS

The study protocol was approved by the West China Hospital of Stomatology (Approval no. WCHSIRB-D-2020-218). Because the investigator could reach the participants only by telephone or the Internet, an anonymous online questionnaire consisting of 5 sections (Figs 1 and 2) was developed in Mandarin Chinese via www.wjx.cn.

A total of 48 orthodontists were invited to distribute the questionnaire to be completed by their patients. The inclusion criteria were as follows: (1) in the process of orthodontic treatment, (2) able to read Mandarin online, (3) had informed consent for the use of the data recorded, and (4) completed all the items in the questionnaire within a reasonable time. The questionnaire was available online from February 20 to February 22, which was during the early stage of the pandemic.

Section 1 assessed demographic and COVID-19-related epidemical information, such as sex, age, education level, residence, family income, marital status, profession and employment status, history of COVID-19–related symptoms, close contact with subjects from Hubei Province, and close contact with confirmed or suspected patients.

Section 2 focused on the perception of the pandemic, which included the knowledge and severity of the pandemic, the risk of infection for themselves and the people around them, and the main concerns about the pandemic.

Section 3 focused on the orthodontic state of the patients, including the type of their dental institutions and orthodontic appliances, the time since their last dental

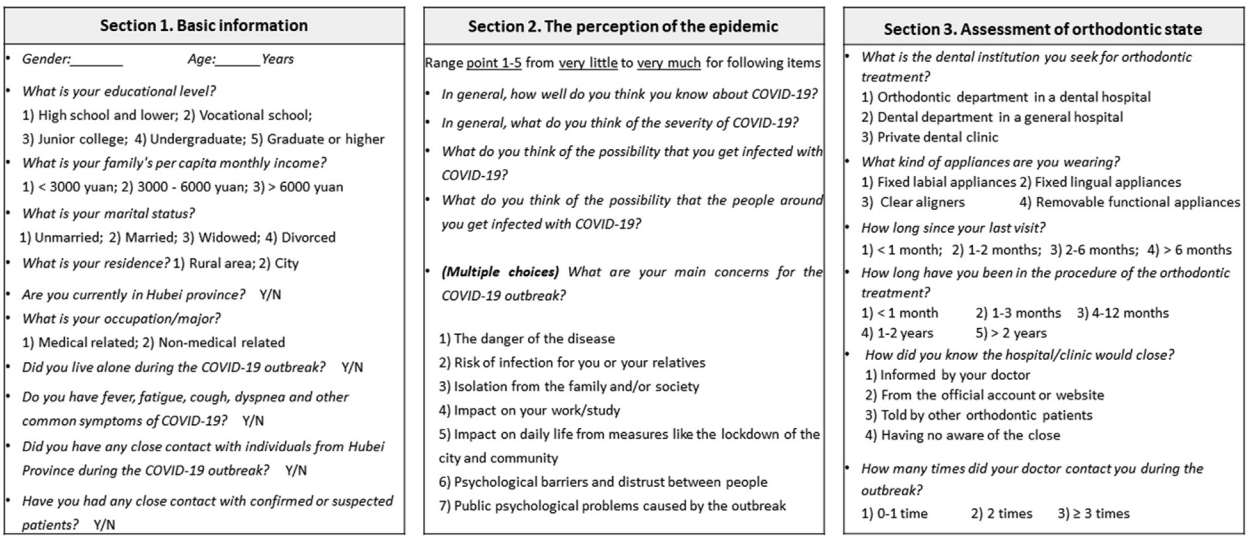
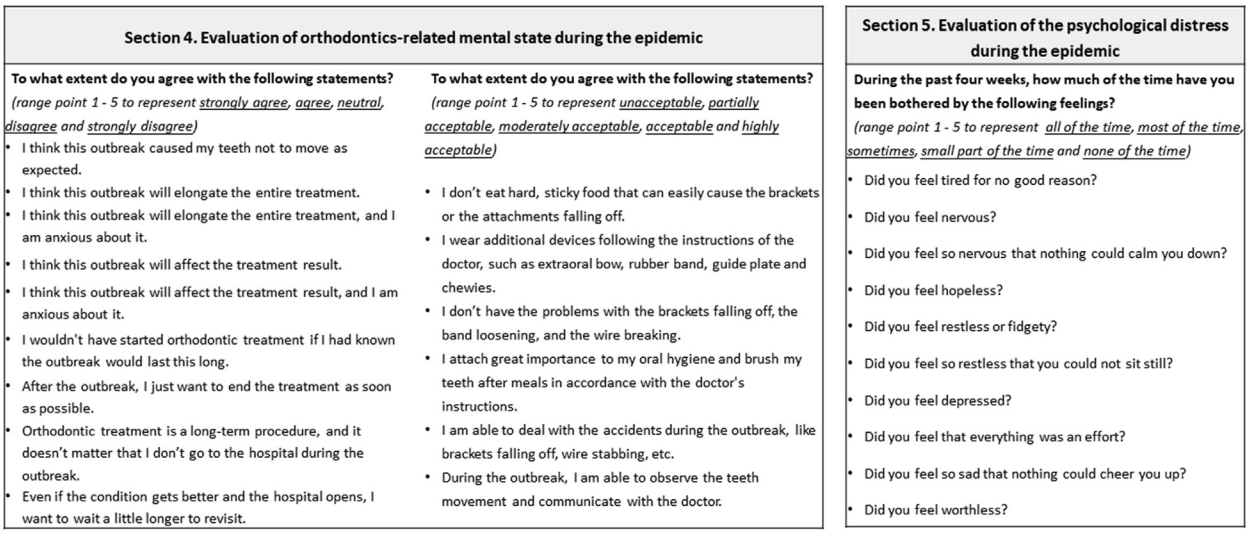


Fig 1. Sections 1-3 of the questionnaire. *Y/N*, yes or no.



Section 4. Evaluation of orthodontics-related mental state during the epidemic

To what extent do you agree with the following statements?
(range point 1 - 5 to represent strongly agree, agree, neutral, disagree and strongly disagree)

- I think this outbreak caused my teeth not to move as expected.
- I think this outbreak will elongate the entire treatment.
- I think this outbreak will elongate the entire treatment, and I am anxious about it.
- I think this outbreak will affect the treatment result.
- I think this outbreak will affect the treatment result, and I am anxious about it.
- I wouldn't have started orthodontic treatment if I had known the outbreak would last this long.
- After the outbreak, I just want to end the treatment as soon as possible.
- Orthodontic treatment is a long-term procedure, and it doesn't matter that I don't go to the hospital during the outbreak.
- Even if the condition gets better and the hospital opens, I want to wait a little longer to revisit.

To what extent do you agree with the following statements?
(range point 1 - 5 to represent unacceptable, partially acceptable, moderately acceptable, acceptable and highly acceptable)

- I don't eat hard, sticky food that can easily cause the brackets or the attachments falling off.
- I wear additional devices following the instructions of the doctor, such as extraoral bow, rubber band, guide plate and chewies.
- I don't have the problems with the brackets falling off, the band loosening, and the wire breaking.
- I attach great importance to my oral hygiene and brush my teeth after meals in accordance with the doctor's instructions.
- I am able to deal with the accidents during the outbreak, like brackets falling off, wire stabbing, etc.
- During the outbreak, I am able to observe the teeth movement and communicate with the doctor.

Section 5. Evaluation of the psychological distress during the epidemic

During the past four weeks, how much of the time have you been bothered by the following feelings?
(range point 1 - 5 to represent all of the time, most of the time, sometimes, small part of the time and none of the time)

- Did you feel tired for no good reason?
- Did you feel nervous?
- Did you feel so nervous that nothing could calm you down?
- Did you feel hopeless?
- Did you feel restless or fidgety?
- Did you feel so restless that you could not sit still?
- Did you feel depressed?
- Did you feel that everything was an effort?
- Did you feel so sad that nothing could cheer you up?
- Did you feel worthless?

Fig 2. Sections 4 and 5 of the questionnaire.

visit, the duration since treatment began, the way they received the suspension notice, and frequency of contacts from their orthodontist.

Section 4 assessed the orthodontic-related mental state. There are 15 items in this section with a 5-point scale ranging in score from 1 to 5 for each item. The 15 items aimed to evaluate the patients' anxiety about treatment duration and outcome, their compliance, patience, and independence. Specifically, compliance is defined as the ability to perform the home instructions such as elastics use, sequential change of aligners, and oral hygiene maintenance. Independence refers to the ability to deal with orthodontic accidents and the initiative to communicate with the dentist. Patience is defined as the willingness to wait for the appointment until the pandemic was under control. Sections 1-4 were developed by a proficient orthodontist (J.W.) who has more than 20 years of experience with the help of 2 junior orthodontists (X.X. and X.F.). All these items were validated preliminarily.

Section 5 focused on the Kessler-10 Psychological Distress Scale, which included 10 items to evaluate the mental distress of patients over the past 4 weeks.[7] The 5-point scale for each item ranged from a score of 1 (none of the time) to a score of 5 (all of the time), with a total score range of 10-50. The Chinese version of the scale was shown to have highly acceptable validity and reliability (Cronbach α ranged from 0.80-0.87) in previous studies.[8-10] A total score of 10-19 was considered normal, whereas a score of 20-50 was indicative of mental distress.

After data collection, the internal consistency of items in Sections 4 and 5 was evaluated by calculating Cronbach α coefficients.[11] The items in Section 4 were selected for subsequent principal component analysis (PCA).[12] Sampling adequacy was tested using the Kaiser-Meyer-Olkin test.[13] Then K-means cluster analysis was performed using each principal component (PC) to classify the study samples into 2 categories on the basis of the characteristics of each PC. The mental distress and the classifications of PC, which were binary variables, were considered as dependent variables in bivariate logistic regression analysis to assess the association with their independent variables. The strength of the relationship was interpreted using odds ratios (ORs) with 95% confidence intervals (CIs). The model adequacy in bivariate logistic regression was approved with Hosmer and Lemeshow[14] goodness of fit test. All statistical tests were 2-sided and were performed by IBM SPSS Statistics (version 24; IBM Corp, Armonk, NY) with a significance level of 0.05.

RESULTS

A total of 458 valid questionnaires were collected by February 22, 2020. The mean age of the participants was 24.78 years, with a standard deviation of 6.33 years. Descriptive statistics of the sample are reported in Tables I-IV. For categorical data, the frequency and percentage of each category are reported. There were 354 females (77.29%) and 104 males (22.71%). For residence, 22 (5.68%) patients were in Hubei Province, and 432 patients were not (Table I).

For the patients' perception of the pandemic, 292 (63.76%) respondents thought they knew much about COVID-19, and 107 (23.36%) thought they knew very much. Three hundred four respondents considered this

Table I. Basic information of orthodontic patients (n = 458)

Independent variables	*Category*	*Frequency, n*	*Percentage, %*
Age	≤24 y	244	53.28
	>24 y	214	46.72
Sex	Male	104	22.71
	Female	354	77.29
Educational level	High school and lower	68	14.85
	Vocational school	28	6.11
	Junior college	72	15.72
	Undergraduate	229	50.00
	Graduate or higher	61	13.32
Monthly income	<3000 yuan	56	12.23
	3000 ≤ income < 6000 yuan	201	43.89
	6000 yuan or more	201	43.89
Marital status	Unmarried	351	76.64
	Married	98	21.40
	Widowed	1	0.22
	Separated or divorced	8	1.75
Residence	Rural area	89	19.43
	City	369	80.57
Currently in Hubei Province	Yes	26	5.68
	No	432	94.32
Occupation and/or major	Medical-related	93	20.31
	Nonmedical-related	365	79.69
Live alone	Yes	79	17.25
	No	379	82.75
COVID symptoms	Yes	4	0.87
	No	454	99.13
Close contact with subjects from Hubei Province	Yes	24	5.24
	No	434	94.76
Close contact with confirmed or suspected patients	Yes	2	0.44
	No	456	99.56

Table II. Patients' perception of the pandemic (n = 458)

Independent variables	*Category*	*Frequency, n*	*Percentage, %*
Knowledge	1	2	0.44
	2	2	0.44
	3	55	12.01
	4	292	63.76
	5	107	23.36
Severity	1	0	0.00
	2	2	0.44
	3	9	1.97
	4	143	31.22
	5	304	66.38
Infection possibility	1	127	27.73
	2	137	29.91
	3	145	31.66
	4	29	6.33
	5	20	4.37
Infection possibility of people around	1	105	22.93
	2	153	33.41
	3	153	33.41
	4	39	8.52
	5	8	1.75

Note. The "Category" column ranges from 1 being "very little" to 5 being "very much."

Table III. Patients' main concerns about COVID-19 (n = 458)

Independent variables	*Category*	*Frequency, n*	*Percentage, %*
Danger of the disease	Yes	332	72.49
	No	126	27.51
Risk of infection	Yes	372	81.22
	No	86	18.78
Isolation	Yes	210	45.85
	No	248	54.15
Impact on work and/or study	Yes	289	63.10
	No	169	36.90
Impact on daily life	Yes	245	53.49
	No	213	46.51
Psychological barriers and distrust	Yes	149	32.53
	No	309	67.47
Public psychological problems	Yes	268	58.52
	No	190	41.48

disease as very severe (Table II). For patients' main concerns about COVID-19, 72.49% (332/458) and 81.22% (372/458) were concerned about the danger of the disease and the risk of infection, respectively, whereas 45.85% (210/458) were concerned about the isolation from the family or society (Table III).

For the patients' orthodontic status, 264 (57.64%) patients were registered in orthodontic departments in dental hospitals. Fixed labial appliances were worn by 309 (67.47%) patients, whereas 94 (20.52%) wore clear aligners, and 35 (7.64%) wore fixed lingual appliances. Only 9.61% (44/458) of the patients had visited the orthodontist within a month. For the suspension notice, 242 (52.84%) patients were informed by the doctor. For the frequency of contact from the dentist, 283 (61.79%) patients had

Table IV. Assessment of patients' orthodontic status (n = 458)

Independent variables	*Category*	*Frequency, n*	*Percentage, %*
Medical institution	Orthodontic department in dental hospital	264	57.64
	Dental department in general hospital	81	17.69
	Private dental clinic	113	24.67
Type of appliances	Fixed labial appliances	309	67.47
	Fixed lingual appliances	35	7.64
	Clear aligners	94	20.52
	Functional appliances	20	4.37
Duration from the last appointment	Within 1 mo	44	9.61
	1-2 mo	350	76.42
	2-6 mo	48	10.48
	More than 6 mo	16	3.49
Duration since the beginning	Within 1 mo	10	2.18
	1-3 mo	63	13.76
	4-12 mo	152	33.19
	1-2 y	147	32.10
	More than 2 y	86	18.78
Way to get the suspension	Informed by doctor	242	52.84
	From the official account or Web site	181	39.52
	Told by other patients	16	3.49
	Not aware	19	4.15
Frequency of contact from dentist	0-1 time	283	61.79
	2 times	105	22.93
	3 times and more	70	15.28

contacted the dentist 0-1 time, whereas 70 (15.28%) patients had contacted the dentist 3 times or more (Table IV).

The Cronbach α value for the 15 items in Section 4 was 0.700. The PCA derived 5 components with 66.26% of cumulative explanation (Tables V and VI). The Kaiser-Meyer-Olkin value was 0.787. PC1 and PC2 depicted the anxiety about treatment duration and treatment outcome. The compliance, independence, and patience of the patients were described in the PC3, PC4, and PC5, respectively (Table VI). The classifications of K-means cluster analysis based on each PC were shown in Table VI.

Cronbach α value (internal consistency) for the 10 items in Section 5 was 0.938. The mean ± standard deviation for the Chinese version of the scale was 18.38 ± 7.21. The prevalence of mental distress among the participants was 38.00% (174/458), with a 95% CI of 33.50-42.50.

As shown in Table VII, the results of multivariable regression showed that female patients (OR, 1.77; 95% CI, 1.07-2.93), concern about isolation from the family or society (OR, 1.54; 95% CI, 1.04-2.30), time intervals of more than 6 months since last visit (OR, 5.02; 95% CI, 1.45-17.38), and Hubei residence (OR, 5.69; 95% CI, 2.30-14.12) had higher odds of mental distress.

Fixed lingual appliance (OR, 0.36; 95% CI, 0.17-0.78) and clear aligners (OR, 0.57; 95% CI, 0.35-0.93) were less associated with high anxiety about treatment duration (PC1) compared with the fixed labial appliance. In addition, 1-2 months (OR, 2.18; 95% CI, 1.12-4.22) and 2-6 months (OR, 2.89; 95% CI, 1.20-6.95) since the last visit were more associated with high anxiety about treatment duration compared with within 1 month since the last visit. Knowing about suspension from official accounts (OR, 1.72; 95% CI, 1.14-2.59) and told by other patients (OR, 3.96; 95% CI, 1.14-13.76) were more associated with high anxiety about treatment duration than those informed by their doctors (Table VIII).

Residing in an urban area (OR, 0.53; 95% CI, 0.33-0.86), concern about isolation (OR, 2.02; 95% CI, 1.37-2.97), and more than 6 months since last visit (OR, 7.44; 95% CI, 1.97-28.11) were more associated with high anxiety about treatment outcome (PC2; Table VIII). No independent variable was found to be associated with high compliance (PC3, $P > 0.05$).

General dental departments (OR, 2.61; 95% CI, 1.97-28.11; compared with dental clinics) and clear aligners (OR, 2.25; 95% CI, 1.34-3.80) showed a higher association with high independence (PC4). Nonmedical-related occupations showed less association with high independence. Dentist contact of 2 times (OR, 2.21; 95% CI, 1.35-3.62) and ≥3 times (OR, 2.06; 95% CI, 1.15-3.69) were more associated with high independence compared with 0-1 time (Table VIII).

Receiving treatment in dental clinics (OR, 1.88; 95% CI, 1.01-3.48) and general dental departments (OR, 1.75; 95% CI, 1.11-2.76) were more associated with

Table V. Principal component analysis after varimax rotation

Item	*PCA1*	*PCA2*	*PCA3*	*PCA4*	*PCA5*
I think this outbreak will elongate the entire treatment	0.838	0.082	−0.019	0.131	0.020
I think this outbreak caused my teeth not to move as expected	0.770	0.082	0.050	0.075	−0.080
I think the outbreak will elongate the entire treatment, and I am anxious about it	0.704	0.486	−0.018	0.060	−0.125
I wouldn't have started orthodontic treatment if I had known the outbreak would last this long	−0.058	0.817	0.003	0.001	−0.024
I think this outbreak will affect the treatment result, and I am anxious about it	0.529	0.692	0.041	0.000	−0.161
After the outbreak, I just want to end the treatment as soon as possible	0.235	0.677	−0.005	0.084	−0.039
I think this outbreak will affect the treatment result	0.574	0.625	0.067	0.046	−0.095
I don't eat hard, sticky food that can easily cause the brackets or the attachments falling off	−0.019	−0.058	0.808	−0.053	−0.033
I wear additional devices following the instructions of the doctor, such as extraoral bow, rubber band, guide plate, and chewies	−0.125	0.144	0.708	0.198	0.087
I attach great importance to my oral hygiene and brush my teeth after meals in accordance with the doctor's instructions	−0.016	0.033	0.667	0.246	0.066
I don't have the problems with the brackets falling off, the band loosening, and the wire breaking	0.207	−0.053	0.660	0.042	−0.060
I am able to deal with the accidents during the outbreak, such as brackets falling off, wire stabbing, etc.	0.055	0.010	0.141	0.859	−0.072
During the outbreak, I am able to observe the teeth movement and communicate with the doctor	0.177	0.080	0.181	0.801	−0.053
Even if the condition gets better and the hospital opens, I want to wait a little longer to revisit	−0.096	0.073	0.021	−0.050	0.842
Orthodontic treatment is a long-term procedure, and it doesn't matter that I don't go to the hospital during the outbreak	−0.043	−0.278	0.019	−0.066	0.773

Table VI. The first 5 principal components, their variance explained (%), cumulative percentage (%), and K-means cluster analysis results based on each principal component

Principal components	*Meaning of the principal component*	*Variance explained, %*	*Cumulative percentage, %*	*Category*	*Frequency, n*	*Percentage, %*
PC1	Anxiety about the treatment duration	27.090	27.090	High	213	46.51
				Low	245	53.49
PC2	Anxiety about the treatment outcome	15.594	42.683	High	184	40.17
				Low	274	59.83
PC3	Compliance	8.711	51.394	High	248	54.15
				Low	210	45.85
PC4	Independence	8.033	59.427	High	243	53.06
				Low	215	46.94
PC5	Patience	6.837	66.264	High	266	58.08
				Low	192	41.92

high patience (PC5). Patients with nonmedical-related occupations (OR, 0.57; 95% CI, 0.34-0.96) had lower odds of high patience (Table VIII).

DISCUSSION

Our study revealed that 38% (174/458) of the participants had mental distress, which was relatively worse compared with previous studies.[7,15] The mean value of this study (18.38) was relatively higher than the mean value (16.66) of 3091 residents with 6 weeks of smoke exposure from an open-cut coalmine fire,[16] which indicated the severely adverse effects of this pandemic on mental health.

The number of female patients was 3 times greater than that of male patients, which was consistent with the trend that females are more likely to seek orthodontic treatment.[17,18] Half of the patients were undergraduates, and 61 (13.32%) patients had a higher education level than undergraduate. The reason might be that patients with higher educational level were familiar with online technology and were more willing to fill the online questionnaires.[19] Another reason might

Table VII. Regressive analysis of mental distress (Kessler-10 Psychological Distress Scale)

Independent variables	*Category*	*OR*	*95% CI*	P
Sex	Male	Reference	Reference	0.027*
	Female	1.77	1.07-2.93	
Concern about isolation	No	Reference	Reference	0.033*
	Yes	1.54	1.04-2.30	
Duration from the last appointment	Within 1 mo	Reference	Reference	0.042*
	1-2 mo	1.35	0.66-2.74	0.414
	2-6 mo	2.01	0.82-4.92	0.127
	More than 6 mo	5.02	1.45-17.38	0.011*
Currently in Hubei Province	No	Reference	Reference	<0.001**
	Yes	5.69	2.30-14.12	

*P <0.05; **P <0.001.

be that some patients in primary or high schools were not allowed to use the smartphones by their parents.

The results of the questionnaires showed that the majority of the respondents considered COVID-19 a serious disease and showed great concern, although this study was conducted at a relatively early stage of the pandemic. The majority of the patients (90.39%) were unable to visit the orthodontists for over 1 month amid the outbreak, and the interval tends to extend as some hospitals and clinics remain closed. Over half of the patients seldom got contact with the orthodontist, because some orthodontists might not share their contact details with the patients.

In PCA, items with larger factor loadings (>0.60; Table V) were considered to be more critical in the meaning of the PCs.[20] Thus, the meaning of each PC was interpreted on the basis of the content of the items. The results of the K-means cluster analysis indicated that the majority of the patients hold relatively positive attitudes toward the pandemic. Over half of them had a low level of anxiety about the treatment duration and outcome, but the anxiety might increase as the suspension goes on.

Many factors were found to be associated with orthodontic patients' mental health. In this study, we found that female patients were more likely to have mental distress, which might be attributed to the biologic nature of their responses to stressors and risk factors,[21] as well as their lower quality of life in orthodontic treatment.[22] In addition, patients currently in Hubei Province had significantly higher odds of mental distress as they might suffer more from the fear of the virus and endure longer isolation from society.

Patients living in rural areas were more prone to develop anxiety about treatment outcomes. The reasons might be that they had lower incomes than urban residents (P <0.001; Supplementary Table) and might be more vulnerable to the economic impact brought by the pandemic. In addition, they might endure more transportation difficulties when revisiting their orthodontists, as most dental clinics and hospitals were located in cities. Patients worried about isolation from the family or society might feel hopeless and being cut off from the society. Therefore, they were apt to have mental distress and anxiety about treatment outcomes. Additional attention could be given to these patients.

The time interval from the last dental visit was shown to be an associated factor. Disruption of routine appointments led to higher odds of mental distress and anxiety about treatment duration and outcome. Beckwith et al[23] reported that each missed appointment added 1.09 months to treatment time, and 64.63% of the patients held the view that the pandemic would extend the entire treatment. It could infer that a prolonged delay during a lockdown could potentially lead to a further increase in the severity and number of patients who developed anxiety and mental distress, although the delivery of orthodontic treatment is considered to be elective and regarded as nonessential dental service when compared with dental emergencies. Orthodontists should work on relieving patients' anxiety because a 2-month delay does not affect much in the overall 2 years of treatment. In addition, the prolonged delay might have an impact on the gingival health and white spot lesion development when the lockdown period is extensive, because not every orthodontic patient develops good home care oral hygiene practices during treatment. This factor has implications on treatment outcome. Future research could investigate the longer-term impact.

The type of appliances was associated with anxiety about treatment duration. Treatment duration of both labial and lingual fixed appliances could be affected by replaced brackets and/or bands and missed appointments.[24] The treatment duration of lingual appliances is similar to buccal appliances,[25] but with the invisible

Table VIII. Regressive analysis of the principal components

Principal component	*Independent variables*	*Category*	*OR*	*95% CI*	P
PC1, anxiety about treatment duration	Type of appliances	Fixed labial appliance	Reference	Reference	0.008**
		Fixed lingual appliance	0.36	0.17-0.78	0.009**
		Clear aligners	0.57	0.35-0.93	0.024*
		Functional appliances	0.42	0.15-1.20	0.107
	Time since the last appointment	Within 1 mo	Reference	Reference	0.003**
		1-2 mo	2.18	1.12-4.22	0.021*
		2-6 mo	2.89	1.20-6.95	0.018*
		More than 6 mo	0.24	0.05-1.27	0.093
	Way to get the suspension	Informed by doctor	Reference	Reference	0.019*
		From the official account or Web site	1.72	1.14-2.59	0.010*
		Told by other patients	3.96	1.14-13.76	0.030*
		Not aware	1.47	0.52-4.15	0.470
PC2, anxiety about treatment outcome	Residence	Rural area	Reference	Reference	0.009**
		City	0.53	0.33-0.86	
	Concern about isolation	No	Reference	Reference	<0.001***
		Yes	2.02	1.37-2.97	
	Time interval since last appointment	Within 1 mo	Reference	Reference	0.022*
		1-2 mo	1.42	0.71-2.81	0.320
		2-6 mo	1.87	0.78-4.48	0.158
		More than 6 mo	7.44	1.97-28.11	0.003**
PC3, compliance	None	–	–	–	–
PC4, independence	Medical institution	Private dental clinic	Reference	Reference	0.020*
		Orthodontic department in dental hospital	1.51	0.92-2.49	0.104
		Dental department in general hospital	2.61	1.33-5.12	0.005**
	Occupation and/or major	Medical-related	Reference	Reference	<0.001***
		Nonmedical-related	0.35	0.20-0.60	
	Close contact with subjects from Hubei Province	Yes	Reference	Reference	0.005**
		No	25.95	2.63-256.51	
	Concern about public psychological problems	No	Reference	Reference	0.035*
		Yes	1.56	1.03-2.35	
	Type of appliances	Fixed labial appliance	Reference	Reference	0.016*
		Fixed lingual appliance	0.92	0.41-2.03	0.828
		Clear aligners	2.25	1.34-3.80	0.002**
		Functional appliances	1.68	0.63-4.49	0.301
	Frequency of contact from dentists	0-1 time	Reference	Reference	0.002**
		2 times	2.21	1.35-3.62	0.002**
		3 times and more	2.06	1.15-3.69	0.015*
PC5, patience	Medical institution	Orthodontic department in dental hospital	Reference	Reference	0.037*
		Dental department in general hospital	1.75	1.11-2.76	0.017*
		Private dental clinic	1.88	1.01-3.48	0.046*
	Occupation and/or major	Medical-related	Reference	Reference	0.034*
		Nonmedical-related	0.57	0.34-0.96	
	Concern about infection	No	Reference	Reference	0.011*
		Yes	1.91	1.16-3.14	
	Concern about work and/or study	No	Reference	Reference	0.048*
		Yes	1.53	1.00-2.33	
	Concern about daily life	No	Reference	Reference	0.001**
		Yes	0.49	0.32-0.74	

*P <0.05; **P <0.01; ***P <0.001.

characteristics of lingual appliances, patients seem to be less worried about the treatment duration. Another consideration is that lingual appliance wearers had higher incomes than buccal appliance wearers (P <0.001; Supplementary Table), and patients with better financial conditions might be less anxious amid this pandemic. However, the explanations to substantiate this finding would require future investigation. The esthetics of clear aligners is better than labial appliances as well,[26] and clear aligners are less affected by orthodontic emergencies and missed appointments if the patients have got enough sets of aligners from the orthodontist. Therefore, patients with clear aligners also tend to be less anxious about the treatment duration.

The type of dental institution was shown to play an important role in the mental behavior of orthodontic patients. Patients registered in dental clinics showed the lowest independence to deal with orthodontic accidents, whereas patients receiving treatment at orthodontic departments in dental hospitals wanted to revisit their dentists more urgently after the pandemic. These findings might be related to the differences of dental institutions, both in practitioners and infrastructures. In the mainland of China, practitioners in public hospitals might provide patients with more official instructions,[27] contributing to their high independence. The infrastructures in general dental departments and dental clinics might not be as comprehensive as the orthodontic departments in dental hospitals,[28] and that would increase patients' concern with nosocomial infection, causing further delay in their revisit.

In this particular period, "teledentistry" is of great value.[29] The manner of communication with patients was associated with anxiety about treatment duration. Patients who got the suspension notice directly from the doctor showed less anxiety compared with patients who got the notices from official accounts, Web sites, or other patients, suggesting effective contact was important for patients whose appointments have been interrupted. Because the pandemic is not totally under control, orthodontists should personally contact the patients regularly, especially patients from the "hotspot" areas, and give them instructions about oral health maintenance and emergency handling. In this way, the patients might express less mental distress and could maintain better orthodontic conditions by themselves.

On the basis of the results, we want to provide the following recommendations to the practitioners: (1) Routinely and directly communicate with the patients during a lockdown, (2) give priority to communication with females and patients in the epicenter and rural areas, (3) give instructions to patients on home care oral hygiene practices and emergency handling via telephones or Internet, (4) apply aligners instead of labial fixed appliances and distribute enough sets of aligners during the early stage of a lockdown, and (5) further research could be conducted to explore the exact reasons for the lingual appliances' positive impact on mental health, and to evaluate the longer-term impact of a lockdown on the mental and oral health of orthodontic patients.

This study had some limitations. In the regression analysis, several factors were found to have ORs with large CIs. For instance, Hubei residence was associated with mental distress (OR, 5.69; 95% CI, 2.30-14.12). The large CI might be due to the uneven distribution of residence, with 26 participants residing in Hubei, whereas 432 participants were from outside the province. In addition, the large CI could impair the accuracy of the estimated effect; however, the direction (damage or protect) would not be affected if the P value were significant (<0.05). In future research, an even distribution of residence might help to assess the accurate strength of the effect of Hubei residence.

Another limitation was that the 5 principal components accounted for 66% of the variance. The response scale for each item was a 5-point scale. Compared with continuous variables, this 5-point scale could impair the explained variance. Although the cumulative percentage reached over 60% in our study, which was acceptable for questionnaire studies,[30] it could be improved by implementing response scales with more points. In addition, no independent variable was found to be associated with PC3 (compliance), whereas personal characteristics, pain, inconvenience, and specific dental knowledge were reported to be correlated with compliance in previous studies.[31] Items related to the associated factors regarding compliance could be added into Section 1 in future questionnaires.

CONCLUSIONS

Over one-third of the orthodontic patients experienced mental distress during the early stage of the COVID-19 pandemic. Multiple factors affected the level of mental distress of orthodontic patients, such as the type of orthodontic appliance, interval from the last dental visit, manner of communication with the orthodontist, and the localities of the pandemic progression.

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.ajodo.2020.07.005.

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Supplementary Table. Differences of incomes between different types of appliances and residence (n = 458)

Independent variables	*Category*	*<3000 yuan (n = 56)*	*3000 ≤ income < 6000 yuan (n = 201)*	*6000 yuan or more (n = 201)*	P
Type of appliances	Fixed labial appliances	44	149	116	<0.001***
	Fixed lingual appliances	1	9	25	
	Clear aligners	3	37	54	
	Functional appliances	8	6	6	
Residence	Rural area	31	41	17	<0.001***
	City	25	160	184	

***P <0.001.