



Psychometric Evaluation of the Fear of COVID-19 Scale Among Chinese Population

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Abstract

Fear is a negative emotional reaction to or persistent worry over an imminent public health event like COVID-19. The COVID-Fear Scale was developed in many countries, but not in China. The current study aims to examine the psychometric properties of Chinese version of the Fear of COVID-19 Scale. Translation into Chinese and back-translation into English were conducted firstly. Item analysis and exploratory factor analysis were conducted in Sample 1, followed by validity tests in Sample 2. Likely, test-retest reliability was conducted in sample 3. A bifactor structure of Chinese version of FCV-19S with a general fear factor and two orthogonal group factors with fear thoughts and physical response was confirmed. Besides, it has good internal consistency reliability ($\alpha = .92$), composite reliability ($CR = .92$), and validity correlation validity. The results of the present study confirmed that the Chinese version of FCV-19S has good psychometric properties in the Chinese communities.

Keywords Fear of COVID-19 Scale · Reliability · Validity

Coronavirus disease 2019 (COVID-19) is a novel and highly infectious respiratory disease, which has threatened to become a global public health crisis (Cucinotta and Vanelli 2020). Specifically, the COVID-19 has affected 215 countries till July 13, 2020, and the number of confirmed cases has exceeded 12.95 million with 560,000 registered deaths worldwide (Worldometers 2020). In China, approximately 80,000 individuals have been diagnosed with COVID-19, with over 4600 officially recorded deaths (Chinese National Health Commission 2020). Such substantial negative effects or damage caused by COVID-19 are not simply observed on the global economy (Al-Awadhi et al. 2020; Laing 2020), but this pandemic is also affecting mental health (e.g., depression, anxiety, and fear) across a variety of age groups and cultural backgrounds (Liu et al. 2020; Rajkumar 2020).

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Fear is a negative emotional reaction to or persistent worry over an imminent public health event like COVID-related death and illness (Van Bavel et al. 2020). Furthermore, the extended parallel process model has defined fear as negative arousal emotion that can be produced by an overestimation of probability of dangerous situations (Witte and Allen 2000). As a life-threatening event, COVID-19 that is characterized by person-to-person infection naturally makes people feel fearful. Such perception of fear is possibly exaggerated by fake news (or misinterpretation of COVID-related information) and future uncertainty during or even after the COVID-19 pandemic (Guan et al. 2020; Rajkumar 2020; Wang et al. 2020). Results from a meta-analytical paper have indicated that individuals with high level of fear report adaptive and maladaptive avoidance behaviors (Witte and Allen 2000). During the COVID-19 pandemic, individuals who subjectively experience fear may present corresponding adaptive or avoidance behaviors such as over-focus on relevant information and excessive hoarding, which may ultimately aggravate their psychological burden (e.g., depression, anxiety, post-traumatic stress disorder, and suicide) and reduce the quality of life (Duncan et al. 2009; Ford et al. 2019; Pappas et al. 2009; Ropeik 2004). Against this background, it is urgently needed to investigate the COVID-related fear.

Researchers have developed a timely self-reported questionnaire, the Fear of COVID-19 Scale (FCV-19S), to measure perception of fear during the COVID-19 pandemic. This measure mainly has focused on two aspects (physical response of fear and fear-thinking) (Ahorsu et al. 2020). Subsequently, this newly developed scale has been validated in different languages (Italian, Arabic, and Ru) (Alyami et al. 2020; Sousa and Rojjanasrirat 2011). Subsequent validation research has found that the Arabic version of the FCV-19S presented good internal consistency ($\alpha = .88$) and sound concurrent validity ($r = .66$) which can be used to examine the psychological influence of COVID-19 among adult population in Saudi (Alyami et al. 2020). Chinese researchers have attempted to measure perception of COVID-fear among individuals aged 18 to 66 years, but single question was used with two mandatory answers (yes vs. no) since no specific measurement of fear could be used (Li et al. 2020). Such question is unable to gain a whole picture about COVID-fear in Chinese population; therefore, the well-established scale should be adapted and validated with Chinese population. In addition, the validation and reliability of the FCV-19S was only conducted in adults in previous studies but not adolescents. It is widely accepted that youths are not fully developed with immature thought and behaviors which may cause cognitive bias or misinterpret irrelevant information during the COVID-19 pandemic, potentially resulting in experience of fear. Therefore, this unique group should be also included in the present study. In addition, with respect to the FCV-19S, a unidimensional structure was consistently reported across the aforementioned three nations. It is still unclear whether different result (two-dimension model) would be observed due to different cultural backgrounds, level of economic development, and stage of COVID-19 infection (e.g., it was effectively controlled in China, whereas other three countries suffered massive infection during data collection) (Sousa and Rojjanasrirat 2011). Fear, as a type of emotion, typically consists of three components within two dimensions (emotional reaction and physical experience (behavioral response and physiological arousal)) (Dror 2014; Gross and Feldman Barrett 2011; Van Bavel et al. 2020). Therefore, we hypothesized that Chinese version of the FCV-19S would present two factors in our study. In addition, the bifactor model that consists of a general factor and two orthogonal group factors was recommended when correlation coefficient between dimensions was higher than 0.4; a model with a general factor affects all items and two orthogonal group factors, accounting for specific subjective experience and physical responses, respectively. Hence, to

better examine conceptual structure of Chinese version of the FCV-19S, model comparison would be executed based on results of exploratory factor analysis (EFA) and correlation analysis results (Reise et al. 2010; Reise et al. 2007).

The current study aimed to examine the psychometric properties, including the factor structure by comparing three kinds of models, concurrent validity, internal consistency, and test-retest reliability of scores on this Chinese version of the FCV-19S.

Methods

Participants

A total of 1700 participants took part in our study and were assigned into two samples (rationale is detailed in statistical analysis). Specifically, sample 1 comprised 793 participants (40.9% male) aged from 10 to 57 (mean age = 18.75, SD = 8.78). Among these participants, primary school students, middle school students, and adults accounted for 20.05% ($n = 159$), 33.29% ($n = 264$), and 46.66% ($n = 370$), respectively. Sample 2 comprised 907 participants (40.0% male) whose age were between 10 to 57 (mean age = 18.02, SD = 7.27). Among them, primary and middle school students were 20.50% ($n = 186$) and 32.41% ($n = 294$), respectively, while 47.07% ($n = 427$) were adults. To perform test-retest reliability, we randomly selected 100 out of 300 participants (who provided contact information and were extracted in Excel) in sample 2, but only 81 participants (a mean age: 22.19, SD = 5.35; 34.6% male) who agreed to participate in the second-round survey were included in sample 3; participants in sample 3 were asked to finish our questionnaire 7 weeks (June) after the time of sample 2 data collection. All demographic variables of each sample have been shown in Table 1.

Table 1 Descriptive statistics of participants for each sample

	Sample 1 ($n = 793$)		Sample 2 ($n = 907$)		Sample 3 ($n = 81$)	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Gender						
Male	324	40.9	363	40.0	28	34.6
Female	469	59.1	544	60.0	53	65.4
Age						
< 18	432	54.7	499	55.0	30	35.8
≥ 18	359	45.3	408	45.0	51	64.2
Residence						
Urban area	414	52.2	466	51.4	58	71.6
Rural area	379	47.8	441	48.6	23	28.4
Family structure						
Complete	681	85.9	795	87.7	68	84.0
Incomplete	112	14.2	112	12.3	13	16.0
Household monthly income per person						
< 6000	564	71.1	638	70.3	40	49.4
≥ 6000	229	28.9	269	29.7	41	50.6

Procedures

Participants were asked to complete a short questionnaire about COVID-19 in February to May. No reward was provided to all participants. Participants who spoke Mandarin were recruited in their residential areas where we used combination of stratified sampling and snowball sampling. In order to recruit children and adolescent subjects, students from one primary school (senior grade) and one senior high school in Guangxi Province, China, finished electronic questionnaires in online form with the assistance of school teachers. Other adult participants recruited willingly through a well-known social platform in China since they would get a simple mental state report after finishing.

Before they completed the survey, written informed consent was obtained from adult participants and minor participants' guardians. All participants were asked to complete a series of questionnaires like FCV-19S and PHQ-9 during the survey. To maximize the effectiveness of self-report, we guarantee the anonymity and confidentiality of the data. The Ethics Committee from School of Medicine, Shenzhen University, approved this study.

Measures

Fear of COVID-19 Scale

The 7-item FCV-19S in English was originally developed by Ahorsu (Ahorsu et al. 2020) to measure individuals' fear of COVID-19 (e.g., "I am most afraid of coronavirus-19."). To ensure "linguistic and conceptual equivalence" (Marsella and Leong 1995), translation into Chinese and back-translation into English were conducted. Specifically, three expert bilingual speakers (English and Chinese) initially translated the original English versions of all items into Chinese according to the Chinese cultural background and language habits. Secondly, the first version of translations was back-translated into English by another two bilingual speakers, and, the back-translated and original versions were compared by one of our authors. In addition, 35 participants were initially recruited to fill out the Chinese version of this scale and determine if it was readable. Meanwhile, we asked for their advice to improve the quality of this scale. As a result, final Chinese version of FCV-19S was confirmed. It is scored on a 5-point Likert (1 is "totally disagree" and 5 is "completely agree"). The mean scores of the scale reflected the degree of COVID-fear.

The Abbreviated PTSD Checklist

The 6-item PTSD Checklist (PCL-C) questionnaire was compiled by Lang et al. (Lang and Stein 2005), which was used to measure the stressing degree of who had experienced a particular symptom during the previous month (e.g., repeated, disturbing memories, thoughts, or images of a stressful experience from the past?). Good validity and reliability of the Abbreviated PCL across various age groups (children, adolescents, and adults) were observed in previous studies (Martin and Wood 2017; Price et al. 2016). Items were recorded on a 5-point Likert scale of 1 (not at all) to 5 (extremely). The higher mean scores of the entire scale indicate higher levels of PTSD symptoms. The model of this 6-item scale was tested by CFA with maximum likelihood estimation. CFA indicated good model fits, $\chi^2 = 83.05$, $df = 8$, $p < .01$, CFI = .96, TLI = .93, RMSEA = .10, and SRMR = 0.04, indicating structural validity. The Cronbach's alpha coefficient of the scale in this study is 0.83.

Generalized Anxiety Disorder Scale

The Generalized Anxiety Disorder Scale (GAD-7) developed by Spitzer et al. (Spitzer et al. 2006) is a 7-item scale that assessed the degree of individuals' generalized anxiety disorders (e.g., being so restless that it is hard to sit still.). A 4-point Likert scale was used to evaluate items, with 0, not at all, and 3, nearly every day. A higher mean score of the scale reflected a greater level of anxiety. GAD-7 was validated with good psychometric features among children, adolescents, and adults (Payne et al. 2011; Quon et al. 2015). The model of this 7-item scale was tested by CFA with maximum likelihood estimation. CFA indicated good model fits: $\chi^2 = 148.92$, $df = 13$, $p < .01$, CFI = .94, TLI = .90, RMSEA = .11, and SRMR = 0.05. The GAD-7 possesses good reliability ($\alpha = 0.97$) in this study.

10-Item Connor-Davidson Resilience Scale

The degree of resilience was measured using the 10-item Connor-Davidson Resilience Scale (CD-RISC-10) which detects persons' ability to tolerate experiences related to change, personal problems, illness, pressure, failure, and painful perception (Connor and Davidson 2003). Sample items are "when I fail at something important to me, I become consumed by feelings of inadequacy." and "I try to see my failings as part of the human condition." Response categories ranged from 0 (not true at all) to 4 (true nearly all the time). A higher mean score of the scale reflected a greater degree of resilience. Psychometric evaluation demonstrated the good reliability and validity of CD-RISC-10 among children, adolescents, and adults in previous studies (Notario-Pacheco et al. 2011; Duong and Hurst 2016). The model of this 10-item scale was tested by CFA with maximum likelihood estimation. CFA indicated good model fits: $\chi^2 = 414.10$, $df = 29$, $p < .01$, CFI = .94, TLI = .91, RMSEA = .12, and SRMR = 0.13. This scale was reliable, with a Cronbach's alpha coefficient of 0.92.

Self-Compassion Scale: Short Form

Degree of self-compassion was measured by the 12-item Self-Compassion Scale: Short Form (SCS-SF) that contains six dimensions (self-kindness, self-judgment, common humanity, isolation, mindfulness, and over-identification) (Raes et al. 2011). Examples of items are "when I fail at something important to me, I become consumed by feelings of inadequacy." and "I try to see my failings as part of the human condition." All the 12 items were scored on a 5-point Likert scale of 1 (almost never) to 5 (almost always). According to results from previous studies, SCS-AF has good psychometric characteristics among children, adolescents, and adults (Cheang et al. 2019; Ferrari et al. 2017). The model of this 12-item scale was tested by CFA with maximum likelihood estimation. CFA indicated good model fits (structural validity): $\chi^2 = 232.77$, $df = 39$, $p < .01$, CFI = .95, TLI = .92, and RMSEA = .07, SRMR = 0.04. The reliability of this scale in current study is good ($\alpha = 0.83$).

Statistical Analysis

In this study, three samples were separately used in different analyses. Since it was the first time to use the FCV-19S in Chinese population, sample 1 was initially tested with item analysis and exploratory factor analysis (EFA). Based on that, we used sample 2 to further evaluate the concurrent validity and construct validity of this scale by confirmatory factor

analysis (CFA) and determine the best fitting model. Finally, sample 3 was used to examine test-retest reliability.

We first present descriptive information for all items in the FCV-19S including central tendency, skewness, kurtosis, and distributions of responses. Byrne and Campbell stated that a normal distribution can be demonstrated when values of skewness and kurtosis are between -1.5 and $+1.5$ (Byrne and Campbell 1999). Second, we conducted exploratory factor analysis (EFA) with maximum likelihood estimate (MLE) and varimax rotation in sample 1 ($n = 793$), using Mplus 8 (Muthén and Muthén 2011). The EFA allows items to load on all factors, and the number of factors was determined by comparison of fitting between a single-factor model and a two-factor model. Model fit was assessed using chi-square, comparative fit index (CFI), Tucker-Lewis Index (TLI), and root mean square error of approximation (RMSEA) and standardized root mean squared residual (SRMR). Accordingly, we expected all models to have a significant chi-square value because of the large sample size. A CFI or TLI score of .90 or more indicated good fit. Both RMSEA and SRMR scores below .08 indicated acceptable fit (Hu and Bentler 1999). Factor that items belong to depends on the strength of the factor loadings.

Third, the factor structure was then examined with confirmatory factor analysis (CFA) in sample 2. Since the data were normally distributed, MLE were used in CFA. Besides, to examine measurement invariance and specificity, factor invariance across groups, multi-group confirmatory factor analysis (MG-CFA) among non-adult (children and adolescents) population and adult population was firstly conducted using Amos 23.0. After that, based on the results of EFA, the following two-order factor models were tested: one two-factor model with fear thoughts (items 1, 2, 4, and 5) and physical response (items 3, 6, and 7); a hierarchical model with one higher factor and two lower factor (fear thoughts and physical response); and a bifactor model with a general factor named general fear and two group factors with fear thoughts (items 1, 2, 4, and 5) and physical response (items 3, 6, and 7). Same method as above, chi-square, CFI, TLI, RMSEA, and SRMR scores were compared between the three models. Finally, concurrent validity, internal consistency, and test-retest reliability were calculated. Concurrent validity was examined by the Pearson correlations between the FCV-19S and PCL-C, GAD-7, CD-RISC-10, and SCS-SF. Internal consistency was examined by alpha coefficients, the mean item-to-total correlation (MITC), and the mean inter-item correlation (MIC). Alpha coefficients higher than .80 indicate good internal consistency. The recommended value of MITC was .30 (Nunnally and Bernstein 1994), and, the MIC should fall in the range of .15 to .59 to be considered adequate (Clark et al. 1995). Test-retest reliability indicates scale's degree of consistency during different period of time which is acceptable of .70 and above (Weir 2005).

Results

Factor Structure

Exploratory Factor Analysis

Information on the central tendency, skewness, kurtosis, and distributions of responses of each item are presented in Table 2. Seven items are normally distributed with all values of skewness and kurtosis that fall in the range of -1.5 to 1.5 . Therefore, to investigate and analyze the

Table 2 Descriptive analysis of seven items of the Chinese version of FCV-19S ($n = 793$)

Item	Mean	SD	Kurtosis	Skewness
1	2.76	1.19	-1.008	0.077
2	2.67	1.17	-1.008	0.082
3	2.06	1.02	0.046	0.785
4	2.85	1.29	-1.196	-0.039
5	2.68	1.15	-1.081	0.028
6	2.00	1.01	0.404	0.931
7	2.16	1.09	-0.416	0.662

factor structure of FCV-19S, EFA (estimator: MLE, varimax rotation) was initially performed in sample 1 (Mîndrilă 2010). Since this scale presented a unidimensional structure in Italian and Arab subjects, we compared the fitting index between a unidimensional model and a two-dimension structure model. Results indicated the unidimensional model with no correlated error variances ($\chi^2 = 523.90$, $df = 14$, $p < .01$, CFI = .87, TLI = .81, RMSEA = .21, SRMR = .06), while the two-dimension solution presented $\chi^2 = 42.85$, $df = 8$, $p < .01$, CFI = .99, TLI = .98, RMSEA = .07, and SRMR = .03. Compared with the unidimensional structure, the fitting index of the two-dimension structure has been apparently improved and met the critical value standard of the Chinese scale (see Table 3). The variance contribution rates of the two factors were 67.84% and 11.42%, respectively; the cumulative variance contribution rate was 79.26%. All factor loadings were higher than .56. One of the factors was named *fear thoughts* including items 1, 2, 4, and 5 which means subjective experience of fear. The other one was named *physical response* including items 3, 6, and 7, which represents physiological response. There was a significant correlation between the two factors ($r = 0.72$, $p < 0.01$) which indicates that the scale was initially revised well.

Confirmatory Factor Analysis

MG-CFA was conducted to determine significant group (non-adults vs. adults) difference on outcome measures, followed by investigations on Δ CFI, Δ TLI, and Δ RMSEA pattern of structural relationships (Byrne et al. 1989). Results are detailed in Table 4, with all fit indices of less than 0.03 that reflects no significant group differences in the goodness-of-fit indices of single-order model, hierarchical factor model, and bifactor model (Cheung and Rensvold 2002). Collectively, the psychometric properties of the Chinese version of FCV-19S can be recommended for both non-adults and adults.

Based on the results from EFA, correlation between two factors (see Table 5) and MG-CFA (see Table 4), we further examined the two-dimension model with a confirmatory factor

Table 3 Goodness-of-fit indices in a single-factor model and a two-factor model ($n = 793$)

	χ^2	df	TLI	CFI	RMSEA	SRMR
Critical value	$p < 0.05$	–	≥ 0.90	≥ 0.90	≤ 0.08	≤ 0.08
Unidimensional model	523.90 ($p < 0.01$)	14	0.81	0.87	0.21	0.06
Two-dimension model	42.85 ($p < 0.01$)	8	0.98	0.99	0.07	0.03

χ^2 chi-square, df degree of freedom, TLI Tucker-Lewis Index, CFI comparative fit index, $RMSEA$ root mean square error of approximation, $SRMR$ standardized root mean squared residual

Table 4 Results of multi-group analysis between non-adults and adults ($n = 907$)

	χ^2	df	Δ TLI	Δ CFI	Δ RMSEA
Single-order model					
Unconstrained	645.03**	29	–	–	–
Measurement weights	682.21**	34	0.02	–0.01	–0.01
Structural covariances	703.83**	35	0.02	–0.01	–0.01
Measurement residuals	751.98**	42	0.04	–0.02	–0.02
Hierarchical factor model					
Unconstrained	326.95**	26	–	–	–
Measurement weights	346.24**	31	0.01	–0.003	–0.02
Structural covariances	364.48**	32	0.01	–0.01	–0.01
Structural residuals	367.98**	34	0.02	–0.01	–0.01
Measurement residuals	440.31**	41	0.02	–0.02	–0.01
Bifactor model					
Unconstrained	281.88**	23	–	–	–
Measurement weights	386.66**	35	0.01	–0.02	–0.01
Structural covariances	392.06**	36	0.01	–0.02	–0.01
Structural residuals	392.11**	38	0.02	–0.02	–0.01
Measurement residuals	458.16**	45	0.02	–0.03	–0.01

**Statistically significant at $p < 0.01$

χ^2 chi-square, df degree of freedom, TLI Tucker-Lewis Index, CFI comparative fit index, $RMSEA$ root mean square error of approximation

analysis (CFA) in sample 2. Compared with single-order model, hierarchical factor model was more concise (Hou et al. 2004). In addition, hierarchical factor model was nested in the bifactor model with unique variance that can be calculated (Yung et al. 1999). The bifactor model can decompose the variance of each item into two portions: (1) one portion explained by the general fear factor and (2) another portion explained by fear thoughts or physical response group factors (Reise et al. 2010). Based on this, we compared the fitting index between each two models. Table 5 reports absolute and relative fit indices for three models. Chi-square statistics were significant for all models. There is no significant difference between the single-order model and hierarchical factor model ($\chi^2 = 147.86$, $df = 12$, $p < .01$, $CFI = .97$, $TLI = .95$, $RMSEA = .11$, $SRMR = .03$; $\chi^2 = 147.86$, $df = 11$, $p < .01$, $CFI = .97$, $TLI = .94$, $RMSEA = .12$, $SRMR = .03$), and both of them own unacceptable $SRMR$ scores. By contrast, the bifactor had all acceptable fit indices and met the critical value standards of the Chinese scale in bifactor model ($\chi^2 = 46.64$, $df = 8$, $p < .01$, $CFI = .98$, $TLI = .99$, $RMSEA = .07$, $SRMR = .02$). Figure 1 presents the Fear of COVID-19 Scale bifactor structure. In conclusion, it suggested that a bifactor model could fit Chinese version FCV-19S, which is better than any single-order or hierarchical factor; it provides an insight on the appropriateness of factor scores (general fear, fear thoughts, and physical response) in Chinese samples.

Table 5 Goodness-of-fit indices in three models ($n = 907$)

	χ^2	df	TLI	CFI	RMSEA	SRMR
Single-order model	147.86 ($p < 0.01$)	12	0.95	0.97	0.11	0.03
Hierarchical factor model	147.86 ($p < 0.01$)	11	0.94	0.97	0.12	0.03
Bifactor model	46.63 ($p < 0.01$)	8	0.98	0.99	0.07	0.02

χ^2 chi-square, df degree of freedom, TLI Tucker-Lewis Index, CFI comparative fit index, $RMSEA$ root mean square error of approximation, $SRMR$ standardized root mean squared residual

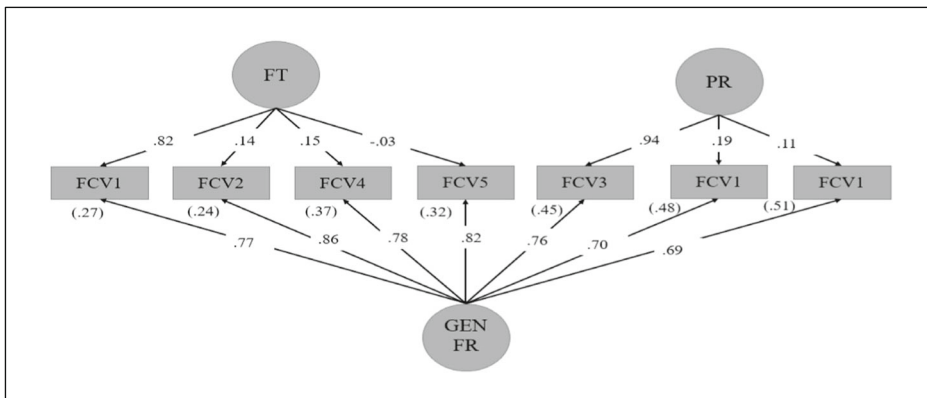


Fig. 1 The Fear of COVID-19 Scale bifactor structure. The standardized factor loadings, with measurement error terms in parenthesis, are reported. FT, fear thoughts; PR physical response; GEN FR, general fear

Concurrent Validity

Results from correlations between FCV-19S and variables (PCL-C, GAD-7, CD-RISC-10, and SCS-SF) were used to determine concurrent validity (Table 6). COVID-fear was significantly positively correlated with the PCL-C ($r=0.26, p<.01$) and the GAD-7 ($r=0.10, p<.01$), whereas it was significantly negatively correlated with the CD-RISC-10 ($r=-0.23, p<.01$) and the SCS-SF ($r=-0.15, p<.01$). Besides, the two factors of FCV-19S were significantly correlated with the PCL-C, the CD-RISC-10, and the SCS-SF, indicating that the revised FCV-19S had good concurrent validity.

Internal Consistency and Test-Retest Reliability

Positive relationships between all items and total score (Table 7) were observed ($r=0.45$ to $0.87, p<.01$), suggesting that the inter-item correlations and total-item correlation are acceptable. In addition, taking 27% as a cutoff value (higher-score group vs. lower-score group), results indicated that the two groups are significantly different in all items ($p<.01$). Moreover, similar to previous FCV-19S validation studies (Ahorsu et al. 2020; Alyami et al. 2020; Soraci et al. 2020), we also assessed the internal consistency of the FCV-19S scores using Cronbach’s alpha coefficients and composite reliability (CR) coefficients. In this study, α was good for the total score ($\alpha = .92$) and acceptable for fear thoughts ($\alpha = .89$) and physical response ($\alpha = .84$).

Table 6 Correlation analysis results between FCV-19S and criteria ($n = 907$)

	FCV-19S	PCL-C	GAD-7	CD-RISC-10	SCS-SF
FCV-19S	1				
PCL-C	0.26**	1			
GAD-7	0.10**	0.47**	1		
CD-RISC-10	-0.23**	-0.26**	-0.15**	1	
SCS-SF	-0.15**	-0.37**	-0.37**	0.50**	1

**Statistically significant at $p < 0.01$

FCV-19S Fear of COVID-19 Scale, PCL-C Abbreviated PTSD Checklist, GAD-7 Generalized Anxiety Disorder Scale, CD-RISC-10 10-Item Connor-Davidson Resilience Scale, SCS-SF Self-Compassion Scale: Short Form

Table 7 Inter-item Pearson's correlation matrix and item-total correlations ($n = 907$)

Item	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Total
Item 1	1							
Item 2	0.79**	1						
Item 3	0.61**	0.68**	1					
Item 4	0.68**	0.68**	0.55**	1				
Item 5	0.62**	0.69**	0.60**	0.59**	1			
Item 6	0.52**	0.56**	0.74**	0.45**	0.58**	1		
Item 7	0.54**	0.59**	0.71**	0.53**	0.63**	0.76**	1	
Total	0.83**	0.87**	0.84**	0.79**	0.82**	0.79**	0.81**	1

**Statistically significant at $p < 0.01$

Composite reliability with a value of 0.92 was higher than .70, which is generally considered acceptable in behavioral research (Nunnally 1978; Raykov 1997). Test-retest coefficient was examined using Pearson correlation to determine the stability of FCV-19S. Results showed that test-retest reliability is acceptable ($\alpha = .71, p < .01$). Compared to total scores at pretest, the degree of COVID-fear has been slightly improved during this retest period.

Demographic Differences of Chinese Version of FCV-19S

Group differences on FCV-19S total score across demographic variables were analyzed. Significant results in gender, age, and residence are observed in both samples (Table 8): (1) females were reported with higher scores as compared to males (sample 1, $F = 17.58, p < .01$, Cohen's $d = 0.25$; sample 2, $F = 10.61, p < .01$, Cohen's $d = 0.27$); (2) children/adolescents (< 18 age) reported higher level of fear of COVID-19 than those adults (≥ 18 age) (sample 1, $F = 31.46, p < .01$, Cohen's $d = 0.19$; sample 2: $F = 20.64, p < .01$, Cohen's $d = 0.27$); and (3) besides, a significant difference between urban and rural area is also found (sample 1, $F = 11.78, p < .01$, Cohen's $d = 0.25$; sample 2, $F = 2.14, p < .01$, Cohen's $d = 0.24$).

Table 8 Demographic differences of the Chinese version of FCV-19S

	Sample 1 ($n = 793$)			Sample 2 ($n = 907$)		
	M \pm SD	F	Cohen's d	M \pm SD	F	Cohen's d
Gender			0.25			0.27
Male	16.19 \pm 7.19	17.58**		16.11 \pm 7.16	10.61**	
Female	17.86 \pm 5.89			17.94 \pm 6.24		
Age			0.19			0.27
< 18	17.74 \pm 7.15	31.46**		18.00 \pm 7.18	20.64**	
≥ 18	16.50 \pm 5.55			16.25 \pm 5.89		
Residence			0.25			0.24
Urban area	16.40 \pm 5.93	11.78**		16.44 \pm 6.38	2.14**	
Rural area	18.02 \pm 6.98			18.03 \pm 6.90		
Family structure			0.06			0.06
Complete	17.23 \pm 6.55	0.39		17.26 \pm 6.71	0.19	
Incomplete	16.85 \pm 6.22			16.84 \pm 6.49		
Household monthly income per person			0.05			0.12
< 6000	17.26 \pm 6.60	2.24		17.45 \pm 6.79	1.83	
≥ 6000	16.97 \pm 6.26			16.65 \pm 6.40		

**Statistically significant at $p < 0.01$

Discussion

In this study, the psychometric characteristics of Chinese version of 7-item FCV-19S were examined among adolescents and adults. Results of the EFA indicated the two-factor model with highly loaded items, which is further confirmed by results of the CFA (the bifactor model had a good model fit and was better than single-order model and hierarchical factor model). Therefore, Chinese version of FCV-19S has a good structural validity. Moreover, the FCV-19S ($r \geq .71$) was significantly correlated with PCL-C, GAD-7, CD-RISC-10, and SCS-SF with acceptable reliability, suggesting that this adapted version in Chinese culture has good concurrent validity. Collectively, the Chinese version of the FCV-19S is a valid instrument to evaluate the degree of COVID-fear with acceptable levels of psychometric properties.

Specifically, we found that EFA supported a two-dimension structure of FCV-19S, which is inconsistent with previous studies indicating a unidimensional structure of this scale (Ahorsu et al. 2020; Alyami et al. 2020; Soraci et al. 2020). Possible explanations for mixed results are discussed below. Firstly, items 3, 6, and 7 (included in *physical response*) have appeared to present discrimination in this study, as compared to four items (1, 2, 4, and 5) in previous studies (Alyami et al. 2020; Soraci et al. 2020). For instance, results from the Arabic version indicated significant covariance in items 3, 6, and 7, which led fitting index (RMSEA) to become unacceptable; these three items have certain commonalities to make up an independent factor. Besides, the related emotion theory has suggested that fear can be defined in multiple discriminable aspects: (1) Gross stated that emotion like fear is an aggregate of many mental states which includes subjective experience, emotional expression, and physical arousal (Gross and Feldman Barrett 2011); (2) Cannon-Bard theory also pointed out that fear can be explained in subjective experience and physiological experience since individual differences were presented in emotional reaction (Dror 2014; Jiang et al. 2009). For example, some individuals may subjectively perceive the fear caused by an adverse event or stimulus, but it may not be strong enough to trigger a physiological response, and vice versa; possibly, some people may have both subjective and physiological experiences (Buck 1989; Kring and Neale 1996). These situations imply that the physical response of fear and the subjective emotional experience of fear are both connected and independent of each other. According to this, in Chinese version of FCV-19S, we found that items 1, 2, 4, and 5 focus more on the subjective experience of fear (e.g., “I am most afraid of coronavirus-19.”, “When watching news and stories about coronavirus-19 on social media, I become nervous or anxious.”), while items 3, 6, and 7 have emphasized the physical response of fear (e.g., “My hands become clammy when I think about coronavirus-19.”, “My heart races or palpitates when I think about getting coronavirus-19.”). Therefore, two dimensions are named as *fear thoughts* (items 1, 2, 4, and 5) and *physical response* (items 3, 5, and 6).

Besides, based on the EFA results, the study further tested single-order, hierarchical factor, and bifactor models with the CFA. Compared with goodness-of-fit of three models, we found that the bifactor model fit displayed a good model fit and was better than single-order model and hierarchical factor model. The bifactor model includes a general factor affecting all items and two orthogonal group factors accounting for a specific fear thought and physical response. Some researchers pointed out that bifactor model has its unique advantages which led the fitting to be significantly better than traditional structural models (Iani et al. 2014; Reise et al. 2007). For Chinese version of FCV-19S, three advantages of bifactor model can be concluded. Firstly, the bifactor model would be allowed to resolve the variance of each item into one portion explained by fear thoughts or physical response factors and one portion explained by

the general fear factor (Iani et al. 2014). The model thereby may provide an insight on the appropriateness of factor scores (general fear, fear thoughts, and physical response) in Chinese general population. Secondly, in bifactor model, items in specific areas are loaded on one or more group factors while allowing all items to be loaded on a general factor as well (Li et al. 2013). Hence, bifactor model would be the best choice for researchers who was interested in both general fear (general factor) and two dimensions of fear named *fear thoughts* and *physical response* (group factors). Finally, better scoring methods of this scale with bifactor model were demonstrated. For instance, a study concluded that calculating total scores and factor scores based on bifactor model by local weighted sum method has good accuracy and reliability (Liu and Liu 2017). Therefore, in further studies, local weighted sum method can be used to calculate scores of Chinese version of FCV-19S.

In addition, age, gender, and residence differences on the FCV-19S were observed, with possible explanations being presented below. Higher level in females relative to males may be due to gender-related physiological differences. For example, genders, as compared to men, women were more emotionally sensitive and easier to perceive negative information, which in turn may increase level of COVID-19 fear (Hankin et al. 1998). For the age-related difference on perceived fear, compared with adults in a stable stage, children and adolescents are still undergoing normal development physically and psychologically—such immature development, to a large extent, may affect their objective and rational judgments during the COVID-19 pandemic, which ultimately lead to greater level of COVID-related fear perception (Field and Lester 2010). Besides, higher degree of fear in individuals living in rural areas may be caused by the lack of medical facilities. Specifically, people living in rural areas are more afraid that they will not get treatment after suffering from COVID-19 since there is no effective treatment or even an experienced doctor in local hospitals (Amon and Todrys 2008), which may greatly exacerbate the degree of COVID-19 fear.

Future research can execute from the following aspects. Firstly, on the basis of this study, future studies research can be carried out in the elderly population to expand the applicability of the scale in the Chinese population. Secondly, when validity and reliability among Chinese healthy individuals (children, adolescent, and young adults) were tested, future studies on such culture-specific scale should also be conducted in clinical settings, particularly individuals with mental disorders or healthcare workers. In addition, this scale can be used in longitudinal study to determine relationships among fear, anxiety, depression, and PTSD. Finally, models can be further established to examine the influencing mechanism of the COVID-fear on public health measures (e.g., social isolation), so as to provide empirical evidence for preventing and interfering with the impact of COVID-fear on psychological state. Finally, future research can further compare the differences in the degree of COVID-fear among different groups (e.g., different ages, gender, socioeconomic status, and countries) to conduct some cross-cultural comparisons. In conclusion, the results of the present study demonstrated that Chinese version of the FCV-19S is a reliable and valid tool for evaluating fear of COVID-19 among Chinese population.

The present study has some limitations. First, restricted to many factors such as environment, time, and sampling condition, this research used convenience sampling and snowball sampling to collect data and investigated the participants of different age (including children, teenagers, young people, and middle-aged people) through anonymous online survey; the elderly who might be also affected deeply by the epidemic were not recruited in this study. Second, the use of self-report method cannot rule out the social desirability, which might influence subjects' response to the questionnaire. Third, this research was carried out among

healthy Chinese population which means that clinical people with formal diagnosis of mood disorders (e.g., anxiety and depression) and healthcare workers (e.g., doctors and nurses) were not included, so the specificity of the scale could not be tested.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11469-020-00441-7>.

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Compliance with Ethical Standards

All procedures performed in this study involving human participants were in accordance with the ethical standards of the Ethics Committee from School of Medicine, Shenzhen University.

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

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