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# The Fear of Coronavirus-19 Infection Questionnaire: Factor Structure, Psychometric Properties, and Measurement Invariance among Hispanic Adults

## Cuestionario de Miedo al Contagio por Coronavirus-19: Estructura Factorial, Propiedades Psicométricas e Invarianza de Medición entre Adultos Hispanos

**Eduardo Cumba-Avilés [1*], Orlando M. Pagán-Torres [2], & Ernesto Rosario-Hernández [3]**

1 University of Puerto Rico, Río Piedras Campus, Puerto Rico. https://orcid.org/0000-0001-5408-915X
2 Ponce Health Sciences University, Ponce, Puerto Rico. https://orcid.org/0000-0002-7195-4202
3 Ponce Health Sciences University, Ponce, Puerto Rico. https://orcid.org/0000-0002-2523-6162

* Correspondence: eduardo.cumba1@upr.edu

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**ABSTRACT**

COVID-19-related fear requires effective tools to assess its occurrence and associations with pandemic-related domains. We examined the factor structure and measurement invariance (MI) of the Fear of Coronavirus-19 Infection Questionnaire (FOCI-Q) among Hispanics (aged 21–79) in Puerto Rico, who completed an online survey. An exploratory factor analysis ($N$ = 527) yielded a two-factor solution: Obsessive/Agoraphobic Fears and Interpersonal Contact Fears. Through confirmatory factor analysis (Maximum Likelihood estimation and Satorra-Bentler corrections) with two samples ($N$ = 525–696), this model showed adequate to excellent fit (TLI = .964–.979; CFI = .976–.986; RMSRA = .065–084; SRMSR = .029–.030). Reliability coefficients were > .90 across samples. Fornell and Larcker's and Heterotrait-Monotrait validity criteria were met. FOCI-Q scores correlated positively with posttraumatic stress, anxiety, and depression symptoms but negatively with self-ratings of physical and mental health. The scale was invariant across sex and age groups. By documenting the structure, reliability, validity, and MI of the FOCI-Q, this study supports its use among Hispanic adults.

***Keywords***: COVID-19 fear, cross-validation study, factor analysis, measurement invariance

**RESUMEN**

El miedo al COVID-19 requiere herramientas eficaces para evaluar su aparición y asociación con ámbitos relacionados a la pandemia. Examinamos la estructura factorial e invarianza de medición (IM) del Cuestionario de Miedo al Contagio por Coronavirus-19 (FOCI-Q por sus siglas en inglés) entre hispanos(as) de Puerto Rico (21–79 años) que completaron una encuesta en línea. Un análisis factorial exploratorio ($N$ = 527) arrojó dos factores: Miedos Obsesivos/Agorafóbicos y Miedos al Contacto Interpersonal. Mediante análisis factorial confirmatorio (con

estimación de máxima verosimilitud y correcciones Satorra-Bentler) en dos muestras ($N$ = 525–696), este modelo mostró un ajuste de adecuado a excelente (TLI = .964–.979; CFI = .976–.986; RMSRA = .065–084; SRMSR = .029–.030). Los coeficientes de confiabilidad fueron > .90. El instrumento cumplió los criterios de validez de Fornell y Larcker y del método Heterorasgo-Monorasgo. Sus puntuaciones correlacionaron positivamente con síntomas de estrés postraumático, ansiedad y depresión, pero negativamente con autoevaluaciones de salud física y mental. La escala fue invariante por sexo y edad. Al documentar la estructura, confiabilidad, validez e IM del FOCI-Q, este estudio respalda su uso entre personas adultas hispanas.

***Palabras Claves***: análisis factorial, estudio de validación cruzada, invarianza de medida, miedo al COVID-19

## INTRODUCTION

For its sudden origin and rapid contagion, COVID-19 detonated worldwide psychological distress (Muller et al., 2021). Fear has been a common pandemic reaction (Luo et al., 2021). Although fear may increase compliance with preventive measures, extreme fear may lead to social isolation, panic buying, deteriorated physical/mental health, and reduced resilience/or functionality (Muller et al., 2021; Taylor et al., 2020). COVID-19-related fear (CRF) requires tools to detect its presence and study its association with other pandemic-related domains. Several CRF measures have been developed since 2020, some of which have been translated into various languages. Five of those CFR measures have a validated Spanish-language version.

The first CRF measure was the 7-item Fear of COVID-19 Scale (FCV-19S), developed with Iranian adults. An exploratory factor analysis (EFA) yielded one factor, which Cronbach's $\alpha$ (.82), composite reliability (CR = .88), and average variance extracted (AVE = .51) were good (Ahorsu et al., 2020). Using confirmatory factor analysis (CFA) with a Spanish version in Perú, Huarcaya-Victoria et al. (2020) found a bifactor structure: a general (AVE = .46) and specific Emotional and Somatic factors. FCV-19S scores were reliable (McDonald's $\omega$ = .89–.94; $\alpha$ = .83–.88). Its correlations with post-traumatic stress (PTSD) were higher than with anxiety. Also with Peruvians, Hernández et al. (2021) found a good fit for a single factor model but including three covariances among errors ($\alpha$ = .79; $\omega$ = .81). In Argentina, a two-factor model ($\omega$ = .73–.80) showed the best fit (Caycho-Rodriguez et al., 2022a), but their high correlation (.89) raised discriminant validity issues. In Spain, a one-factor model (AVE = .56) showed great reliability ($\alpha$ = .91; $\omega$ = .98) and model fit (Sánchez-Teruel et al., 2022). FCV-19S scores correlated more with anxiety (ANX) than with depression (DEP) in these four studies. Caycho-Rodriguez et al. (2022b) found an acceptable fit for a two-factor model in most Latin American countries, but intercorrelations (.80 – .90) were high. In 4 out of 7 samples an AVE < .50 was found in at least one factor. Convergent validity issues (AVE < .50) with Spanish versions occurred in at least three more studies (Martínez-Lorca et al., 2020; Piqueras et al., 2021; Soto-Briseño et al., 2021). Another study by Huarcaya-Victoria et al. (2022) confirmed a two-factor structure but item 5 had mixed loadings. In Colombia, Cassiani-Miranda et al. (2022) obtained good fit for a one-factor model but after erasing items 1 and 5 ($\alpha$ = .75; $\omega$ = .78). Mercado-Lara et al. (2021) also erased two items (#4 and #7) to obtain a good model fit and improve reliability using a Yes/No response format (Kuder Richardson-20 = .67, $\omega$ = .68). Since at least three models had been supported by studies in several countries, the structure of the FCV-S19 remains unclear (Sawicki et al., 2022).

The 6-item Perceived Coronavirus Threat Questionnaire (PCTQ) was developed early in 2020 in the United States (US). It assesses how threatened people are about COVID-19. In a principal component analysis (PCA) with Varimax rotation, one factor was retained (Conway et al., 2020). A CFA in another sample yielded an adequate model fit. The PCTQ showed $\alpha$ values of .88 and .90 for its 6- and 3-item versions, respectively. In Mexico, Arroyo-Belmonte et al. (2021) found an $\alpha$ of .89 and a direct correlation with a scale of adversity and stress using a 3-item Spanish version. Corral-Verdugo et al. (2021) reported an $\alpha$ of .80 for the 6-item and a 5-item Spanish version, whose AVE (.52) was acceptable. One of its items, however, obtained a factor loading of only .22. No more studies using a Spanish version of this scale were found.

The 36-item COVID Stress Scales (CSS) were developed in Canada to assess COVID-related distress,

including fears (Taylor et al., 2020). A confirmatory US sample was recruited. The CSS has six subscales: Danger, Fears about Economic Consequences, Xenophobia, COVID Contamination Fears, Traumatic Stress Symptoms, and Compulsive Checking and Reassurance Seeking. In an EFA, items intended to assess danger and contamination fears loaded into a single factor. Using CFA, this model was confirmed on the US sample with a good to excellent fit. Factors and Total scores across samples showed $\alpha$ values were from .83–.95 (Taylor et al., 2020). Validity was evidenced via correlations with other measures. The measure was first translated into Spanish by Pulido-Guerrero and Jimenez-Ruiz (2020), in whose study with Colombians a six-factor model best fitted the data and high $\alpha$ values (.85–.96) were obtained. However, this model included > 30 pairs of correlated errors. The CSS correlated with scores on perception of affectation by the pandemic. A Spanish CSS was used with Puerto Ricans showing good fit, reliability (.86–.97), and concurrent validity, with a revised 5-factor model after two items were excluded (Martínez-Taboas et al., 2021). As in Taylor's et al. (2020) study, higher correlations were observed with ANX than with DEP. Yet, a discriminant validity issue emerged for the Compulsive Checking factor: its AVE was lower than its maximum shared variance (MSV). A six-factor model best fitted data with Peruvians (Noe-Grijalva et al., 2022). Factors had good $\alpha$ and $\omega$ values but the authors did not provide support for its concurrent validity.

The 20-item COVID-19 Phobia Scale (C19P-S) was developed in Turkey (Arpaci et al., 2020). It examines psychological, psycho-somatic, economic, and social factors. This structure was validated using CFA with a good model fit and support for its convergent and discriminant validity. In a US sample, C19P-S scores correlated with ANX but three factors showed an AVE < .50 and some had intercorrelations ≥ .85 (Arpaci et al., 2022), limiting their convergent and discriminant validity, respectively. Reliability ($\alpha$ and $\omega$, or $\alpha$ and CR) was good (> .90 for Total scores) in both samples. In Paraguay, Torales et al. (2022) used CFA with the Spanish C19P-S and found excellent model fit, reliability ($\alpha$, $\omega$, and CR), and validity, via correlations with the FCV-19S and ANX. Yet, some of its factors had either an AVE < MSV and/or Heywood cases.

Finally, Ehrenreich-May (2020) created the 35-item Fear of Illness and Virus Evaluation (FIVE) scales. The adult version has subscales on Fears about Contamination and Illness (1-9), Fears about Social Distancing (10-19), Behaviors Related to Illness and Virus Fears (20-33), and Impact of Illness and Virus Fears (34-35). The meaning of anchors from the first two subscales is the same, but different in remaining subscales. Villalobos and Hernandez-Rodriguez (2021) used the FIVE with Latino(a) adults (78.4% had English as primary language) and reported $\alpha$ values from .73–.94. FIVE scores correlated higher with PTSD and ANX than with DEP. Tounsi et al. (2021) used an Arabic version and found $\alpha$ values from .84–.91 ($\omega$ = .87–.91) and correlations from .44 – .54 with the FCV-19S. However, no CFA model using the 35 items yielded an adequate fit in all indexes. A two-factor model (with items 1-9) had a good fit. Using a Spanish version, Cottin et al. (2021) also discarded 35-item models but proposed four (items 1-19) or two factors (items 1-9). These models had adequate to excellent fit and good reliability. However, two subscales in the four-factor model and one in the two-factor model had an AVE < .50 and < MSV. The two factors associated to fear of infection correlated more with PTSD than with DEP.

Although it is considered an important part of the validation of measurement scales for conducting valid group comparisons, only a small portion of studies have tested the measurement invariance (MI) of a CRF scale. The first step is to examine the configural invariance model, which imposes no equality restrictions on model parameters. The second step conveys examining the metric invariance, in which the factor loadings are treated as invariant across groups. This ensures that the measures are on the same scale across groups for making valid comparisons. The third step requires the examination of the scalar invariance model which imposes invariance on both factor loadings and item intercept across groups. This is to ensure the underlying factors can be compared across groups. The final step is the testing of the strict invariance model, which requires the factor loadings, intercepts, and residual variances to be invariant. This is to examine whether the variances of the regression equations for each item are invariant across groups.

Among studies that have examined the MI of a CRF scale, some focused on a Spanish version. Huarcaya-Victoria et al. (2020) tested the MI of the FCV-19S bifactor model in Perú, including the configural, metric, and scalar invariance but not the strict invariance. The model was invariant for age (18-39 vs. ≥ 40 years old) and healthcare worker status (Yes vs No), but results did not support the scalar invariance by sex. Caycho-Rodriguez et al. (2022a) examined the MI of the FCV-19S across age groups (18-40/41-65/66-80 years old) in Argentina and reached criteria for strict invariance with a two-related factor model but they did not test MI by sex. When Caycho-Rodriguez et al. (2022b) showed the cross-cultural configural and partial scalar invariance of a two-factor model for this scale among samples from seven Latin American countries, they did not assess MI across sex and age groups. Meanwhile, Piqueras et al. (2021) found that a one-factor structure was invariant across sex and age groups. Although strict MI by sex was supported by three criteria, MI by age was supported only by only one. Notably, there were six age groups in their analysis, with very small sizes at extreme categories. Sánchez-Teruel et al. (2021) reported that the FCS-19S was not invariant across sex or age in Spain. Although Cassiani-Miranda et al. (2022) claimed for sex invariance in Colombia, they conducted separate CFAs by sex but did not use multigroup CFA to examine MI hierarchically. Lastly, Noe-Grijalva et al. (2022) tested the MI of the Spanish CSS and found strict invariance by sex (men/women).

CRF should be carefully assessed given its potential to generate or worsen mental health-related problems (e.g., phobic, social ANX, general ANX, DEP, PTSD, hypochondriasis, and obsessive-compulsive symptoms) as well as social disruptive behaviors such as xenophobia, panic buying, and conspiracy theories (Mertens et al., 2020). To identify people at risk of psychopathology associated with CRF and provide appropriate treatment, valid measures of this construct are needed. Among CRF scales available in Spanish, only the CSS has been tested in adults from Puerto Rico (PR). Still, for its length, it may not be suitable for all clinical scenarios or research aimed to explore multiple domains using several brief scales (Pakpour et al., 2021).

In this study, we tested the structure, psychometrics, and MI of a brief CFR measure in adults from PR. We explored its structure with a learning sample and examined fit statistics of the observed model in other two samples. We examined the scale reliability and the factor loadings and discrimination indexes of its items. We tested the scale convergent and discriminant validity via CFA-based statistics and its concurrent validity via correlations with criteria assumed to be positively or negatively related to the scale. Then, we analyzed the scale MI across sex and age groups. We expected to find support for a two-factor model, discrimination indexes ≥ .30, item loadings ≥ .70, reliability values ≥ .80, convergent and discriminant validity statistics within psychometric standards, and significant correlations with concurrent criteria. Lastly, we expected that our brief scale would show strict MI across sex and age groups when using multigroup CFA.

## METHOD

### Research Design

This research follows an instrumental design based on data collected during a cross-sectional online survey. Specifically, we performed a cross-validation study of a CRF measure developed in Puerto Rico, including EFA and CFA conducted in different samples (see below), and a second confirmatory sample with which we examined MI by sex and age groups.

### Participants

We recruited 1736 adults from June 10, 2020–June 9, 2021 for an online survey. The respondents (79.84% women) were aged 21 or older ($M$ = 46.36; $SD$ = 13.49; range from 21–79 years), had lived in PR for ≥ 3 months before their participation, had to understand Spanish, and must had access to the internet. We drew three subsamples for this study. We randomly selected samples A and B (SA and SB) from the first 1055 cases. We identified multivariate outliers within samples, yielding a size of 527 for SA and 525 for SB. Sample C (SC) was purposely formed by all men with valid data for the questionnaire targeted in this study ($n$ = 348) and an equally sized random sample of women selected from the final survey sample (total n = 696). In Table 1 we showed the distribution of cases by sociodemographic categories, which was similar among samples, except for the biological sex ratio in SC.

**Table 1**

*Sociodemographic Characteristics for Study Samples.*

| Variables | Sample A ($N$ = 527) % ($f$) / $M$ ($SD$) | Sample B ($N$ = 525) % ($f$) / $M$ ($SD$) | Sample C ($N$ = 696) %($f$) / $M$ ($SD$) |
|---|---|---|---|
| Biological Sex (% Women) | 80.27 (423) | 80.00 (420) | 50.00 (348) |
| Mean Age | 47.38 (12.94) | 45.67 (13.70) | 46.98 (14.14) |
| Household Size | 2.77 (1.28) | 2.74 (1.24) | 2.61 (1.25) |
| *Age Groups* | | | |
| 21–39 | 29.98 (158) | 34.86 (183) | 33.91 (236) |
| 40–59 | 49.34 (260) | 45.71 (240) | 43.68 (304) |
| 60 and above | 20.68 (109) | 19.43 (102) | 22.41 (156) |
| *Sexual Orientation* | | | |
| Heterosexual | 88.80 (468) | 88.76 (466) | 80.75 (562) |
| Gay or Lesbian | 6.07 (32) | 6.48 (34) | 13.79 (96) |
| Bisexual | 3.61 (19) | 3.24 (17) | 3.45 (24) |
| Other | 0.00 (0) | 0.95 (5) | 0.57 (4) |
| Preferred not to answer | 1.52 (8) | 0.57 (3) | 1.44 (10) |
| *Educational Level* | | | |
| High school (or less) | 5.69 (30) | 5.52 (29) | 6.75 (47) |
| Technical Course/Certificate | 2.66 (14) | 4.95 (26) | 4.02 (28) |
| Associate Degree | 11.20 (59) | 10.48 (55) | 9.63 (67) |
| Bachelor's Degree | 34.91 (184) | 34.48 (181) | 30.07 (265) |
| Master Degree | 30.55 (161) | 31.05 (163) | 27.44 (191) |
| Doctoral Degree or Higher | 14.99 (79) | 13.53 (71) | 14.08 (98) |
| *Household Income* | | | |
| $0 – $19,999 | 26.00 (137) | 28.00 (147) | 24.57 (171) |
| $20,000 – $39,999 | 33.40 (176) | 31.05 (163) | 30.89 (215) |
| $40,000 – $59,999 | 22.20 (117) | 20.95 (110) | 21.41 (149) |
| $60,000 – $79,999 | 7.59 (40) | 9.71 (51) | 9.20 (64) |
| $80,000 – 99,999 | 3.80 (20) | 5.90 (31) | 5.89 (41) |
| $100,000 or more | 7.02 (37) | 4.38 (23) | 8.05 (56) |
| *Marital Status* | | | |
| Married and living together | 44.59 (235) | 39.43 (207) | 38.36 (267) |
| Living together (but not married) | 9.68 (51) | 9.90 (52) | 11.06 (77) |
| Separated | 2.47 (13) | 1.52 (8) | 1.29 (9) |
| Divorced (not living with someone) | 15.18 (80) | 16.00 (84) | 13.94 (97) |
| Single never married (not cohabitating) | 23.72 (125) | 29.52 (155) | 31.32 (218) |
| Widow (not living with someone) | 2.28 (12) | 2.29 (12) | 2.87 (20) |
| None of the above | 1.71 (9) | 1.14 (6) | 1.15 (8) |
| Preferred not to answer | 0.38 (2) | 0.19 (1) | 0.00 (0) |

## Instruments

**Sociodemographic and Health History Module**. We collected basic sociodemographic data. We also asked adults to rate their physical and mental health status in single items using a response format from 0 (Worst) to 10 (Optimal).

**Fear of Coronavirus-19 Infection Questionnaire (FOCI-Q).** This 8-item scale assesses the fear of being or becoming infected with COVID-19. Its items allow rating different fear of infection sources on a scale from 0 (Absent) to 10 (Extreme). Four indicators relate to infection from contact with someone at home, a close friend/relative not living at home, acquaintances (e.g., a co-worker, a physician, a stylist, etc.), or

unknown people. The remaining items target COVID-related obsessive-like (e.g., fear of infection despite washing hands, cleaning unpackaged food items, or using extra gloves) and agoraphobic-like fears (e. g., fear of not being helped if getting infected or suffering a panic attack in public places). Adults rated the scale considering how they have felt since the pandemic started. No Spanish version of a CRF scale was available at the time the FOCI-Q was created.

**Patient Health Questrionnaire-4 (PHQ-4).** This is a 4-item screener for depressed and anxious symptoms in the past 2 weeks. Two items assess major depression core criteria (i.e., depressed mood and anhedonia) and two assess generalized anxiety core criteria on a scale from 0 (Not at all) to 3 (Nearly every day). For the English version, coefficients $\alpha$ for the Total (.85), Anxiety ($\alpha$ = .82), and Depression ($\alpha$ = .81) scores were adequate (Kroenke et al., 2009). In the current study, the $\alpha$ values for the Total scores were .90 (SA), .89 (SB), and .92 (SC). These coefficients ranged from .85 (SB) to .88 (SA) for Anxiety and from .87 (SB) to .90 (SA and SC) for Depression scores.

**Primary Care PTSD Screen for DSM-5 (PC-PTSD-5) COVID-19 Adaptation.** This is a 5-item screener of PTSD symptoms. In its original version, items are rated as Yes or No. Targeted areas include efforts to avoid reminders about the event(s); nightmares or intrusive thoughts; being constantly on guard, watchful, or easily startled; problems experiencing positive emotions, or being detached/emotionally distant; and feeling guilty or unable to stop blaming oneself or others. The alpha value (.83) and diagnostic accuracy of the PC-PTSD-5 are excellent (Cheng et al., 2021). We used a response format from 0 (Not at all) to 4 (Extremely). Adults rated how often they had experienced PTSD symptoms during the 1-month period or more in which they felt worst due to pandemic-related events that put their lives or lives of their loved ones in danger (e.g., being infected, being fearful that infection would lead to death, or COVID-19-related deaths). In this study, we found $\alpha$ values of .88 (SA and SB) and .89 (SC)..

## General Procedures

After approval (#1920-194) by the Institutional Review Board of the University of Puerto Rico, Río Piedras Campus, we shared information about our survey via e-mail, social media (WhatsApp and Messenger), notes in local newspapers, and paid advertisements on Facebook. In promotional flyers we included a direct link and a QR code to access a consent form with detailed information about the survey. Those who consented and met screening criteria (age and time living in PR) got access to the survey, available through Google Forms (1736 consented and 10 did not). We did not provide any incentives for participants.

## Data Analysis

We used SPSS 28.0, STATA 15.0, and R Statistical Software (v4.2.0) for most statistical analyses. We characterized the study samples using descriptive statistics (Table 1). With SA, we conducted an EFA in SPSS using the Maximum Likelihood (ML) extraction (Promax rotation). Retention criteria were eigenvalues ≥ 1.0 for factors and factor loadings ≥ .50 for items. The solution obtained in SA was tested in SB and SC using single group CFA with R. After assessing each item for normality (in SPSS) as well as the multivariate normality (in STATA), we confirmed the need for a non-normality correction of CFA using the robust ML estimation with the Satorra-Bentler adjustment (Satorra & Bentler, 2001). In both confirmatory samples, we tested these models: a single-factor structure (M1) and a two-correlated factors model (M2).

Criteria to assess model fit were diverse. We computed Satorra-Bentler (sb) corrected versions for the Chi-square test, the normed Chi-square test ($\chi^2$ / *df*), the Root Mean Square Error of Approximation (RMSEA), the Tucker–Lewis Index (TLI), and the Comparative Fit Index (CFI). We also considered the Standardized Root Mean Square Residual (SRMR). Values of $\chi^2$ / *df* < 3.0 are indicative of a very good fit (< 5.0 is acceptable). RMSEA and SRMR values < .08, as well as CFI and TLI values > .90, are indicative of acceptable model adjustment (Kline, 2011). To examine the significance ($p \leq .01$) of changes in model fit, we used the Satorra-Bentler Scaled Chi-Square Difference Test ($\Delta\chi^2_{sb}$ test). We used Cohen's w to assess the size of such changes. Guidelines for small (.1), medium (.3), and large (.5) effects are in parenthesis.

Using Cronbach's $\alpha$ (which assumes tau-equivalence) and McDonald's $\omega$ (a measure for congeneric models), we assessed the reliability of FOCI-Q scores. For each latent factor, we also estimated composite

reliability (CR) and maximal reliability [MaxR(H)]: a weighted coefficient developed by Hancock and Mueller (2001). The first focuses on the total amount of true score variance relative to the total scale score variance. The second focuses on the degree to which the scale indicators reflect an underlying factor (Brunner & SÜβ, 2005). These coefficients must be ≥ .70. We also examined the convergent validity of the FOCI-Q via an AVE ≥ .50 (Fornell & Larcker, 1981). To evidence convergent validity, the CR for any given factor must be ≥ .70 and > AVE. To test its discriminant validity, the AVE of each factor must be > MSV, and the square root of its AVE must exceed the highest correlation of that factor with other constructs (Fornell & Larcker, 1981).

We also used the Heterotrait-Monotrait ratio of correlations (HTMT) to test discriminant validity. This is the average between the correlations of indicators across constructs measuring different phenomena and those of indicators within the same construct. An HTMT value of < .85 is a strict discriminant validity criterion (Henseler et al., 2015). A related tool for congeneric models is the HTMT2 (Romer et al., 2021), which we also estimated. To compute CR, MaxR(H), and indicators of convergent/discriminant validity, we used Gaskin et al.'s (2019) plugin for AMOS 26.0. We used the tool created by Henseler (2022) to compute HTMT2. We tested the FOCI-Q concurrent validity via correlations with the PC-PTSD-5, PHQ-4, and self-ratings of physical/mental health. To interpretate results, we used Evans' (1996) criteria: .00–.19 (very low), .20–.39 (low), .40–.59 (moderate), .60–.79 (strong), and .80–1.00 (very strong).

Finally, through multi-group CFA, we assessed MI using the lavaan package of R (R Core Team, 2022; Rosseel, 2012) to test whether the same construct was being measured across sex and age groups. We tested configural, metric, scalar, and strict invariance as suggested by some of the literature (e.g., Byrne, 2016; Muthén & Muthén, 1998-2012; Wang & Wang, 2012). We conducted hierarchical tests for invariance of measurement parameters. We capitalized on fit index differences for CFI, TLI, SRMR, and RMSEA reference points (i.e., ΔCFI and ΔTLI should not be ≤ -.01; ΔSRMR and ΔRMSEA should not be ≥ .015) as argued by Chen (2007), who found in a Monte Carlo study that these points were equally sensitive to all types of invariances in large samples. As the $\chi^2$ is highly influenced by the sample size, it was reported but not considered as a fit index for the invariance testing.

## RESULTS

### Exploratory Factor Analysis (EFA)

Bartlett's Test of Sphericity [$\chi^2(28, N = 527) = 3729.894$, $p \leq .001$] and Kaiser-Meyer-Olkin statistic (.886) supported the factorability of SA data. We identified two factors with eigenvalues ≥ 1 (5.283 and 1.286). The solution explained 82.12% of the variance. The factors (F) emerged in this order: (1) Obsessive-Agoraphobic Fears (items 5–8; 66.04% variance) and (2) Personal Contact Fears (items 1–4; 16.08% variance). We assigned items to factors based on their loadings. For items 1 through 4, loadings in F1 were .896, .972, 821, and .739, respectively. Loadings for items 4 through 8 in F2 were .762, .950, .924, and .764, respectively. Mean loadings (.857 for F1 and .850 for F2) and corrected item-factor correlation (CIFC; .826 for F1 and .832 for F2) were > .80 for both factors. Specifically, CIFC were .848, .863, .845, and .771 for items 5–8 in F1. These values were .789, .859, .854, and .800 for items 1–4 in F2. Corrected item-total correlations ranged from .708 (item 2) to .805 (item 5) with a mean of .748. Inter-factor correlation was .626. Only 1 out of 28 of the residuals in the reproduced correlation matrix had absolute values > .05 and none had absolute values > .10; thus, the solution was an excellent representation of the data. Coefficients $\alpha$ and $\omega$ for Total scores were .924 and .920, respectively. These values were also > .90 for F1 ($\alpha$ = .928; $\omega$ = .927) and F2 ($\alpha$ = .925; $\omega$ = .925).

### Assessment of the Normality Assumptions

Kolmogorov-Smirnov and Shapiro-Wilks Tests evidenced that no item had a normal distribution in either sample (p < .001). Tests for multivariate normality also showed normality violations in SB [Mardia mSkewness = 16.97, $\chi^2(120, N = 525) = 1495.30$, $p < .001$; Mardia mKurtosis = 133.45, $\chi^2(1, N = 525) = 2343.61$, $p < .001$; Doornik-Hansen test, $\chi^2(16, N = 525) = 492.15$, $p < .001$)] and SC [Mardia mSkewness = 12.01, $\chi^2(120, N = 696) = 1400.58$, $p < .001$; Mardia mKurtosis = 130.61, $\chi^2(1, N = 696) = 2785.35$, $p < .001$; Doornik-Hansen test, $\chi^2(16, N = 696) = 569.88$, $p < .001$)]. Given these results, we used the Satorra-Bentler adjustments for ML.

**Table 2**

*Regression Coefficients, CIFC, and Reliability and Validity Statistics in Confirmatory Samples.*

| Items from the Fear of Coronavirus-19 Infection Questionnaire (FOCI-Q) | Sample B ($N$ = 525) | | | Sample C ($N$ = 696) | | |
|---|---|---|---|---|---|---|
| *How afraid have you been of the following?* | *CIFC* | *B* | 95% $CI_{sb}$ | *CIFC* | $\beta$ | 95% $CI_{sb}$ |
| 1. That you or someone who lives in your home can get or be infected without knowing it | .709 | .861 | .813 – .909 | .671 | .795 | .747 – .844 |
| 2. That a close relative, not living at home, or a close friend, can get or be infected | .736 | .922 | .894 – .951 | .731 | .902 | .874 – .930 |
| 3. That someone you know who is not your friend or close relative but with whom you had/will have contact, can get or be infected | .729 | .900 | .863 – .936 | .738 | .896 | .863 – .929 |
| 4. That someone unknown with whom you had/could have contact, may be infected | .721 | .863 | .819 – .908 | .727 | .843 | .806 – .881 |
| 5. That your hands may have traces of the virus after washing them for 20 seconds repeatedly | .777 | .882 | .847 – .916 | .780 | .884 | .858 – .912 |
| 6. That unpackaged foods can be infected with the virus even after you have washed them thoroughly and repeatedly before consumption | .797 | .939 | .919 – .960 | .796 | .936 | .918 – .954 |
| 7. That it is unsafe to touch anything if you don't have at least two disposable gloves per hand | .738 | .858 | .828 – .887 | .752 | .855 | .826 – .885 |
| 8. That public places are unsafe because you may not have a way to escape/receive help if you feel in risk for infection or suffer a panic attack | .721 | .787 | .743 – .831 | .718 | .783 | .741 – .824 |

| CFA-Based Statistics for Scores | Sample B ($N$ = 525) | | Sample C ($N$ = 696) | |
|---|---|---|---|---|
| Average Variance Extracted- Factor 1 (95% *CI*) | .754 | .687 – .813 | .751 | .698 – .802 |
| Average Variance Extracted- Factor 2 (95% *CI*) | .787 | .705 – .861 | .740 | .670 – .802 |
| Cronbach's $\alpha$ for Factor 1 (95% *CI*) | .924 | .910 – .936 | .922 | .910 – .933 |
| Cronbach's $\alpha$ for Factor 2 (95% *CI*) | .935 | .917 – .949 | .917 | .901 – .931 |
| Composite Reliability for Factor 1 (95% *CI*) | .924 | .897 – .945 | .923 | .902 – .942 |
| Composite Reliability for Factor 2 (95% *CI*) | .936 | .905 – .961 | .919 | .890 – .942 |
| Maximal Reliability for Factor 1 / Factor2 | | 939 / .940 | | .937 / .927 |
| Maximum Shared Variance / LFC | | .372 / .610 | | .414 / .643 |
| HTMT/HTMT2 | | .625 / .625 | | .664 / .665 |
| Cronbach's $\alpha$ for Total Scale (95% *CI*) | .920 | .907 – .931 | .921 | .910 – .930 |
| McDonald's $\omega$ for Total Scale (95% *CI*) | .915 | .899 – .928 | .917 | .905 – .928 |

*Note*. Coefficients are significant at $p \leq .001$. CIFC = Corrected item-factor correlation; $\beta$ = Item standardized coefficient on its own factor; HTMT = Heterotrait-Monotrait ratio of correlations; *CI* = confidence intervals; *sb* = Satorra-Bentler correction; LFC = Latent factors correlation.

### Confirmatory Factor Analysis (CFA)

The fit for M1 (single-factor) was poor in SB [$\chi^2_{sb}$ (20) = 827.802, $p \leq .001$; $RMSEA_{sb}$ = .277 (.264 – .291), SRMR = .152, $CFI_{sb}$ = .721, $TLI_{sb}$ = .609, $\chi^2_{sb}$ / *df* = 41.390] and SC [$\chi^2_{sb}$ (20) = 835.387, $p \leq .001$; $RMSEA_{sb}$ = .242 (.231 – .253), SRMR = .123, $CFI_{sb}$ = .796, $TLI_{sb}$ = .715, $\chi^2_{sb}$ / *df* = 41.769]. So, in the next step (M2), we estimated a two-correlated factors model. M2 provided better adjustment to data than M1, as evidenced by adequate to excellent fit indexes in SB [$\chi^2_{sb}$ (19) = 89.609, $p \leq .001$; $RMSEA_{sb}$ = .084 (.070 – .099); SRMR = .030; $CFI_{sb}$ = .976, $TLI_{sb}$ = .964, $\chi^2_{sb}$ / *df* = 4.716] and SC [$\chi^2_{sb}$ (19) = 74.789, $p \leq .001$; $RMSEA_{sb}$ = .065 (0.53 – .078); SRMR = .029; $CFI_{sb}$ = .986, $TLI_{sb}$ = .979, $\chi^2_{sb}$ / *df* = 3.936]. Comparing M1 and M2 yielded significant ($p \leq .001$) results in SB ($\Delta\chi^2_{sb}$ = 1170.319) and SC ($\Delta\chi^2_{sb}$ = 1543.386). Cohen's w for this comparison was 1.493 in SB and 1.489 in SC, both considered large. Given its adequacy and parsimony, we proceeded for further examination of M2 in subsequent analysis.

### Validity and Reliability of the FOCI-Q

Supporting its convergent validity, the AVE in SA and SB was > .50 and > MSV for both factors (Table 2). Factor inter-correlations (p ≤ .001) were .61 (SB) and .64 (SC). In both cases, the square root of the AVE (.868 to .887 for SA and .867 to .860 for SB) exceeded those inter-correlations, supporting the discriminant validity of the factors. For SB, HTMT and HTMT2 values were .625. These values were .664 and .665 for SC. Lower and upper bounds (95% CI) for HTMT values were .575 – .666 for SB and .622 – .698 for SC.

Regarding the FOCI-Q reliability, the range of $\alpha$ and CR values were quite high (all > .90) for the factors in SA and SB. Supporting their convergent validity, all CRs were also > AVE values for each factor. In Figure 1, we presented the latent structure of the FOCI-Q, factor loadings and squared multiple correlations of its items in SC.

Except for Factor 2 in SB, we found mostly moderate correlations of FOCI-Q Total and latent factor scores with the PC-PTSD-5 (Table 3). Total and F1 scores correlated mostly ≥ .40 with the PHQ-4 Anxiety subscale. Except in SB, a similar pattern emerged in correlations of FOCI-Q F1 and Total scores with PHQ-4 Total scores. Associations of these FOCI-Q scores with DEP were smaller. In general, F2 correlated about .40 with PTSD symptoms, < .40 with ANX and DEP, and somewhat higher with ANX than with DEP. Finally, FOCI-Q scores related inversely with self-ratings of physical and mental health.

We also showed discrimination indexes (CIFCs) of each item in SB and SC in Table 2. Their size ranged from .67 – .80 across samples, with most coefficients (15 out of 16) being > .70. Factor loadings ranged from .78 – .94 across samples. We estimated standard errors for loadings using the Satorra-Bentler adjustment in STATA. No standardized coefficient showed a CI lower limit value < .70. In contrast, 13 out of 16 had CI lower limits ≥ .80.

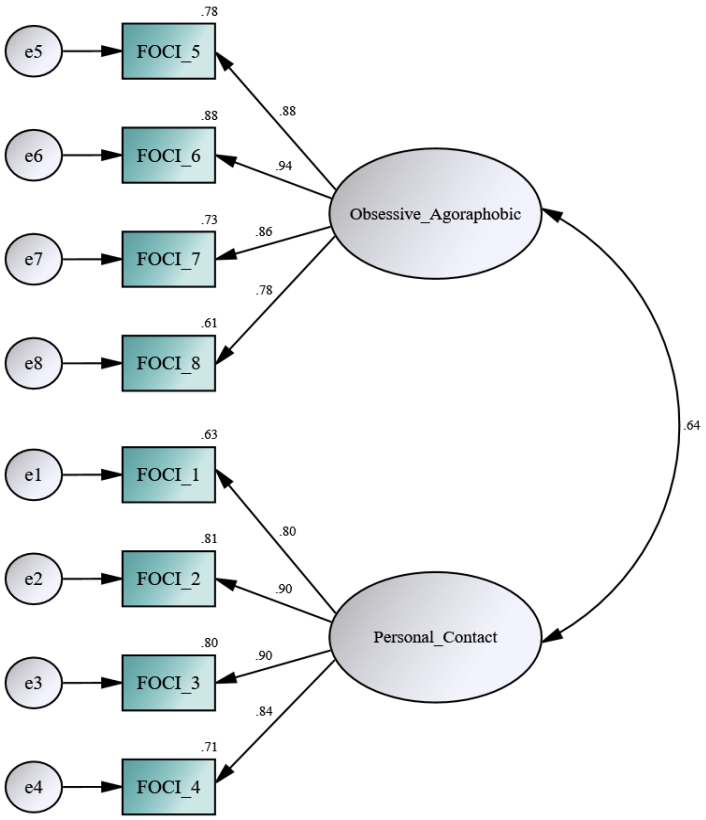


Figure 1. *Two-Correlated-Factors Model for the Fear of Coronavirus-19 Infection Questionnaire*

### Measurement Invariance (MI)

We tested MI across various groups, specifically sex (male/female) and age (21-39/40-59/≥60 years old). The M2 of the FOCI-Q was integrated into the configural invariance model, with the same pattern of fixed and free factor loadings, but no equality restrictions

on parameters across groups. The configural invariance model fitted the data well (Table 4). We used this model to compare against the more restrictive metric invariance model. The latter fitted the data well for all groups. Changes in CFIsb, TLIsb, SRMR, and RMSEAsb were within acceptable values for all group comparisons. These results indicated that the metric of factor scores was invariant across the groups compared. The scalar invariance model also fitted the data well (Table 4). This model, which constrained the factor loadings and item intercept, resulted in the demonstration of strong invariance. This indicates that both factor loadings and item intercept were invariant between groups compared; in other words, the set of items of the FOCI-Q had the same meaning for the compared groups. Finally, we inspected the strict invariance model, which constrained the factor loadings, item intercepts, and residual variances. The changes in the fit indexes were also below the thresholds for sex and age groups. This suggests that average item score comparisons are valid across groups.

**Table 3**

*Association of FOCI-Q Scores with Relevant Concurrent Validity Criteria*

| Criterion Variable | Sample A | | | Sample B | | | Sample C | | |
|---|---|---|---|---|---|---|---|---|---|
| | F1 | F2 | Total | F1 | F2 | Total | F1 | F2 | Total |
| PHQ-4 Anxiety[a] | .41*** | .36*** | .44*** | .40*** | .29*** | .39*** | .44*** | .32*** | .43*** |
| PHQ-4 Depression[a] | .32*** | .29*** | .34*** | .31*** | .18*** | .29*** | .36*** | .26*** | .35*** |
| PHQ-4 Total Score[a] | .40*** | .35*** | .42*** | .38*** | .25*** | .37*** | .43*** | .30*** | .41*** |
| PC-PTSD-5[b] | .53*** | .44*** | .54*** | .50*** | .39*** | .51*** | .50*** | .40*** | .50*** |
| Physical Health Self-Ratings[c] | -.21*** | -.16*** | -.21*** | -.17*** | -.10* | -.16*** | -.25*** | -.16*** | -.23*** |
| Mental Health Self-Ratings[d] | -.25*** | -.26*** | -.28*** | -.20*** | -.11* | -.18*** | -.27*** | -.21*** | -.27*** |
| Total Health Self-Ratings[e] | -.27*** | -.25*** | -.29*** | -.21*** | -.13** | -.20*** | -.30*** | -.22*** | -.29*** |

*Note.* FOCI-Q = Fear of Coronavirus-19 Infection Questionnaire; F1 = Obsessive/Agoraphobic Fears; F2 = Interpersonal Contact Fears; PHQ-4 = Patient Health Questionnaire 4-item version; PC-PTSD-5 = Primary Care PTSD Screen for DSM-5 (COVID-19 Adaptation). [a] $N$ = 526 for Sample A, 524 for Sample B, and 696 for Sample C; [b] $N$ = 526 for Sample A, 525 for Sample B, and 696 for Sample C; [c] $N$ = 519 for Sample A, 518 for Sample B, and 687 for Sample C; [d] $N$ = 519 for Sample A, 518 for Sample B, and 685 for Sample C; [e] $N$ = 519 for Sample A, 517 for Sample B, and 685 for Sample C. $^{*}p \leq .05$; $^{***}p \leq .001$

**Table 4**

*Measurement Invariance of the Fear of Coronavirus-19 Questionnaire by Gender and Age ($N$ = 696)*

| Model | $\chi^2_{sb}$ | $df$ | $\chi^2_{sb}/df$ | $SRMR_{sb}$ | $RMSEA_{sb}$ (90% CI) | $CFI_{sb}$ | $TLI_{sb}$ | Ref. Model | $\Delta\chi^2_{sb}$ | $\Delta\chi^2_{sb}/\Delta df$ | $\Delta SRMR_{sb}$ | $\Delta RMSEA_{sb}$ | $\Delta CFI_{sb}$ | $\Delta TLI_{sb}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Multigroup analysis by sex* | | | | | | | | | | | | | | |
| 1. Configural | 93.870*** | 38 | 2.470 | .028 | .065 (.052 - .078) | .986 | .980 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 2. Metric | 106.323*** | 44 | 2.416 | .034 | .064 (.051 - .077) | .985 | .980 | 1 | 10.923 | 1.821 | +.006 | -.001 | -.001 | .000 |
| 3. Scalar | 119.531*** | 50 | 2.391 | .036 | .063 (.051 - .076) | .983 | .981 | 2 | 12.580 | 2.100 | +.002 | -.001 | -.002 | +.001 |
| 4. Residual | 139.634*** | 58 | 2.407 | .037 | .064 (.053 - .074) | .980 | .980 | 3 | 19.676 | 2.460 | +.001 | +.001 | -.003 | -.001 |
| *Multigroup analysis by age (21-39/40-59/≥60)* | | | | | | | | | | | | | | |
| 1. Configural | 149.353*** | 57 | 2.620 | .035 | .084 (.071 - .097) | .978 | .967 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 2. Metric | 171.862*** | 69 | 2.491 | .044 | .080 (.068 - .093) | .975 | .970 | 1 | 17.586 | 1.466 | +.009 | -.004 | -.003 | +.003 |
| 3. Scalar | 190.309*** | 81 | 2.349 | .045 | .076 (.064 - .088) | .974 | .973 | 2 | 13.416 | 1.118 | +.001 | -.004 | -.001 | +.003 |
| 4. Residual | 200.301*** | 97 | 2.065 | .043 | .068 (.057 - .078) | .975 | .979 | 3 | 21.634 | 1.352 | -.002 | -.008 | +.001 | +.006 |

*Note.* Cohen's $w$ (effect size) for $\Delta\chi^2_{sb}$ were 0.051 (Model 2 vs. 1), 0.055 (Model 3 vs. 2), and 0.059 (Model 4 vs. 3), respectively, for analysis by sex. These values were 0.046 (Model 2 vs. 1), 0.040 (Model 3 vs 2), and 0.044 (Model 4 vs .3), respectively, for analysis by age. All of them are considered of trivial or negligible size. $\Delta\chi^2_{sb}$ = Satorra-Bentler Scaled Chi Squared Difference Test; Ref. = Reference; $\Delta df$ = Change in degrees of freedom from one model to another; Δ = Change; *RMSEA* = Root Mean Square Error of Approximation; *SRMR* = Standardized Root Mean Square Residual; *CFI* = Comparative Fit Index; *TLI* = Tucker–Lewis Index.
$^{***}p < .001$.

## DISCUSSION

We examined the factor structure, psychometric properties and MI of the FOCI-Q among adults living in PR. In an EFA, two factors explained 82% of the variance of FOCI-Q scores and reproduced the correlation matrix of the observed data with excellent accuracy. Our CFA findings supported the suitability of a two-related factors model over a single-factor solution. Reliability for the scale scores reflected outstanding magnitudes across samples. We also evidenced the concurrent validity of the FOCI-Q via correlations with constructs expected to be associated with CRF across the three samples. In addition, we rigorously tested the scale convergent and discriminant validity in two confirmatory samples, with results that exceeded the standards of relevant CFA-based statistics. Finally, we documented the MI of the instrument using state-of-the-art methods. By doing so, this study contributes to the research literature on the assessment of COVID-related distress (particularly fear) among Hispanics.

The size, variety, and consistency of our reliability coefficients compare favorably with previous studies. For other scales, such as the FCV-19S, the PCTQ, the FIVE, the CSS, and the C19P-S, reliability values ≥ .80 for its Total scores and ≥ .70 for subscales (if applicable) have been reported with few exceptions (Cassiani-Miranda et al., 2022; Hernández et al., 2021; Mercado-Lara et al., 2022). However, only the reliability of the Spanish C19P-S was evidenced by reporting $\alpha$, $\omega$, and CR coefficients (Torales et al., 2022). In our study, we also reported the MaxR(H). For other scales, two coefficients at most have been reported for the same sample (e.g., Ahorsu et al., 2020; Arpaci et al., 2020; Martinez-Taboas et al., 2021; Tounsi et al., 2021).

We documented the positive associations of FOCI-Q scores with symptoms of mental health problems. As reported in at least three studies (Cottin et al., 2021; Huarcaya-Victoria et al., 2020; Villalobos & Hernández-Rodríguez, 2021), we found that the highest association of our scale was with PTSD symptoms. We also found that correlations of FOCI-Q scores were higher with ANX than with DEP, which confirmed our hypothesis, findings from a systematic review (Muller et al., 2021), a meta-analysis (Şimşir et al., 2022), and results of many individual studies (e.g., Ahorsu et al., 2020; Martinez-Taboas et al., 2021; Villalobos & Hernández-Rodríguez, 2021). In addition, our finding of negative associations of CRF with self-ratings of physical and mental health is consistent with reports by Mertens et al. (2020) and Hernández et al. (2021). Considering this relationship, it is possible that assessing CRF levels could help professionals in designing plans to prevent or ameliorate any exacerbation of current physical or mental illnesses. This may be if particular importance for PTSD, ANX, and DEP symptoms.

Remarkably, the validity of most CRF scales was documented via correlations with other scales, but not with CFA-based statistics aimed to support convergent and discriminant validity. Ahorsu et al. (2020) reported the AVE (.51) to support FCS-19S convergent validity, but it barely reached the minimum standard and was estimated based on EFA loadings (not CFA). In other cases in which the AVE was reported for some measures (or could be estimated from CFA loadings), results showed values < .50. This finding suggests that the scale (or some of its factors) accounted for < 50% of the score variance (e.g., Arpaci et al., 2022; Caycho-Rodriguez et al., 2022b; Cottin et al., 2021; Huarcaya-Victoria et al., 2020; Martínez-Lorca et al., 2020; Piqueras et al., 2021; Soto-Briseño et al., 2021). This result also occurred when Lin et al. (2021) combined samples from 11 countries in which the FCV-19S was used (AVE was .49).

Another validity type examined via CFA statistics is discriminant validity. This can be documented either by HTMT analysis or if the square root of the AVE exceeds inter-factor correlations for each factor or if AVE > MSV (Fornell & Larcker, 1981). Few studies reported this information (which is not applicable to single-factor models). Among those that reported it, discriminant validity issues arose in at least six cases, either for the report of high (≥ .85) inter-factor correlations without reporting the AVE or because an AVE < MSV was found (Arpaci et al., 2022; Caycho-Rodriguez et al., 2022a, 2022b; Cottin et al. 2021; Martinez-Taboas et al., 2021; Torales et al., 2022). Regarding the FOCI-Q, the AVE for both factors was way above .50, comparing favorably with studies about other scales whose AVE did support its convergent validity (e.g., Arpaci et al., 2020; Corral-Verdugo et

al., 2021; Sánchez-Teruel et al., 2022). Our study is the first to document the discriminant validity of a CRF measure not only by examining Fornell and Larcker's (1981) criteria but also by considering HTMT and HTMT2 criteria.

The present study provides insight into MI of the FOCI-Q across sex and age. After establishing configural invariance, exploration of the next two levels revealed metric or factor loading invariance and scalar invariance of the two-factors model across sex and age. Metric invariance is important to ensure that the measurement across multiple groups is considered to be on the same scale, or that the factors are measured in the same way in all groups (Meredith & Teresi, 2006; Wang & Wang, 2012; Vandenberg & Lance, 2000). Our findings about scalar invariance refer to the item intercept being invariant across multiple groups. This indicates that none of the groups tends to respond systematically higher or lower to the items of subscales than other groups (Meredith & Teresi, 2006; Wang & Wang, 2012; Vandenberg & Lance, 2000). The present study met both invariance requirements. These results confirm that the compared groups had an equivalent understanding of each item in the measure, which is an important prerequisite for making a meaningful comparison between groups on fear of coronavirus.

Researchers have argued that residual invariance is not required for substantive analyses in many disciplines (Wang & Wang, 2012). However, such invariance is crucial if the difference in items' reliability across groups is of concern. This is because the latter is considered invariance of item reliabilities across groups (Schmitt & Stults, 1985), given that the factor variances are invariant across groups (Vandenberg & Lance, 2000). The current finding on the FOCI-Q across sex and age also met the strict MI criterion and outperformed the psychometric standards in invariance testing. Only one study has evidenced the MI of the Spanish CSS by sex (Noe-Grijalva et al., 2022) and no study has examined its MI by age. On the other hand, mixed or partial findings have been reported for the MI of Spanish versions of the FCV-19S (Cassiani-Miranda et al., 2022; Caycho-Rodriguez et al., 2022a, 2022b; Huarcaya-Victoria et al., 2020; Piqueras et al., 2021; Sánchez-Teruel et al., 2021). Thus, we can argue that the level of evidence provided to support the MI of the FOCI-Q (within SC) has not been provided for any other CRF measure available in Spanish. The latter is also true about any other study conducted among adults in PR assessing any COVID-related distress measure and not only a CRF scale.

### Limitations, Strengths, and Recommendations for Future Research

Our study has several limitations. We did not recruit adults without access to the internet or electronic devices. It is unknown to what extent the observed psychometric properties would generalize to adults with these characteristics. Second, our measure focuses on a very specific (although important) form of CRF: fear of infection. Our results may not generalize to other forms of CRF. However, after using various CRF measures, Mertens et al. (2021) conducted a second-order CFA and a network analysis with all items and found that items targeting fear of contamination, health-related consequences, and danger formed the core component of CRF and recommended using questionnaires that capture this cluster. Third, since no Spanish-language CRF measure was publicly available when we planned our survey, this study relied on measures of symptoms of mental health problems as the main concurrent validity criteria. Further studies may examine the association of FOCI-Q scores with another validated Spanish version of CRF measure (e.g., the FCV-19S). Fourth, our study did not assess the temporal reliability of the scale or its ability to predict membership in clinical groups. Future research should include a test-retest evaluation and may explore if adults with a history of phobic, obsessive-compulsive, stress, or anxiety disorders report significantly higher FOCI-Q scores than those without such history. Finally, given the scope of this study, we could not include an examination of MI among other groups of adults. Further studies should examine this issue across groups defined by annual family income, educational level, residential zone, position on religious beliefs (e.g., no religious belief vs. any religious belief), and healthcare worker status, among other criteria.

In general, results obtained for the FOCI-Q overcame the limitations observed in Spanish versions of other CRF scales. Some of these limitations include: inconsistent convergent validity, as is the case for the FCV-19S (Caycho-Rodriguez et al., 2022b; Huarcaya-Victoria et al., 2020; Martínez-Lorca et al., 2020;

Piqueras et al., 2021; Soto-Briseño et al., 2021); discriminant validity issues, as in the CSS (Martinez-Taboas et al., 2021), the C19P-S (Torales et al., 2022) and the FCV-19S (Caycho-Rodriguez et al., 2022, 2022b); or lack of a CFA study and validity data for its standard 6-item version, as in the PCTQ (Corral-Verdugo et al., 2021). Some Spanish versions of CRF scales have an unclear latent structure such as the FCV-19S (Sawicki et al., 2022), the CSS (Martínez-Taboas et al., 2021; Noe-Grijalva et al., 2022; Pulido-Guerrero & Jimenez-Ruiz, 2020), and the FIVE (Cottin et al., 2021). In other cases, researchers have relied on erasing items (Martínez-Taboas et al., 2021) or using correlated errors excessively (Pulido-Guerrero & Jimenez-Ruiz, 2020) to reach adequate model fit for the scale, as has been the case with the Spanish CSS. Other CRF measures, such as the Fear of Coronavirus Questionnaire (FCQ; Mertens et al., 2020) do not even have a validated Spanish version, or a CFA-based validation study for its original version. In contrast, we tested our scale with EFA and CFA, documented its reliability and concurrent validity in three samples, and exhaustively examined its factorial, convergent, discriminant, and concurrent validity, as well as its MI by sex and age.

## CONCLUSION

In sum, our findings suggest that the FOCI-Q is a brief, valid, reliable, strictly-invariant (at least across sex and age groups), and promising measure of CRF, with a stable latent structure, and suitable for use in studies and clinical scenarios with Spanish-speaking adults, particularly from PR. As Hispanics have been disproportionally affected by the pandemic (Center for American Progress, 2021), valid and reliable Spanish-language measures may orientate health education efforts to improve their knowledge and attitudes toward COVID-19, potentiate their access to care, prevent illnesses, and contribute in reducing health disparities in this group. Currently, the FOCI-Q is the option with the most robust psychometric properties among the Spanish-language scales validated for the assessment of CRF within this population.

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**Conflict of Interest:** The authors have no financial or non-financial interest to declare.

**Approval of the Institutional Board for the Protection of Human Subjects in Research:** The Ethics Committee (IRB) of the University of Puerto Rico, Río Piedras Campus approved this study (approval #1920-194).

**Informed Consent:** All participants completed an informed consent form.

**Review Process:** This study has been reviewed by external peers in double-blind mode.

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