




Psychometric properties of the Brazilian version of the fear of COVID-19 scale (FCV-19S)

Emerson Diógenes de Medeiros¹ · Lorena Mota Reis¹ · Clara Lohana Cardoso Guimarães² · Paulo Gregório Nascimento da Silva² · Renan Pereira Monteiro³ · Gabriel Lins de Holanda Coelho⁴  · Clarissa Maria Cardoso Guimarães⁵ · Emanuely Rayane dos Santos Martins⁶ · Ludymilla Linéia Almeida de França⁶

Accepted: 3 February 2021 / Published online: 20 February 2021

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC part of Springer Nature 2021

Abstract

COVID-19 can bring several psychological problems to patients and non-patients, which highlights the need for a better understanding of outcomes that can emerge due the occurrence of the virus. One of these variables is fear, present in situations of continuous uncertainty. Fear is a key variable for mental health and tracking it and its correlates might help to develop proper education and prevention programs. Currently, Brazil is one of the epicentres of the COVID-19 pandemic, with its public health system scrapped and not being able to contain the amount of infected people. Therefore, a proper measure to screen the fear of COVID-19 will help to provide improvements in mental health in such contexts. For that, two studies were performed. In Study 1 ($N = 230$) we assessed the factorial structure of the measure through exploratory factor analysis, and item parameters using item response theory. In Study 2 ($N = 302$), we assessed whether the structure would replicate in an independent sample and through confirmatory factor analysis, besides assessing convergent validity using Structural Equation Modelling and proposing a shorter version of the measure. Both long and short versions presented a reliable unidimensional structure and similar patterns of correlations with depression, anxiety, and stress. Overall, our results showed that the FCV-19S and its short version are useful measures to the assessment of fear of COVID-19 in Brazil.

Keywords Brazil · COVID-19 · Fear · Measure · Psychometric

Introduction

In December 2019, in the city of Wuhan (China), new cases of a virus from the coronavirus family, SARS-Cov-2 (COVID-19), caused a variety of diseases (Li, Bai, & Hashikawa, 2020). The infection spread rapidly and caused unprecedented effects in the world (Sloan et al., 2020), leading the World Health Organization (WHO) to decree, on March 11, 2020, the pandemic state of COVID-19. This pandemic brought not

only the risk of death from viral infection, but also a psychological overload (Duan & Zhu, 2020; Xiao, Zhang, Kong, Li, & Yang, 2020), because of the implementation of widespread interventions of physical distancing (e.g., social isolation, quarantine, lockdown). Although such measures are vital to prevent the spread of the virus, together with the unknown scenario and the unfavorable prognosis, they can cause several psychological problems, such as anxiety, depression, and panic disorder (Qiu et al., 2020), financial distress and loneliness (Tull et al., 2020), and stress (Taylor et al., 2020).

In situations of continuous uncertainty, as the one lived in this pandemic, fear becomes a key variable for mental health, becoming chronic and mal-adaptive (Mertens, Gerritsen, Saleminck, & Egelhard, 2020). Therefore, despite being a self-preservation response, fear is harmful to the mental health of individuals when disproportionate, irrational, and/or chronic (Ahorsu et al., 2020; Pakpour & Griffiths, 2020; Sakib et al., 2020; Soraci et al., 2020). It can also be a trigger for other problems, such as suicide (Mamun & Griffiths, 2020; Pakpour & Griffiths, 2020). In the current situation, fear has been especially seen in individuals working on the front line

✉ Emerson Diógenes de Medeiros
emersondiogenes@ufpi.edu.br

¹ Department of Psychology, Federal University of Delta do Parnaíba, Parnaíba, PI 64.202-020, Brazil

² Federal University of Paraíba, Paraíba, Brazil

³ Federal University of Mato Grosso, Cuiabá, Brazil

⁴ University College Cork, Cork, Ireland

⁵ State University of Paraíba, Campina Grande, Paraíba, Brazil

⁶ Hospital Infantil Arlinda Marques, João Pessoa, Paraíba, Brazil

(Lu, Wang, Lin, & Li, 2020). Additionally, because of its emergency nature, the severity of the pandemic is shown daily on the media and social networks. This excessive exposure can provoke fear, leading individuals to constantly think on such information, having a negative effect on well-being (Satici, Saricali, Satici, & Griffiths, 2020b), and being an additional risk factor for the development of generalized anxiety and depression (Gao et al., 2020; Huang & Zhao, 2020).

Research have found that demographic variables are important to understand the fear of COVID-19. For example, women and people of lower socioeconomic levels presented higher levels of fear of COVID-19 (Bitan et al., 2020). These authors also indicated that fear is higher in people who reported having a chronic disease, being in at-risk groups, or having family members affected by the pandemic. Also, individuals report a higher level of fear of contact with people who may be infected, when considering the COVID-19 context (Center for Disease Control and Prevention, 2020; Lin, 2020).

Therefore, it is clear the important role that fear has when it comes to face the challenges of the current global scenario, and it is essential to have measures to properly evaluate this variable. To cover this, a measure has gained prominence, the *Fear of COVID-19 Scale* (FCV-19S; Ahorsu et al., 2020). For its elaboration, Ahorsu et al. (2020) performed an extensive review about fear measures, gathering an initial set of 10 items. After using different psychometric techniques (classic and modern), results showed a one-dimensional structure composed of seven items (Cronbach's Alpha, $\alpha = .82$). The measure has been quickly adapted in several countries and cultures, such as Turkey (Satici, Gocet-Tekin, Deniz, & Satici, 2020a; Satici et al., 2020b), Italy (Soraci et al., 2020), Saudi Arabia (Alyami, Henning, Krägeloh, & Alyami, 2020), Greece, (Tsiropoulou et al., 2020), and Russia and Belarus (Reznik, Gritsenko, Konstantinov, Khamenka, & Isralowitz, 2020). All these cultures replicated the FCV-19S structure and presented reliable results. Additionally, to assess its convergent validity, research has shown significant associations to variables like depression, anxiety, stress, and specific phobias (Bitan et al., 2020; Soraci et al., 2020).

The Present Research

It is evident that the emergence of COVID-19 and its consequences have become one of the eminent global challenges (Ahorsu et al., 2020), in which there is little importance given to mental health (Ahorsu et al., 2020; Dong, Du, & Gardner, 2020; Wang et al., 2020; Xiang et al., 2020). Currently (December 2020), Brazil is one of the epicenters of the pandemic (Menezes, Garner, & Valenti, 2020), the third country in number of total cases worldwide. On the other hand, the Brazilian government is one of the most ineffective to combat the COVID-19 (The Lancet, 2020), with its public health system scrapped and not being able to contain the amount of

infected people. Therefore, considering the chaotic situation in the context, it is essential to have measures to assess the effects of fear of COVID-19 on mental health (Satici et al., 2020a, b), since this global reality will still be present for a long time. Moreover, tracking the levels of fear in different groups and their correlates can help to develop education and prevention programs, identifying more urgent needs (Pakpour & Griffiths, 2020) in view of the condition of social invisibility, rapid transmission, and mortality rate of the virus (Ahorsu et al., 2020), as well as how to deal with stigmatization and discrimination of those who have been or are contaminated (Pappas, Kiriaze, Giannakis, & Falagas, 2009).

Therefore, as the FCV-19S is theoretically grounded and has solid psychometric properties, having a Brazilian Portuguese version is important. Specifically, considering the current moment of pandemic, testing the psychometric properties of FCV-19S in Brazil may enable the conduction of cross-cultural studies, testing the effect of sociocultural variables or even verifying whether public policies implemented by national governments contribute to the lower level of fear and, consequently, better mental health of the population. Thus, the present research gathers evidence of validity (factorial and convergent), accuracy and individual parameters of the items (difficulty, discrimination, and psychometric information) of the Fear of COVID-19 Scale. To achieve this goal, two independent studies were developed. In Study 1, we aimed to adapt the FCV-19S to the Brazilian context, assessing its factorial structure (i.e., Exploratory Factor Analysis) and individual parameters. Based on these individual parameters, we selected the best items and proposed a shorter version of the FCV-19S. In Study 2, we aimed to assess whether the structure could be replicated using an independent sample and more robust analysis (i.e., Confirmatory Factor Analysis), for both long and short versions of the scale. Also, we assessed convergent validity by associating the measure with mental health outcomes (e.g., anxiety, stress, and depression), variables widely used in the literature (Satici et al., 2020a, b).

Study 1. Adaptation and Psychometric Evidence of the Fear of COVID-19 Scale

Method

Participants and Procedure

Participants were 230 volunteers, aged between 18 and 71 years ($M = 35.33$; $SD = 11.26$). Most participants were women (76.1%), single (48.7%), and with complete higher education (34.8%). The survey was developed using Google Forms. To collect data, snowball technique was used. We started advertising the survey in social media (e.g., Facebook, Instagram), and asked participants to help advertising. We considered a non-

probabilistic sample composed of individuals over 18 years old. Those who agreed to collaborate were clarified the purposes and guaranteed anonymity and confidentiality.

Material

Fear of COVID-19 Scale - (FCV-19S; Ahorsu et al., 2020). It is composed by seven items (e.g., “Item 1. *I am most afraid of coronavirus-19*” and “Item 7. *My heart races or palpitates when I think about getting coronavirus-19*”), which globally assess the fear of COVID-19. Participants indicate their level of agreement with the items, using a five-point Likert scale (1 = *Strongly Disagree*; 5 = *Strongly Agree*).

To translate the FCV-19S to Portuguese, we used the back-translation method, following the procedure suggested by Borsa, Damásio, and Bandeira (2012). Therefore, the scale was first translated to Brazilian Portuguese by two independent translators and then retranslated to English, through blind translations, to verify the equivalence of the items of the two versions (Portuguese and English). After that, with the preliminary version in Brazilian Portuguese, semantic validation was performed (Pasquali, 2016), which sought to evaluate whether the items and the format of the measure were clear. No further change was necessary.

Data Analysis

To assess the structure of the FCS-19S, we used the *software* Factor 10.10.03 (Ferrando & Lorenzo-Seva, 2017). To determine the number of factors, we considered the Hull method (CFI; Lorenzo-Seva, Timmerman, & Kiers, 2011), known as one of the best in estimating the dimensionality of a given set of items (Lorenzo-Seva et al., 2011). After, the structure properties were assessed through a categorical exploratory factor analysis (Diagonally Weighted Least Squares; DWLS), implemented in the matrix of polychoric correlations. Also, we assessed complementary indicators of unidimensionality, following recommendations by Ferrando and Lorenzo-Seva (2018). In addition, internal consistency (reliability) was verified using Cronbach's Alpha (α), based α on polychoric correlations, and McDonald's Omega (ω). Finally, we assessed the parameters of the FCS-19S items using Item Response Theory. For that, we used the package *mirt* (Chalmers, 2012) in R. Considering the ordinal polytomous nature of the items, we used the Graded Response Model in our IRT analyses (GRM; Samejima, 1969).

Results

Factorial Structure and Reliability

Initially, we aimed to gather evidence of construct validity, assessing the factorial structure of the measure through a robust categorical factor analysis (500 resamples through

Bootstrap). To allow the performance of an EFA, we first observed the adequacy of the matrix of polychoric correlations to the EFA [KMO = .88 (95% CI = 0.859–0.914) and $\chi^2_{\text{Bartlett}}(21) = 1012.8$ and $p < .001$]. When assessing the dimensionality of the measure, results pointed to a single factor with eigenvalue greater than 1 (4.16), that explained 64.69% of the total variance. This structure was supported by the Hull method (CFI = 0.98; *Scree Test* = 59.73), in addition to additional indicators of one-dimensionality: UniCo (Unidimensional Congruence) = .98 (95% CI = .949–.994) and MIREAL (Mean of Item Residual Absolute Loadings) = .262 (95% CI = .207–.304).

Therefore, we proceeded with an EFA (DWLS). As can be seen in Table 1, all items presented loadings greater than .70 ($M = .78$; $SD = .04$), ranging from .73 (Item 1. *I am most afraid of coronavirus-19*) at .88 (Item 3. *My hands become clammy when I think about coronavirus-19*). Results also pointed to an adequate internal consistency (≥ 0.70 ; Kline, 2013), assessed through standardized Cronbach's Alpha ($\alpha = .91$) and McDonald's omega *McDonald* ($\omega = .90$).

Item Response Theory

Additionally, Item Response Theory (GRM) was used to know, in greater detail, how the items of the FCS-19S differentiate people with distinct levels of fear of COVID-19, their thresholds, and amount of psychometric information provided by these items. Results can be seen in Table 1. All items presented very high discrimination values ($M_a = 2.12$; $SD_a = .35$) ranging from 1.71 (Item 1) to 2.72 (Item 3; Baker, 2001; Baker & Kim, 2017). The thresholds serve to identify the levels of *theta* (θ) necessary to select the next upper category on the response scale. These thresholds can be understood as the difficulty of the item, which should not be too easy nor too difficult (e.g., means across b_1 – b_4 between -1.5 and 1.5 ; Rauthmann, 2013). The lowest thresholds (b_{1-4}) were found in items 1 and 2, with means of b_{1-4} of -1.26 and -1.09 . That is, these items require lower levels of fear of COVID-19 to be fully endorsed. Finally, the Item Information Curve and Test Information Curve were assessed and can be seen in Fig. 1.

When assessing the amount of psychometric information $I(\theta; -4/+4)$ of the items individually (Table 1), an average information $I(\theta)$ of 5.08 ($SD = 0.89$) is found, ranging from 4.16 (item 1) to 6.33 (Item 3). The graphical evaluation of the Item Information Curves and Test Information Curve indicate that the measure covers a wide range of the latent trait (-2.56 to 2.04). Additionally, it is possible to identify items 2, 3, 6 and 7 as the most informative and, therefore, more central to the fear of COVID-19 measure. In this sense, a short version of the FCV-19S is suggested, also evaluated via EFA and TRI (see Table 1).

Table 1 Factorial structure, discrimination, thresholds and amount of information of the FCV-19S

Items	Robust EFA			Graded Response Model (IRT)						
	F1	IC95%	2 a.m.	a	b1	b2	b3	b4	I(θ)*	
7 items	I_3	.88	.82–.92	.77	2.72	−.50	.01	.50	1.09	6.33
	I_7	.80	.71–.85	.63	2.35	−.32	.39	1.00	1.74	5.84
	I_6	.78	.71–.84	.61	2.27	−1.46	−.84	−.14	.64	5.69
	I_5	.77	.65–.83	.57	2.07	−1.72	−1.12	−.45	.13	4.56
	I_2	.76	.64–.85	.57	1.93	−2.56	−1.48	−.64	.31	4.99
	I_4	.75	.67–.83	.59	1.84	−.02	.77	1.47	2.04	4.00
	I_1	.73	.61–.82	.53	1.71	−2.73	−1.84	−.72	.25	4.16
4 items	I_3	.80	.67–.88	.65	2.92	−.48	.03	.50	1.06	6.99
	I_7	.75	.65–.82	.57	2.54	−.30	.37	.96	1.67	6.42
	I_6	.75	.68–.82	.56	2.45	−1.43	−.82	−.13	.62	6.22
	I_2	.58	.44–.70	.33	1.61	−2.80	−1.61	−.67	.35	4.09

Note: * Amount of psychometric information between −4 and +4 deviations

Short FCS-19S

For the EFA, we followed the same procedure used for the full version of the measure. Results indicated a one-

dimensional structure (*Eigenvalue* = 2.55; *Hull_{CFI}* = .997) composed by 4 items, with factor loadings above .50 (*M* = .72; *SD* = .09) and acceptable reliability (*α* = .81). The discrimination values ranged from moderate (Item

Item information trace lines

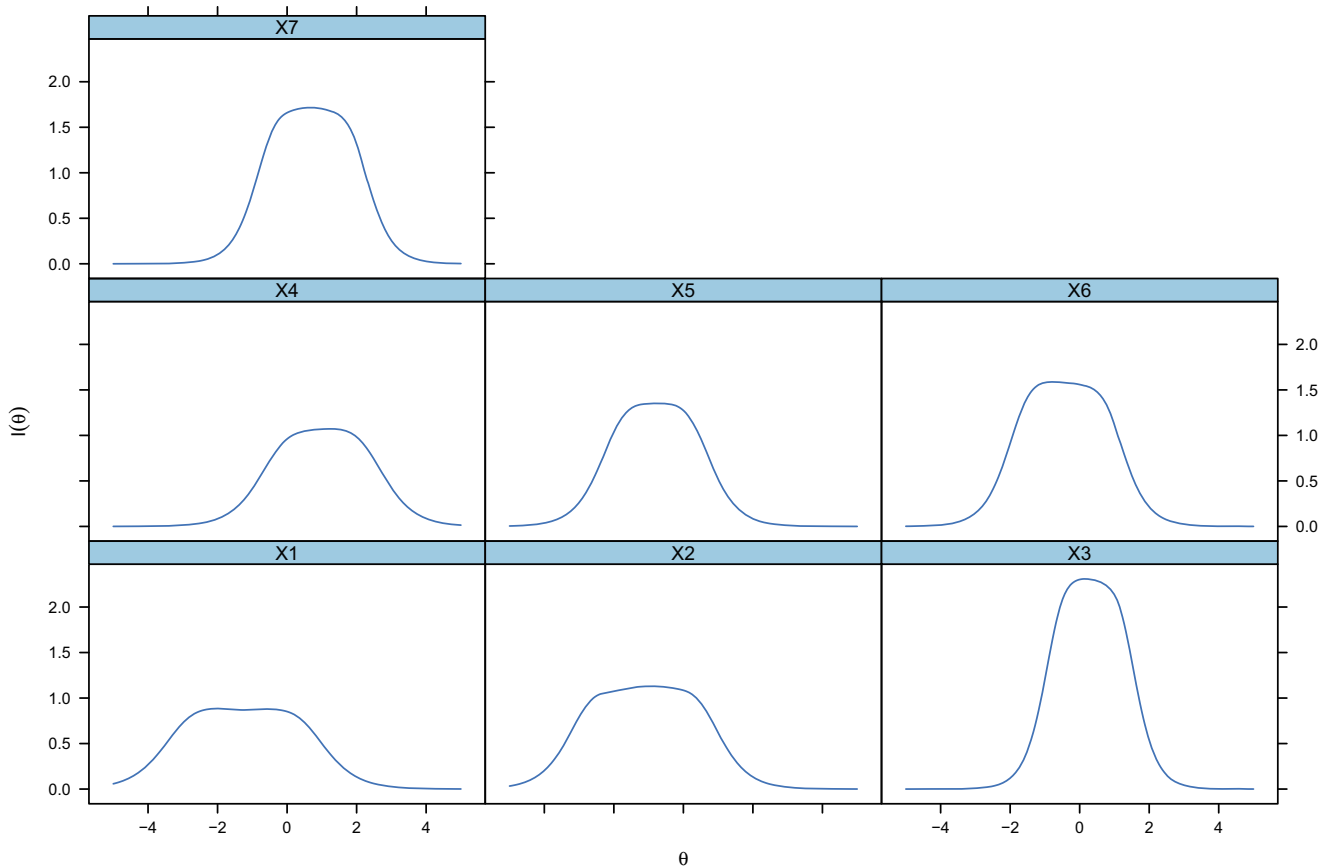


Fig. 1 Item and Test Information Curves of the FCV-19S

Test Information and Standard Errors

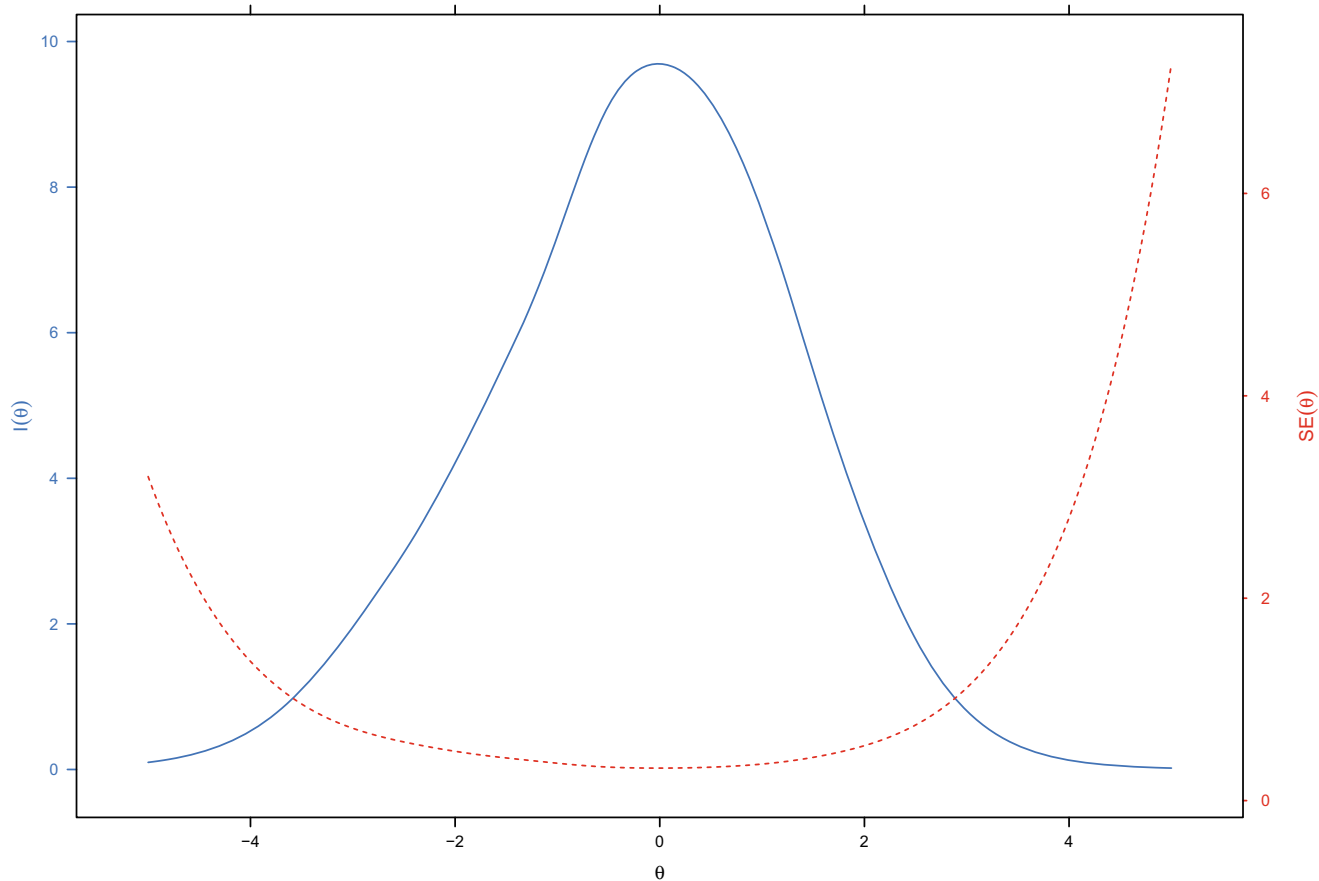
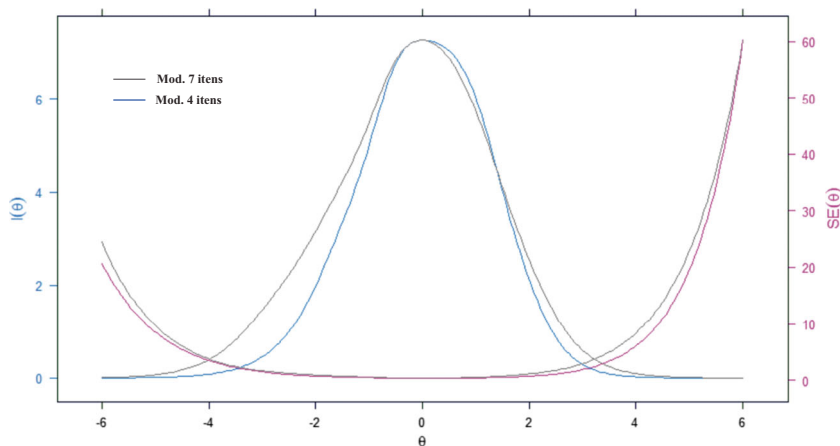


Fig. 1 (continued)

2, $a=1.61$) to very high (Item 3, $a=2.92$), with a mean of 2.38 ($SD=.55$). The thresholds indicate that the items cover an extensive amplitude of the latent trait (b_{1-4} between -2.80 and 1.67), with Item 2 ($M b_{1-4} = -1.18$) requiring a lower level of latent trait to be

fully endorsed and Item 7 ($M b_{1-4} = .67$) as the one requiring higher levels. Figure 2 shows the test information curves for the full and short version of the FCV-19S, indicating that the shorter version is a suitable alternative, without losing psychometric information.

Fig. 2 Test Information Curves comparing the full and short versions of the FCV-19S



Study 2. Proof of Factorial Structure and Convergent Validity

Method

Participants and Procedure

The sample consisted of 302 individuals ($M_{age} = 31.07$; $SD_{age} = 9.28$; ranging from 18 to 65), mainly women (75.8%), and with a postgrad (41.7%). For the data collection, the same procedure used in Study 1 was applied.

Material

Besides the FCV-19S, participants also answered the following measures:

Depression, Anxiety and Stress Scale (DASS- 21; Lovibond & Lovibond, 1995) Adapted for Brazil by Vignola and Tucci (2014), 21 items are evenly divided into three factors: depression (e.g. “I felt down-hearted and blue”), anxiety (e.g. “I felt I was close to panic”) and stress (e.g. “I found it difficult to relax”). Participants indicate to what extent the statements apply to them over the past week, using a four-point scale (0 = Did not apply to me at all; 4 = Applied to me very much or most of the time).

Data Analysis

Analyzes were performed using R. With the *Lavaan* package (Rosseel, 2012), a categorical confirmatory factor analysis (ordinal) was performed, considering the estimator Least Squares Mean and Variance-Adjusted (WLSMV; Muthén &

Muthén, 2014). This estimator is recommended for ordinal data that do not follow normal distribution (Asún, Rdz-Navarro, & Alvarado, 2015; Holgado-Tello, Chacón-Moscoso, Barbero-García, & Vila-Abad, 2010). The following indicators were used to assess model fit (Byrne, 2010; Hair, Black, Babin, & Anderson, 2019; Sun, 2005; Tabachnick & Fidell, 2013): (1) *Comparative Fit Index* (CFI) and (2) *Tucker-Lewis Index* (TLI), with values over .90 recommended; and (3) *Root-Mean-Square Error of Approximation* (RMSEA), with recommended values below .08. The reliability was once again assessed, using Cronbach’s Alpha, McDonald’s Omega, average variance extracted (AVE) and Composite Reliability (CR) through the *semTools* package (semTools Contributors, 2016).

Results

Confirmatory Factor Analysis

First, we assessed whether the unifactorial structure of the FCV-19S would replicate using a different sample and through a robust statistical technique, CFA, using the WLSMV estimator. We considered both the full version, composed by the 7 original items (Ahorsu et al., 2020), and the shorter version, composed by the items identified as most informative in our previous study (Items 2, 3, 6, and 7; [I(θ; -4/+4)]). The results indicated good fit for both models tested, with slight improvement in the short version [CFI = .996; TLI = .989; RMSEA = .039 (90%CI = .000–.081, $p > .05$)] when compared to the full measure [CFI = .985; TLI = .977; RMSEA = .073 (90%CI = .044–0.101 and $p > 0.05$)]. Once again, the measures presented good reliability levels (Short FCV-19S, $\alpha = .87$, $\omega = .83$, AVE = .56

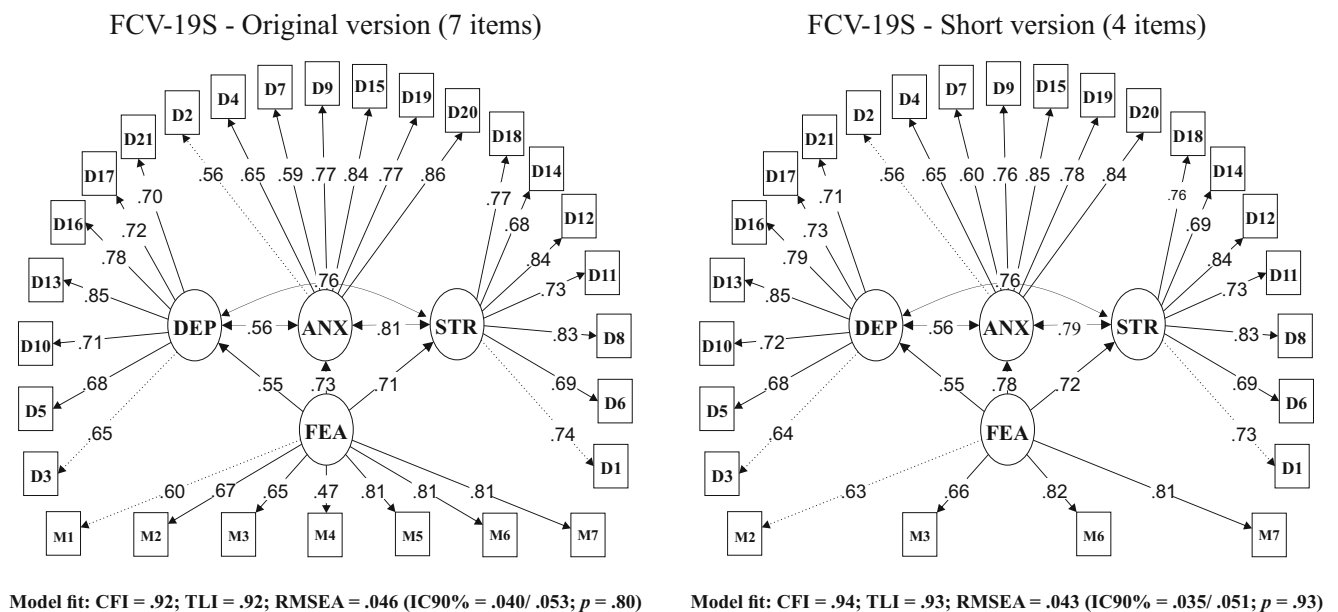


Fig. 3 Convergent validity of the full and short FCV-19S

and $CR = .83$; Full FCV-19S, $\alpha = .87$, $\omega = .86$, $AVE = .51$ and $CR = .87$; Kline, 2013).

Convergent Validity

To calculate the convergent validity, Structural Equation Modeling (SEM) was used, considering the WLSMV estimator. Thus, we tested two models (Full and Short FCV-19S), with four latent variables each: one representing the FCV-19S and the other three representing depression, anxiety, and stress (each with 7 items). See Fig. 3 for the full models. For the full version of the FCV-19S, results showed that the latent variable Fear of COVID-19 significantly and positively predicted the three other constructs [depression ($\lambda = .55$; $p < .001$), anxiety ($\lambda = .73$; $p < .001$) and stress ($\lambda = .71$; $p < .001$)], presenting a reasonable fit [CFI = .92; TLI = .92; RMSEA = .046 (90%CI = .040/.053; $p = .80$)]. Similar results were found for the short version, with Fear of COVID-19 positively predicting depression ($\lambda = .55$; $p < .001$), anxiety ($\lambda = .78$; $p < .001$) and stress ($\lambda = .72$; $p < .001$), and with a slightly better model fit [CFI = .94; TLI = .93; RMSEA = .043 (90% CI = .035/.051; $p = .93$)].

General Discussion

The COVID-19 pandemic is one of the groundbreaking events of the century, causing unprecedented damage (Sloan et al., 2020), with hundreds of thousands of victims all over the world, in addition to the possibility of causing severe damage in people's mental health (Duan & Zhu, 2020; Xiao, 2020). An ineffective government (The Lancet, 2020) and poor conditions of the public health system might help to explain why Brazil is one of the epicenters of the pandemic (Menezes et al., 2020). As a result, the effects of COVID-19 are higher in this context, and it is essential to have measures that allow the assessment of variables that can impact people's mental health and contribute to the development of intervention programs.

Factorial Structure

The present research aimed to adapt the FCV-19S to the Brazilian context, gathering evidence of validity and accuracy. In Study 1, we gathered evidence for its one-dimensional structure, with items presenting high factorial loadings (Pasquali, 2012). These results are in line with studies in different countries, indicating that the FCV-19S structure is cross-culturally consistent (e.g., Alyami et al., 2020; Satici et al., 2020a, b). The measure presented acceptable levels of internal consistency, attesting its accuracy (Urbina, 2014). Moreover, the items presented adequate discrimination (Baker, 2001) and information levels, covering a wide range of the latent trait evaluated.

We also proposed a short version of the FCV-19S. Considering that COVID-19 and its effects will remain indefinitely, shorter, and precise measures are useful in contexts such as primary care or hospital, places that might not present much time available for questionnaires. In our analyses, we selected four items that proved to be as informative, valid, and accurate as the full-version of the FCV-19S. In other words, a useful alternative for screening people with potential for mental health problems because of the intense fear of COVID-19.

In Study 2, we confirmed the structure of the full FCV-19S and its short version, with results indicating a good model fit (e.g., CFI and TLI ≥ 0.90 and RMSEA < 0.08 ; Tabachnick & Fidell, 2013). Once again, the measures presented adequate levels of internal consistency (α and $\omega \geq 0.70$; Kline, 2013).

Convergent Validity

In addition to the evidence gathered about the internal structure of the measure, we verified the validity of the short and full versions of the FCV-19S based on their associations with external variables. For that, using Structural Equation Modeling, we developed models in which the Fear of COVID explained stress, depression, and anxiety. As expected, we found that both versions of the FCS-19S positively predict these three constructs. These models presented adequate fit (Tabachnick & Fidell, 2013), with the short version presenting slightly better results in comparison to the full version. These results endorse previous findings on the COVID-19 literature, indicating that its fear may be a risk factor for the development of mental health problems (Ahorsu et al., 2020; Sakib et al., 2020; Satici et al., 2020a, b; Soraci et al., 2020; Tsiropoulou et al., 2020).

Therefore, assessing constructs such as the fear of COVID-19, that can predict negative psychological reactions or effects (such as anxiety, depression, and stress), is essential. It is known that these psychological distresses can diminish people's well-being and satisfaction with life (Alyami et al., 2020), especially at times like the present (Ahorsu et al., 2020; Mertens et al., 2020). FCV-19S could still be useful in developing strategies to minimize the psychological impact that depression, anxiety, and stress might cause in individuals infected and non-infected by COVID-19, besides helping to work on the stigma associated with disease and the fear of contracting it (*Centers for Disease Control and Prevention*, 2020).

Limitations, Future Studies and Final Considerations

The present research brings the Brazilian adaptation of the FCV-19S, besides providing a shorter measure with comparable quality to the original version. In despite of the promising findings for the Brazilian context and research about COVID-19, this project is not without limitations. First, the

use of non-probabilistic sample, not representative of the whole population of Brazil. This implies that is impossible to generalize the results reported (Markus & Borsboom, 2013). Also, in despite of the limited and non-representative sample (Comrey & Lee, 1992), it is important to highlight that our number of participants extrapolates known criteria to support the use of multivariate techniques. For instance, the recommended proportion of 20 participants per item (Clark & Watson, 1995; Hair et al., 2019; Gorsuch, 2015). Another limitation is the gender imbalance across our studies. In both samples, around three fourths of our participants were women. Therefore, more heterogeneous samples are recommended in future studies.

Both versions of the measure may be useful in future research, extremely needed. These studies can especially focus in the most vulnerable groups (e.g., with pre-existing diseases or elderly), people positively diagnosed for coronavirus, and professionals working on the front line. Another important point is to conduct longitudinal studies to assess the fear of COVID-19 and its effects over time. This is especially important in Brazil, which has no control of the spread of the virus. As the measures of social distancing and lockdown are not being met, it is expected a substantial increase in contamination in the coming months, especially considering that in many places of the country there has been a flexibilization of such measures. Therefore, verifying the fear of COVID-19 over time can help in preventive public health practices for the mitigation of the virus (Alyami et al., 20,200).

Data Availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Considerations All procedures performed in this study involving human participants were in accordance with the 1975 Helsinki Declaration.

Informed Consent Informed consent was obtained from all participants.

Conflict of Interest The authors have no conflict of interest to declare.

Appendix. Portuguese Items of the FCV-19S

01. Eu tenho muito medo do COVID-19.
02. Me sinto desconfortável ao pensar no COVID-19.
03. Minhas mãos ficam suadas quando penso no COVID-19.
04. Tenho medo de perder minha vida por causa do COVID-19.

05. Quando assisto notícias e histórias sobre o COVID-19 nas mídias sociais, fico nervoso e ansioso.

06. Não consigo dormir porque estou preocupado em contrair COVID-19.

07. Meu coração dispara ou palpita quando penso em contrair COVID-19.

References

- Ahorsu, D. K., Lin, C., Imani, V., Saffari, M., Griffiths, M., & Pakpour, A. H. (2020). The fear of COVID-19 scale: Development and initial validation. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-020-00270-8>.
- Alyami, M., Henning, M., Krägeloh, C. U., & Alyami, H. (2020). Psychometric evaluation of the Arabic version of the fear of COVID-19 scale. *Journal Mental Health Addiction*, 16, 1–14. <https://doi.org/10.1007/s11469-020-00316-x>.
- Asún, R. A., Rdz-Navarro, K., & Alvarado, J. M. (2015). Developing multidimensional likert scales using item factor analysis: The case of four-point items. *Sociological Methods & Research*, 45, 109–133. <https://doi.org/10.1177/0049124114566716>.
- Baker, F. B. (2001). The basics of item response theory (second edition). ERIC. <http://eric.ed.gov/?id=ED458219>
- Baker, F. B., & Kim, S. H. (2017). *The basics of item response theory using R* (pp. 55-67). New York: Springer.
- Bitan, D. T., Grossman-Giron, A., Bloch, Y., Mayer, Y., Shiffman, N., & Mendlovic, S. (2020). Fear of COVID-19 scale: Psychometric characteristics, reliability and validity in the Israeli population. *Psychiatry Research*, 289, 113100. <https://doi.org/10.1016/j.psychres.2020.113100>.
- Borsa, J. C., Damásio, B. F., & Bandeira, D. R. (2012). Adaptação e validação de instrumentos psicológicos entre culturas: algumas considerações. *Paidéia*, 22(53), 423–432. <https://doi.org/10.1590/S0103-863X2012000300014>.
- Byrne, B. M. (2010). *Structural equation modeling with AMOS: basic concepts, applications, and programming (multivariate applications series)*. New York: Taylor & Francis Group, 396, 7384.
- Centers for Disease Control and Prevention. (2020). *Coronavirus Disease 2019 (COVID-19)*. https://www.cdc.gov/coronavirus/2019-ncov/daily-lifecoping/reducingstigma.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fsymptoms-testing%2Freducing-stigma.html.
- Chalmers, R. P. (2012). Mirt: A multidimensional item response theory package for the R environment. *Journal of Statistical Software*, 48(6), 1–29. <https://doi.org/10.18637/jss.v048.i06>.
- Clark, L. A., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment*, 7, 309–319. <https://doi.org/10.1037/1040-3590.7.3.309>.
- Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *The Lancet infectious diseases*, 20(5), 533–534. [https://doi.org/10.1016/S1473-3099\(20\)30120-1](https://doi.org/10.1016/S1473-3099(20)30120-1).
- Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis*. New York: Academic Press.
- Duan, L., & Zhu, G. (2020). Psychological interventions of people affected by the COVID-19 epidemic. *The Lancet Psychiatry*, 7(4), 300–302. [https://doi.org/10.1016/S2215-0366\(20\)30073-0](https://doi.org/10.1016/S2215-0366(20)30073-0).
- Ferrando, P. J., & Lorenzo-Seva, U. (2017). Program FACTOR at 10: Origins, development and future directions. *Psicothema*, 29, 236–240. <https://doi.org/10.7334/psicothema2016.304>.
- Ferrando, P. J., & Lorenzo-Seva, U. (2018). Assessing the quality and appropriateness of factor solutions and factor score estimates in

- exploratory item factor analysis. *Educational and Psychological Measurement*, 78, 762–780. <https://doi.org/10.1177/0013164417719308>.
- Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., Wang, Y., Fu, H., & Dai, J. (2020). Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One*, 15(4), e0231924. <https://doi.org/10.1371/journal.pone.0231924>.
- Gorsuch, R. L. (2015). *Factor analysis (classic 2nd ed.)*. New York: Routledge.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). U.K.: Cengage Learning.
- Holgado-Tello, F. P., Chacón-Moscoso, S., Barbero-García, I., & Vila-Abad, E. (2010). Polychoric versus Pearson correlations in exploratory and confirmatory factor analysis of ordinal variables. *Quality & Quantity*, 44(1), 153–166. <https://doi.org/10.1007/s1135-008-9190-y>.
- Huang, Y., & Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: A web-based cross-sectional survey. *Psychiatry research*, 112954. <https://doi.org/10.1016/j.psychres.2020.112954>.
- Kline, P. (2013). *Handbook of Psychological Testing* (2nd ed.). Routledge. <https://doi.org/10.4324/9781315812274>
- Lin, C. Y. (2020). Social reaction toward the 2019 novel coronavirus (COVID-19). *Social Health And Behavior*, 3(1), 1–2. https://doi.org/10.4103/SHB.SHB_11_20.
- Li, Y. C., Bai, W. Z., & Hashikawa, T. (2020). The neuroinvasive potential of SARS-CoV2 may play a role in the respiratory failure of COVID-19 patients. *Journal of Medical Virology*, 92(6), 552–555. <https://doi.org/10.1002/jmv.25728>.
- Lorenzo-Seva, U., Timmerman, M. E., & Kiers, H. A. L. (2011). The Hull method for selecting the number of common factors. *Multivariate Behavioral Research*, 46(2), 340–364. <https://doi.org/10.1080/00273171.2011.564527>.
- Lovibond, S.H. & Lovibond, P.F. (1995). *Manual for the Depression Anxiety & Stress Scales*, (2nd Ed.) Sydney: Psychology Foundation.
- Lu, W., Wang, H., Lin, Y., & Li, L. (2020). Psychological status of medical workforce during the COVID-19 pandemic: A cross-sectional study. *Psychiatry Research*, 288, 112936. <https://doi.org/10.1016/j.psychres.2020.112936>.
- Mamun, M. A., & Griffiths, M. D. (2020). First COVID-19 suicide case in Bangladesh due to fear of COVID-19 and xenophobia: Possible suicide prevention strategies. *Asian Journal of Psychiatry*, 51, 102073. <https://doi.org/10.1016/j.ajp.2020.102073>.
- Markus, K. A., & Borsboom, D. (2013). *Frontiers in test validity theory: Measurement, causation and meaning*. New York: Routledge.
- Mertens, G., Gerritsen, L., Duijndam, S., Saleminck, E., & Engelhard, I. M. (2020). Fear of the coronavirus (COVID-19): Predictors in an online study conducted in March 2020. *Journal of Anxiety Disorders*, 74, 102258. <https://doi.org/10.1016/j.janxdis.2020.102258>
- Menezes, P. L., Garner, D. M., & Valenti, V. E. (2020). Brazil is projected to be the next global COVID-19 pandemic epicenter. *medRxiv*, 1, 1–10. <https://doi.org/10.1101/2020.04.28.20083675>.
- Muthén, L. K., & Muthén, B. O. (2014). *Mplus user's guide*. (Seventh Ed.). Muthén & Muthén.
- Pakpour, A. H., Griffiths, M. D. (2020). The fear of CoVid-19 and its role in preventive behaviors. *Journal of Concurrent Disorders*. ISSN 2562-7546.
- Pakpour, A.H., & Griffiths, M.D. (2020). The fear of COVID-19 and its role in preventive behaviors. *Journal of Concurrent Disorders*, 2(1), 58–63.
- Pappas, G., Kiriakou, I. J., Giannakis, P., & Falagas, M. E. (2009). Psychosocial consequences of infectious diseases. *Clinical Microbiology and Infectious Diseases*, 15, 743–774. <https://doi.org/10.1111/j.1469-0691.2009.02947.x>.
- Pasquali, L. (2012). *TRI – Teoria de resposta ao item: teoria, procedimentos e aplicações*. Curitiba, PR: Apriss Editora.
- Pasquali, L. (2016). *TEP – Técnicas de exame psicológico: os fundamentos*, (2nd ed.). São Paulo, SP: Vetor Editora.
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., & Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: Implications and policy recommendations. *General psychiatry*, 33(2), e100213. <https://doi.org/10.1136/gpsych-2020-100213>.
- Rauthmann, J. F. (2013). Investigating the MACH-IV with item response theory and proposing the trimmed MACH*. *Journal of Personality Assessment*, 95, 388–397. <https://doi.org/10.1080/00223891.2012.742905>.
- Reznik, A., Gritsenko, V., Konstantinov, V., Khamenka, N., & Isralowitz, R. (2020). COVID-19 fear in Eastern Europe: Validation of the fear of COVID-19 scale. *International Journal Mental Addiction*, 12, 1–6. <https://doi.org/10.1007/s11469-020-00283-3>.
- Rossel, P. (2012). Early detection, warnings, weak signals and seeds of change: A turbulent domain of futures studies. *Futures*, 44(3), 229–239. <https://doi.org/10.1016/j.futures.2011.10.005>.
- Sakib, N., Bhuiyan, A. I., Hossain, S., Al Mamun, F., Hosen, I., Abdullah, A. H., ... & Mamun, M. A. (2020). Psychometric validation of the Bangla fear of COVID-19 scale: confirmatory factor analysis and Rasch analysis. *International Journal of Mental Health and Addiction*, 11, 1–2. <https://doi.org/10.1007/s11469-020-00289-x>
- Samejima, F. (1969). Estimation of latent ability using a response pattern of graded scores. *Psychometrika Monograph Supplement*, 34(4, Pt. 2), 100. <https://www.psychometricsociety.org/sites/default/files/pdf/MN17.pdf>.
- Satici, B., Gocet-Tekin, E., Deniz, M. E., & Satici, S. A. (2020a). Adaptation of the fear of COVID-19 scale: Its association with psychological distress and life satisfaction in Turkey. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-020-00294-0>.
- Satici, B., Saricali, M., Satici, S. A., & Griffiths, M. D. (2020b). Intolerance of uncertainty and mental wellbeing: Serial mediation by rumination and fear of COVID-19. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-020-00305-0>.
- Sloan, M. M., Haner, M., Graham, A., Cullen, F. T., Pickett, J. T., & Jonson, C. L. (2020). *Pandemic emotions: The extent, correlates, and mental health consequences of personal and altruistic fear of COVID-19*. Working Paper: University of South Florida.
- Soraci, P., Ferrari, A., Abbiati, F. A., Del Fante, E., De Pace, R., Urso, A., & Griffiths, M. D. (2020). Validation and psychometric evaluation of the Italian version of the fear of COVID-19 scale. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-020-00277-1>.
- Sun, J. (2005). Assessing goodness of fit in confirmatory factor analysis. *Measurement and Evaluation in Counseling and Development*, 37(4), 240–256. <https://doi.org/10.1080/07481756.2005.11909764>.
- Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). London, England: Pearson Education.
- Taylor, S., Landry, C. A., Paluszek, M. M., Fergus, T. A., McKay, D., & Asmundson, G. J. G. (2020). Development and initial validation of the COVID stress scales. *Journal of Anxiety Disorders*, 72, 102232. <https://doi.org/10.1016/j.janxdis.2020.102232>.
- The Lancet (2020). COVID-19 in Brazil: “So what?”. *Lancet (London, England)*, 395(10235), 1461. <https://doi.org/10.1016/S0140-6736>
- Tsipropoulou, V., Nikopoulou, V. A., Holeva, V., Nasika, Z., Diakogiannis, I., Sakka, S., Kostikidou, S., Varvara, C., Spyridopoulou, E., & Parlapani, E. (2020). Psychometric properties of the Greek version of FCV-19S. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-020-00319-8>.

- Tull, M. T., Edmonds, K. A., Scamaldo, K., Richmond, J. R., Rose, J. P., & Gratz, K. L. (2020). Psychological outcomes associated with stay-at-home orders and the perceived impact of COVID-19 on daily life. *Psychiatry Research*, 113098. <https://doi.org/10.1016/j.psychres.2020.113098>.
- Urbina, S. (2014). *Essentials of behavioral science. Essentials of psychological testing* (2nd ed.). New Jersey: John Wiley & Sons Inc.
- Vignola, R. C. B., & Tucci, A. M. (2014). Adaptation and validation of the depression, anxiety and stress scale (DASS) to Brazilian Portuguese. *Journal Affective Disorders*, 155, 104–109. <https://doi.org/10.1016/j.jad.2013.10.031>.
- Wang, D., Hu, B., Hu, C., Zhu, F., Liu, X., Zhang, J., Wang, B., Xiang, H., Cheng, Z., Xiong, Y., Zhao, Y., Li, Y., Wang, X., & Peng, Z. (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA*, 323(11), 1061–1069. <https://doi.org/10.1001/jama.2020.1585>.
- Xiang, Y.-T., Yang, Y., Li, W., Zhang, L., Zhang, Q., Cheung, T., & Ng, C. H. (2020). Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *Lancet*, 7, 228–229. [https://doi.org/10.1016/S2215-0366\(20\)30046-8](https://doi.org/10.1016/S2215-0366(20)30046-8).
- Xiao, C. (2020). A novel approach of consultation on 2019 novel coronavirus (COVID-19)-related psychological and mental problems: Structured letter therapy. *Psychiatry Investigation*, 17(2), 175–176. <https://doi.org/10.30773/pi.2020.0047>.
- Xiao, H., Zhang, Y., Kong, D., Li, S., & Yang, N. (2020). The effects of social support on sleep quality of medical staff treating patients with coronavirus disease 2019 (COVID-19) in January and February 2020 in China. *Medical Science Monito*, 26, e923549-1. <https://doi.org/10.12659/MSM.923549>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.