Research Paper

# Psychometric properties of the COVID-19 related Perceived Stress Scale online version in the Spanish population

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## ARTICLE INFO

## ABSTRACT

Objective: In Spain, there is no detailed information on the psychometric characteristics of the COVID-19 related Perceived Stress Scale (PSS-10-C). This study aimed to examine the psychometric properties of the PSS-10-C in the general Spanish population.

Methods: The sample was selected using a non-probabilistic incidental sampling method. A psychometric study was performed with 290 participants (18–65 years). We used the PSS-10-C and an ad-hoc sociodemographic questionnaire. These instruments were administered in an online format. The data was collected between March and April 2021. Internal consistency, exploratory and confirmatory factor analysis, and K-means cluster analysis were carried out.

Results: The PSS-10-C presented good internal consistency ($\alpha = 0.87$) and a unidimensional structure of 10 items (which explained 46.1 % of the variance). We identified a cut-off point $\geq 26$ as a reference for high-perceived stress and, consequently, identified that 5.9 % of the participants had high levels of COVID-19 related-stress.

Conclusions: The PSS-10-C may be a helpful tool for assessing the general Spanish population's perceived stress associated to COVID-19. This preliminary study may be of interest for Spanish health professionals since report the specific PSS-10-C psychometric characteristics in the local population. It would be necessary to deepen into the psychometric study of the scale (i.e., examining convergent and discriminant validity).

## 1. Introduction

The public health problem generated by the COVID-19 pandemic has a significant negative impact on psychological well-being and mental health globally (Rojnic et al., 2021; Xiong et al., 2020). During this health crisis, isolation and social restriction measures, the perception of lack of control and the feeling of threat and uncontrollability of the disease has been related to the development of stress processes in the general population (Brooks et al., 2020; Torales et al., 2020; Xiong et al., 2020).

Conceptually, perceived stress is defined as thoughts or feelings that a person has about the stress level they are in a specific period (Gellman and Turner, 2013). During the COVID-19 pandemic, different researches were accomplished in Spain to examine the population's perceived stress. In these researches applied to the Spanish population, the instruments usually used to examine perceived stress assess this construct as the degree to which life situations (non-related with the pandemic) are valued as stressful (using the Perceived Stress Scale - PSS, in its versions of 10 and 14 items) or as a general state of activation or difficulty to relax that the person manifests (through the application of the Anxiety, Depression and Stress Scale - DASS-21) (Gamonal-Limcaoco et al., 2022; Gutiérrez-Hernández et al., 2021; Rodríguez et al., 2020; Rodríguez-Rey et al., 2020).

These studies found frequencies of high perceived stress that ranged between 6.7 % and 9 % (Gutiérrez-Hernández et al., 2021; Rodríguez-Rey et al., 2020; Sánchez-Sánchez et al., 2021) and different factors frequently associated to a high level of perceived stress, such as being a woman, being younger or suffering from a chronic or mental pathology (Gamonal-Limcaoco et al., 2022; Gutiérrez-Hernández et al., 2021; Lacomba-Trejo et al., 2022; Monistrol-Mula et al., 2022; Rodríguez et al., 2020; Rodríguez-Rey et al., 2020). Furthermore, in other studies has been found that fear of COVID-19 infection in the general Spanish

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population is perceived differently by men and women and affects some specific ages more than others (Sánchez-Teruel et al., 2021, 2022).

Few studies in the general Spanish population have specifically analysed perceived stress towards the COVID-19 pandemic by means of psychometric instruments designed to measure this aspect. Specifically, the studies performed that include the measures pointed above were focused on particular subgroups, such as a sample of pregnant women (García-Silva et al., 2021) and a group of Health Sciences university students (Marcén-Román et al., 2021; Rodríguez-Roca et al., 2021), using the Pregnancy Stress Scale related to the Pandemic and the Perceived Stress Scale related to the COVID-19 pandemic (PSS-10-C), respectively.

The PSS-10-C is the most widely used instrument to assess perceived stress regarding COVID-19 in Spanish-speaking countries (Campo-Arias et al., 2020; Hernández-García et al., 2021; Marcén-Román et al., 2021; Miranda et al., 2022; Pedrozo-Pupo et al., 2020; Sucapuca et al., 2022). The PSS-10-C is a modified version of the PSS-10 aimed to assess coronavirus related stress and developed during the pandemic (Campo-Arias et al., 2020; Pedrozo-Pupo et al., 2020). Since its first use in Colombia (Campo-Arias et al., 2020; Pedrozo-Pupo et al., 2020), this instrument has been used in other countries such as Cuba (Hernández-García et al., 2021), Argentina (Miranda et al., 2022), Peru (Sucapuca et al., 2022) and Spain (Marcén-Román et al., 2021). However, in Spain, there is no detailed information on the instrument's psychometric characteristics and possible cut-off points for the general population since only have been examined Cronbach's alpha value in a sample of university students (Marcén-Román et al., 2021).

The main contribution of this study will be to provide information about PSS-10-C reliability and validity and possible cut-off points for determining the high COVID-19 related-stress in the Spanish population. Considering the aspects mentioned above, this manuscript aims to establish the internal consistency, construct validity and a cut-off point for the original version of the PSS-10-C scale in a general Spanish population sample.

## 2. Methods

### 2.1. Participants

We used a psychometric cross-sectional study, and the sample was selected using a non-probabilistic incidental sampling method (snowball sampling). The inclusion criteria were (1) being over 18 years and (2) being a resident of Spain. Presenting incomplete data in any survey item or not being fluent in Spanish were considered exclusion criteria. A priori power analysis (using G*Power, Faul et al., 2007) estimated a required sample of 210 participants for an effect size $d = 0.50$, $\alpha = 0.05$, and 95 % power (1-$\beta$). Of the total people who agreed to participate ($n = 300$), 10 cases were excluded due to the absence of any data in the examined variables. The final sample ($n = 290$) also met the recommendation of 20 subjects per item, a criterion used to determine the minimum number of participants in psychometric and validation studies (Anthoine et al., 2014).

### 2.2. Instruments

We used the Perceived Stress Scale related to the COVID-19 pandemic (PSS-10-C) developed by Campo-Arias et al. (2020). The PSS-10-C had ten items with five different response options (never, hardly ever, occasionally, often and always). The score range of the instrument varied from 0 to 40 points. The higher the score, the greater the perceived stress related to the COVID-19 pandemic. The scale showed an adequate internal consistency with Cronbach's alpha values ranging between 0.75 and 0.86 in the Spanish-speaking countries where it was used (Campo-Arias et al., 2020; Hernández-García et al., 2021; Marcén-Román et al., 2021; Miranda et al., 2022; Pedrozo-Pupo et al., 2020; Sucapuca et al., 2022). The authors of the PSS-10-C scale

considered scores $\geq 25$ as those that determined a high level of stress related to COVID-19 in the Colombian population (Campo-Arias et al., 2020; Pedrozo-Pupo et al., 2020).

Moreover, an *ad hoc* survey was used to examine sociodemographic (age, gender and level of education), clinical (presence of chronic disease and prior COVID-19 infection) and contextual-occupational factors (work situation and existence of close relatives infected with COVID-19 in their environment).

### 2.3. Procedure

The data was collected during March and April 2021. An online questionnaire was developed using the Google Forms tool, consisting of the PSS-10-C instrument and the *ad hoc* survey. The Ethics and Research Commission of the Faculty of Health Sciences of the Universidad Internacional de La Rioja approved the study project (approval number ERC-2021/808). This online survey was administered using different distribution methods (i.e., social networks, email, etc.) to reduce sampling bias. A web platform readily usable by the participants and adaptable to any electronic device was used to minimize the measurement bias. Before starting the online survey, the participants had to read the information about the research and explicitly give their informed consent if they agreed to participate. Electronic consent was necessary in order to access the survey.

### 2.4. Data analysis

To study the reliability, we used the Cronbach's $\alpha$ coefficient and the item-total association of the scale. A value of $\alpha$ greater than 0.7 was regarded as acceptable internal consistency (DeVellis, 2003; Nunnally and Bernstein, 1994). An evaluation of the variability of each item was performed using asymmetry and kurtosis indices (considering acceptable values in the range of -1−+1). The construct validity was examined by exploratory factor analysis (EFA) using the Kaiser principle and the principal component method with varimax rotation (the Bartlett test and the Kaiser-Meyer-Olkin index were previously calculated).

Subsequently, a confirmatory factor analysis (CFA) was performed to determine the model's goodness-of-fit using the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), the comparative fit index (CFI) and the Tucker-Lewis index (TLI). A RMSEA lower than 0.08, a SRMR lower than 0.08, and CFI and TLI greater than 0.95 were considered adequate model fit criteria (Hu and Bentler, 1999; Kline, 2023). Previously, the multivariate normality was calculated using the Mardia test (Mardia = 419.13; $p < 0.001$). Since there was no multivariate normality in the PSS-10-C items, we used the diagonally weighted least squares (DWLS) as an estimation method in CFA. We examined the measurement invariance for gender with a CFA multigroup analysis.

Lastly, a K-means cluster analysis was performed (using the total score of the PSS-10-C as the dependent variable) to determine a cut-off point proposal of high perceived stress related to COVID-19 in the study target population. Statistical analyses were performed using SPSS 25.0, JAMOVI 2.3 and JASP 0.18.1 programs.

## 3. Results

### 3.1. Sociodemographic and clinical characteristics of the sample

The final sample comprised 290 participants aged 18 to 65 (mean = $40.11 \pm 14.15$ years). The sociodemographic, clinical, and contextual-occupational data of participants are presented in Table 1.

### 3.2. Internal consistency of the PSS-10-C

The psychometric analysis of the instrument showed good reliability at a general level ($\alpha = 0.87$). This good internal consistency is observed

**Table 1**
Sociodemographic, clinical, and occupational-contextual characteristics of the sample of participants ($n = 290$).

| Variables | n (%) |
|---|---|
| Age group | |
| 18–35 years | 145 (50 %) |
| 36–65 years | 145 (50 %) |
| Gender | |
| Woman | 203 (70 %) |
| Men | 87 (30 %) |
| Educational level | |
| Without compulsory education | 8 (2.8 %) |
| Secondary education | 11 (3.8 %) |
| High School | 23 (7.9 %) |
| Vocational Training | 22 (7.6 %) |
| University studies | 226 (77.9 %) |
| Suffer from any pathology or chronic disease | |
| Yes | 32 (11 %) |
| No | 258 (89 %) |
| Affected by COVID-19 | |
| Yes | 41 (14.1 %) |
| No | 249 (85.9 %) |
| Work situation | |
| Active | 238 (82.1 %) |
| Inactive | 52 (17.9 %) |
| Presence of people infected with COVID-19 close to you | |
| Yes | 242 (83.4 %) |
| No | 48 (16.6 %) |



**Fig. 1.** Sedimentation figure which represents the values of the factor analysis for the Perceived Stress Scale related to the COVID-19 pandemic (PSS-10-C).

the mean scores obtained by the participants classified in each group. Cluster 2 comprised 47 people with the highest scores on the PSS-10-C scale, so its center was used as the cut-off point proposal ($\geq 26$) of high perceived stress related to the COVID-19 pandemic in the study population (see Table 3). Therefore, we identified that 5.9 % ($n = 17$) of the total participants presented a high level of stress due to COVID-19.

## 4. Discussion

To the best of our knowledge, this is the first study to investigate the internal consistency, construct validity and factorial invariance for gender of the PSS-10-C in the general Spanish population and to identify a cut-off point to determine a high level of perceived stress against COVID-19 in this population.

This study showed that the original version of the PSS-10-C has good internal consistency and is valid for its administration in the general Spanish population. The results obtained show that the unifactorial solution of the scale has high reliability, which is similar to the one found in the initial studies that developed the instrument (Campo-Arias et al., 2020; Pedrozo-Pupo et al., 2020) and higher than the one reported in different international researches (Hernández-García et al., 2021; Miranda et al., 2022; Sucapuca et al., 2022; Tikka et al., 2022), as well as in the study by Marcén-Roman et al. (2021) in a Spanish sample of university students.

Based on the cluster analysis, a score $\geq 26$ is proposed to classify a person with high stress related to the COVID-19 pandemic in the general Spanish population. This finding indicates the need to review the psychometric performance of assessment instruments due to the variations

in the correlations of each item with the total scale score (greater than 0.40 in all cases, with the minimum acceptable score being $\geq 0.30$; Brzoska and Razum, 2010) and in that the value of $\alpha$ does not increase even if some item was deleted (see Table 2).

### 3.3. Construct validity of the PSS-10-C

The Kaiser-Meyer-Olkin (KMO = 0.903) and Bartlett ($\chi^2 = 1020$; df $= 45$; $p < 0.001$) test indicated the adequacy of the data matrix for factor analysis. The EFA showed the presence of a single factor (made up of the 10 items of the scale) with a value greater than 1 (eigenvalue $= 4.61$; see Fig. 1) that explained 46.1 % of the variance.

All the items presented saturations greater than 0.4 in a single factor in EFA and CFA (see Table 2). The goodness-of-fit indices of the CFA showed an adequate fit of the model to the unidimensional internal structure ($\chi^2 = 62.67$; df $= 35$; $p = 0.003$; RMSEA $= 0.05$; SRMR $= 0.04$; CFI $= 0.99$; TLI $= 0.99$). The measurement invariance tests performed for gender (RMSEA $< 0.01$; SRMR $= 0.05$; CFI $= 1$; TLI $= 1$) revealed a factorial invariance with adequate fit across females and males.

### 3.4. Cut-off points of the PSS-10-C in the Spanish population sample

Table 3 shows the clusters that were obtained after the K-means analysis. We identified three homogeneous groups that differed significantly from each other (Table 3). The centres of the final clusters show

**Table 2**
Descriptive statistics, reliability analysis and factor load of the PSS-10-C items in the Spanish general population sample examined ($n = 290$).

| PSS-10-C | Mean (SD) | Skewness | Kurtosis | r item-total | α-item | Factor 1 EFA | Factor 1 CFA |
|---|---|---|---|---|---|---|---|
| Item 1 | 1.08 (0.96) | 0.54 | -0.26 | 0.61 | 0.85 | 0.71 | 0.71 |
| Item 2 | 1.17 (0.98) | 0.50 | -0.29 | 0.67 | 0.84 | 0.76 | 0.80 |
| Item 3 | 1.67 (0.94) | 0.05 | -0.05 | 0.71 | 0.84 | 0.80 | 0.83 |
| Item 4 | 1.10 (0.84) | 0.60 | 0.14 | 0.60 | 0.85 | 0.69 | 0.70 |
| Item 5 | 2.13 (0.86) | 0.08 | -0.42 | 0.41 | 0.86 | 0.48 | 0.44 |
| Item 6 | 1.11 (1.01) | 0.85 | 0.23 | 0.49 | 0.86 | 0.59 | 0.59 |
| Item 7 | 1.48 (0.95) | 0.59 | -0.16 | 0.52 | 0.85 | 0.61 | 0.62 |
| Item 8 | 2.04 (1.08) | 0.44 | -0.83 | 0.59 | 0.85 | 0.68 | 0.69 |
| Item 9 | 2.06 (1.00) | -0.01 | -0.20 | 0.51 | 0.85 | 0.60 | 0.57 |
| Item 10 | 1.27 (0.92) | 0.56 | 0.32 | 0.67 | 0.84 | 0.76 | 0.78 |
| Total | 15.10 (6.46) | 0.42 | -0.06 | | | | |

*Note.* Factor 1: Factor load of each item; r item-total: correlation item-total of the scale; α-item: Cronbach's α of the instrument if the item is eliminated.
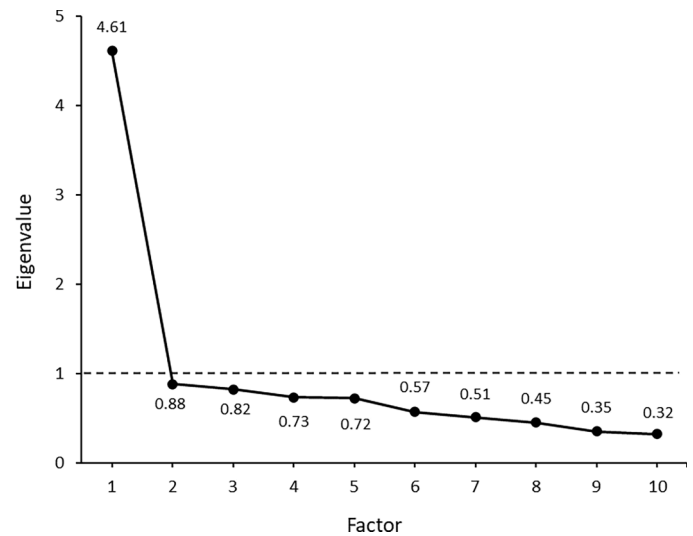
**Table 3**

Cluster analysis of K-means based on the total score on the PSS-10-C scale in the Spanish population sample ($n = 290$).

| | Centres of the finals clusters | | | Individuals in each cluster | | | MS (df) | ANOVA | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 | | F | p |
| PSS-10-C | 9 | 26 | 17 | 115 | 47 | 128 | 4994.41 (2) | 681.50 | <0.001* |

*Note.* PSS-10-C: total score; df: degrees of freedom; MS: mean square.

\* : statistically significant difference.

that may occur between different populations. Specifically, this study shows the need to consider specific cut-off points for the PSS-10-C in different countries since, in the studies where this aspect was addressed, different cut-off values were found (such as scores ≥ 25 in the Colombian population or ≥ 20 in a sample of Cuban participants) in samples of different nationalities (Campo-Arias et al., 2020; Hernández-García et al., 2021). These findings complement the existing studies on Spanish university students that, although having used the PSS-10-C, did not address in deep the psychometric analysis of this instrument (Marcén-Román et al., 2021; Rodríguez-Roca et al., 2021).

Considering the proposed cut-off point, we identified that 5.9 % of participants perceived a high stress level related to the COVID-19 pandemic in the evaluation performed. This frequency of high perceived stress related to coronavirus was lower than the frequencies of high stress levels reported by previous studies accomplished in the general Spanish population at the beginning of the pandemic, with percentages of 9 %, 7.74 %, and 6.7 % (Gutiérrez-Hernández et al., 2021; Rodríguez-Rey et al., 2020; Sánchez-Sánchez et al., 2021). This percentage was also lower than that reported by Spanish university students ten months after the pandemic's start, where 13.1 % of the participants showed high-perceived stress against COVID-19 (Marcén-Román et al., 2021).

The discrepancy observed in these frequencies could be explained, on the one hand, by the use of different evaluation instruments to assess stress in this research and in previous studies performed at the beginning of the health crisis (Gutiérrez-Hernández et al., 2021; Rodríguez-Rey et al., 2020; Sánchez-Sánchez et al., 2021). On the other hand, it may also be explained due to the different cut-off points used for the PSS-10-C in this study and in the one previously used in Spanish students (that considered the score of ≥ 25 proposed for the Colombian population) (Marcén-Román et al., 2021). This difference could also be due to a better socio-sanitary context existing one year after the pandemic start, with the general availability of vaccines against COVID-19, the progress of the vaccination campaign, and more precise knowledge about the disease. These aspects could be associated with a lower psychological impact (Koltai et al., 2022; Wang et al., 2020).

In this research it is necessary to consider different limitations. In the first place, it should be considered that this cross-sectional study does not allow providing long-term conclusions on COVID-19 related-stress. This design would only show the population's stress toward the pandemic at a specific moment. Secondly, although all the studies administered the PSS-10-C in an online format (Campo-Arias et al., 2020; Hernández-García et al., 2021; Marcén-Román et al., 2021; Miranda et al., 2022; Pedrozo-Pupo et al., 2020; Rodríguez-Roca et al., 2021; Sucapuca et al., 2022), at the methodological level this way of applying the scale and the non-probabilistic sampling used could determine a possible selection bias. Third, the factorial analysis results show that the one-dimensional solution explained a percentage of variance somewhat less than the 50 % recommended in the social sciences (Campo-Arias et al., 2012; Gorsuch, 1997; Tikka et al., 2022). In this case, since it is identified in an EFA, a factorial solution that explains at least 30 % of the total variance is admissible (Campo-Arias et al., 2012; Macía, 2010), something that is fulfilled for the identified structure of the PSS-10-C.

As future perspectives, it would be necessary to deepen into the psychometric study of the scale by performing studies that examined

aspects such as convergent and discriminant validity that we did not explored in the study. Lastly, it could be relevant that future studies in the general population examine the coronavirus related-stress (using the PSS-10-C) and different factors (e.g., age, gender, etc.) associated with stress and fear toward COVID-19 (Gamonal-Limcaoco et al., 2022; Gutiérrez-Hernández et al., 2021; Lacomba-Trejo et al., 2022; Monistrol-Mula et al., 2022; Rodríguez et al., 2020; Rodríguez-Rey et al., 2020 Sánchez-Teruel et al., 2021, 2022) several years after the pandemic, since have been underexplored in this period.

## 5. Conclusions

In conclusion, considering the need for additional psychometric studies, the use of the original version of the PSS-10-C in the general Spanish population could be recommended. In the scenario that arises after several years from the beginning of the pandemic, is of interest that health professionals know the characteristics of the specific instruments available to assess coronavirus-related stress in the local populations of different countries.

## Ethical considerations

This study was approved by The Ethics Commission of the Faculty of Health Sciences of the Universidad Internacional de La Rioja. Electronic informed consent was obtained from all participants.

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## CRediT authorship contribution statement

**Juan Antonio Becerra-García:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Irene Valdivieso:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sara Barbeito:** Writing – review & editing, Methodology, Writing – original draft, Investigation, Data curation, Formal analysis, Conceptualization. **Ana Calvo:** Writing – review & editing, Data curation, Writing – original draft, Funding acquisition, Formal analysis. **Teresa Sánchez-Gutiérrez:** Writing – review & editing, Supervision, Methodology, Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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