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RESEARCH ARTICLE

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Factor structure of the 10-item CES-D Scale among patients with persistent COVID-19

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Abstract

The presence of persistent coronavirus disease 2019 (COVID-19) might be associated with significant levels of psychological distress that would meet the threshold for clinical relevance. The Center for Epidemiologic Studies Depression Scale (CES-D) version 10 has been widely used in assessing psychological distress among general and clinical populations from different cultural backgrounds. To our knowledge, however, researchers have not yet validated these findings among patients with persistent COVID-19. A cross-sectional validation study was conducted with 100 patients from the EXER-COVID project (69.8% women; mean (±standard deviation) ages: 47.4 ± 9.5 years). Confirmatory factor analyses (CFAs) were performed on the 10-item CES-D to test four model fits: (a) unidimensional model, (b) two-factor correlated model, (c) three-factor correlated model, and (d) second-order factor model. The diagonal-weighted least-squares estimator was used, as it is commonly applied to latent variable models with ordered categorical variables. The reliability indices of the 10-item CES-D in patients with persistent COVID-19 were as follows: depressive affect factor (α_{Ord} = 0.82; ω_{u-cat} = 0.78), somatic retardation factor (α_{Ord} = 0.78; ω_{u-cat} = 0.56), and positive affect factor (α_{Ord} = 0.56; ω_{u-cat} = 0.55). The second-order model fit showed good Omega reliability (ω_{ho} = 0.87). Regarding CFAs, the unidimensional-factor model shows poor goodness of fit, especially residuals analysis (root mean square error of approximation [RMSEA] = 0.081 [95% confidence interval, CI = 0.040–0.119]; standardized root mean square residual [SRMR] = 0.101). The two-factor correlated model, three-factor correlated model, and second-order factor model showed adequate goodness of fit, and the χ^2 difference test (ΔX^2) did not show significant differences between the goodness of fit for these models (ΔX^2 = 4.1128; p = 0.127). Several indices showed a good fit with the three-factor correlated model: goodness-of-fit index = 0.974, comparative fit index = 0.990, relative noncentrality index = 0.990, and incremental fit index = 0.990, which were all above 0.95, the traditional cut-off establishing adequate fit. On the other hand,

RMSEA = 0.049 (95% CI = 0.000–0.095), where an RMSEA < 0.06–0.08 indicates an adequate fit. Item loadings on the factors were statistically significant ($\lambda_j \geq 0.449$; p's < 0.001), indicating that the items loaded correctly on the corresponding factors and the relationship between factors ($\phi \geq 0.382$; p's ≤ 0.001. To our knowledge, this is the first study to provide validity and reliability to 10-item CES-D in a persistent COVID-19 Spanish patient sample. The validation and reliability of this short screening tool allow us to increase the chance of obtaining complete data in a particular patient profile with increased fatigue and brain fog that limit patients' capacity to complete questionnaires.

KEYWORDS
COVID-19, depression, mental illness, statistical factor analyses

1 | INTRODUCTION

Depression is the most common mental disorder in the world.[1] It presents high chronicity and high comorbidity with other mental and physical disorders and is a leading cause of disability worldwide.[1] In this line, numerous scales were used to study depression during the coronavirus disease 2019 (COVID-19) pandemic in the general population (e.g., Self-rating Depression Scale (SDS),[2] Hospital Anxiety and Depression Scale,[3] Depression, Hamilton Anxiety Scale,[4] Anxiety and Stress Scale-21 items,[5,6] Patient Health Questionnaire-9,[7] Goldberg Depression and Anxiety 7-Item Scale,[8] Zung's SDS,[9] and the Center for Epidemiological Studies Depression Scale (CES-D) 20 items[8]). Additionally, the scientific community has been working eagerly to validate different psychological assessment tools specified for COVID-19-related distress. Among the recently developed instruments were: the fear of COVID-19 Scale,[10] the COVID-19 Phobia Scale (C19P-SE),[11] the COVID Stress Scales,[12] and CES-D.[13]

Among the various tools, CES-D 20 items appear to be an acceptable tool for assessing and screening individuals with depressive symptoms in the general population.[13] The CES-D 20 items were developed by Radloff.[14] It is a tool widely used in population research to assess four dimensions of mood and includes positive mood, physical symptoms, depressed mood, and interpersonal relationships. The CES-D 20 items have also been widely used as a measure of depression in both the general and clinical adult populations.[15] Its broad use may be due to its free availability[16,17] and multiple cross-cultural adaptations to several countries/languages, such as Spanish-speaking countries,[16,18] Greece,[19] Portugal,[20] and China,[21] among others.

The CES-D has a modified form of 10 items (CES-D 10), considerably reducing the time it takes to administer. It was originally validated in the healthy adult population in the United States,[22] and later in several populations, such as African youth,[15] human immunodeficiency virus-positive people,[23] adolescents[24] Canadians, and American individuals with multiple sclerosis,[25] among others. The majority of these studies suggest a two-factor structure, with depressed and positive affect,[15,23,24,26] although others have one-factor[25] and three-factor[27] structures.

The CES-D 10 Scale has been used during the COVID-19 pandemic to assess depression prevalence among the general population, with and without severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.[28,29] Disasters and public health crises have a negative impact on people's mental health. Feelings such as uncertainty, stress, hopelessness, and worry are common reactions to stressors arising during the COVID-19 pandemic prompted by massive lockdowns, economic crisis, hospitalizations, and death rates.[30–32] Thus, there has been an increase in mental health disorders (e.g., depression, anxiety) [33,34] and mental health awareness among health professionals and the general population. Depressive symptoms after COVID-19 infection are common in the period following discharge and even among people who are not hospitalized. Reviews by Mazza et al.[35] reported high rates of clinically significant depression, with rates that varied from 21% to 45%. Individuals who develop post-COVID-19 syndrome (long-lasting symptoms after SARS-CoV-2 infection that persist for more than 12 weeks.[36,37] Furthermore, it has been reported that after the 12-month follow-up period, while neurological, respiratory, and gastrointestinal symptoms significantly improved from discharge, psychiatric disorder symptoms (i.e., anxiety, depression) increased.[38]

High rates of neuropsychiatric symptoms (e.g., fatigue, depression) have been reported among individuals affected by COVID-19.[36–38] According to Mazza et al.,[35] some studies have reported depressive symptomatology after COVID-19 infection to be significantly associated with a range of negative outcomes, such as poor neurocognitive performance, persistent fatigue, pain and dyspnea, or even reduced quality of life. Taken together, depressive symptoms and clinically-significant depression in post-COVID-19 syndrome may have severe implications as it relates to the quality of life outcomes.[39]

Brief depressive screening scales, such as CES-D 10, may be an important tool in the COVID-19 infection context. Its administration becomes easier and faster, reducing interviewee fatigue (an important sequelae after infection, as well as brain fog,[40] increasing the

chance of completing the scale.[24] Therefore, CES-D 10 is suitable for primary care settings, where time is limited. Despite its relevance, this screening tool needs to be validated in individuals with post-COVID-19 syndrome to ensure its capacity for detecting depressive symptoms (especially among individuals who meet the clinical threshold). The availability of a free, brief, and validated tool, such as CES-D 10 for post-COVID-19 syndrome, may allow clinicians to improve depression detection and follow-up during illness. Thus, the main objective of this study was to determine CES-D 10 validity and reliability in a sample of individuals with persistent COVID-19 from Navarre, Spain replicating previously reported model fits.

2 | METHODS

2.1 | Participants and recruiting procedure

Data were collected within the EXER-COVID project, a randomized controlled trial intended to investigate the effects of an exercise program on the clinical status of patients with postdischarge symptoms after hospitalization for COVID-19 (ClinicalTrials.gov Identifier: NCT04797871).[41] One hundred and five participants fulfilled the following inclusion criteria: over 18 years of age, a SARS-CoV-2 diagnosis using real-time reverse transcriptase polymerase chain reaction (PCR) tests or a positive result for SARS-CoV-2 virus antigen >90 days before randomization, a chronic symptomatic phase lasting >90 days since the onset of symptoms, no hospitalizations, no clinical evidence of pneumonia or organ failure related to SARS-CoV-2, and capability and willingness to provide informed consent. Patients previously treated for persistent COVID-19 symptoms (i.e., physical therapy or rehabilitation), who were pregnant or breastfeeding, or who had cardiovascular or endocrine comorbidities (i.e., atrial fibrillation, acute myocarditis, acute heart attack or unstable angina, aortic stenosis, acute endocarditis/pericarditis, uncontrolled high blood pressure, acute thromboembolism, severe heart failure, respiratory failure, and uncontrolled acute decompensated diabetes mellitus or low blood sugar), or neurological or musculoskeletal comorbidities were excluded. For the present study, we focused on individuals who had completed the CES-D 10 Scale, yielding a final sample of 96 participants.

Data were collected (March 2021 to February 2022) from 105 patients older than 18 years from Navarra, Spain, who were invited to attend the Hospital Universitario de Navarra (HUN) and the Biomedical Research Center of Navarra (Navarrabiomed). All patients were screened for inclusion by a physician to ensure that they had been diagnosed with COVID-19 and had no psychiatric or somatic condition that could explain the persistent COVID-19 symptoms. For all identified participants, we revised psychiatric disorder patients with revised psychiatric diagnostic codes from their electronic health records using billing/encounter diagnoses, external claim diagnoses, and inpatient hospital problems before their testing encounter such as (1) schizophrenia spectrum disorders, (2) mood disorders, and (3) anxiety disorders. This study was conducted according to the Declaration of Helsinki and was approved by the Ethics Committee on Human Research (CEIH, Procotol No. PI_2020/140) of the HUN (Pamplona, Spain). All the patients were asked for their consent and were informed about Spain's data protection law. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guideline for cohort studies.

2.2 | Measure

2.2.1 | Depressive symptoms

Participants were evaluated via the brief Spanish version of the CES-D, a 10-item self-report in the past week. The CES-D 10 short form has shown high reliability and internal consistency,[17] as well as validity for the identification of depressive symptoms,[42] including those of individuals with Hispanic/Latino ethnicity.[16,43] The brief CES-D 10 Scale consists of three factors: depressed affect (blues, depressed, fear, lonely), somatic retardation (difficulty going to bed and falling asleep, lethargy, lack of focus), and positive affect (happy, hopeful). The time frame for assessing depressive symptoms was 7 days before the interview. The response format is 0 = not at all; 1 = sometimes; 2 = occasionally; and 3 = always. The CES-D 10 score was calculated by summing the scores across all 10 items after reverse-coding items for "felt happy (sintió feliz)" and "enjoyed life (disfrutó de la vida)". Possible scores ranged from 0 to 30, with higher scores reflecting more severe depressive symptoms.

2.3 | Data analysis

Mean (*M*), median (Mdn), standard deviation (SD), skewness (SK; values |>3.0| indicative of severely skewed distribution), and kurtosis (*K*; values |>10.0| indicative of significant deviation from a normal distribution) were calculated for each item.[44] The proportion of participants who reported "not at all," "sometimes," "occasionally," and "always" was obtained for each item.

Confirmatory factor analyses (CFAs) were performed on the 10-item CES-D to test four model fits: (a) unidimensional model,[24] (b) two-factor correlated model,[27] (c) three-factor correlated model,[27] and (d) second-order factor model.[27] The diagonal-weighted least-squares (DWLS) estimator was used, as it is commonly applied to latent variable models with ordered categorical variables.[45] CFA is a multivariate statistical modeling technique used for latent variable measurement specification based on structural equation modeling (SEM). A CFA model is built based on previous theory and analysis, which specifies the number of factor loadings fixed at zero to reflect a hypothesis that only certain factors influence certain items. The use of CFA measurement models in SEM has the advantage of formalizing the measurement hypotheses and developing measurement instruments that have a simple or complex measurement structure.[27] In other words, the goals of CFA are to test an a priori specified model based on the observed variance–covariance matrix

of empirical data (*S*) and to know if the model fits the data (or not) to the "model-implied" variance–covariance matrix ($\hat{\Sigma}$), where if $\hat{\Sigma}$ is close to *S*, the model fits well.

Diverse indices were analyzed in CFA analysis: (a) goodness-of-fit index (GFI); (b) adjusted goodness-of-fit index (AGFI); (c) comparative fit index (CFI); (d) Tucker–Lewis index (TLI); (e) root mean square error of approximation (RMSEA); (f) standardized root mean square residual (SRMR); (g) Bentler relative noncentrality index (RNI); (h) Bentler–Bonett nonnormalized fit index (NFI); and (i) normalized fit index (NFI). The χ^2 difference test (ΔX^2) was used to show significant differences between the goodness-of-fit models. Cronbach's and ordinal coefficient α and Omega ω_{u-cat} were used to assess internal consistency reliability.[46] Analyses were performed using R program 4.0.5. The *lavaan* package[47] and semTool *package*[48] were used to conduct CFA and reliability analyses, respectively.

3 | RESULTS

The majority of participants were female (69.8%), with a mean age of 47.4 years (SD = 9.5; Mdn = 48.9; range: 21–63), and the majority of participants had completed vocational training or university, 29% and 30%, respectively. Sixty-six percent were in a relationship or married, and 46.9% were full-time employees.

Descriptive analysis of individual items showed arithmetic means across participants ranging from 0.8 (Items 3 "Depressed" and 9 "Lonely") to 1.8 (Item 4 "Effort") with asymmetry (SK) of −0.30 (Item 4 "Effort") to 0.13 (Item 9 "Lonely"). Analysis of the proportions of each response category showed that the items with the highest proportion in the category "Not at all" were Item 9 "Lonely" (56.3%), in the category "Sometimes," Item 8 "Happy" (40.0%), in category "Occasionally," Item 5 "Hopeful" (40.6%), and in category "Always," Item 10 "Get Going" (32.3%). See more details in Table 1.

Regarding CFAs, the unidimensional-factor model shows poor goodness of fit, especially in residual analysis (RMSEA = 0.081 [95% confidence interval, CI = 0.040–0.119]; SRMR = 0.101). The two-factor correlated model, three-factor correlated model, and second-order factor model showed an adequate goodness of fit (Table 2), and the χ^2 difference test (ΔX^2) did not show significant differences between the goodness of fit for these models ($\Delta X^2 = 4.1128$; $p = 0.127$). The goodness-of-fit tests provided initial evidence that overall, the three-factor correlate and second-order factor model solutions have adequate goodness of fit.[49] Several indices showed a good fit with the three-factor correlated model: GFI = 0.974, CFI = 0.990, RNI = 0.990, and IFI = 0.990, which were all above 0.95, the traditional

TABLE 2 Comparative goodness model fits

Index	Model fit			
	Unidimensional-factor	Two-factor	Three-factor	Second-order
X^2	57.078	43.362	39.250	39.250
X^2/df	1.631	1.275	1.227	1.227
CFI	0.970	0.987	0.990	0.990
GFI	0.962	0.971	0.974	0.974
AGFI	0.919	0.937	0.939	0.939
NFI	0.926	0.944	0.949	0.949
NNFI	0.961	0.983	0.986	0.986
RNI	0.970	0.987	0.990	0.990
IFI	0.970	0.987	0.990	0.990
RMSEA	0.081	0.054	0.049	0.049
SRMR	0.101	0.092	0.088	0.088

Abbreviations: AGFI, adjusted goodness-of-fit index; CFI, comparative fit index; GFI, goodness-of-fit index; IFI, incremental fit index; NFI, normalized fit index; NNFI, Bentler–Bonett nonnormalized fit index; RMSEA, root mean square error of approximation; RNI, Bentler relative noncentrality index; SRMR, standardized root mean square residual; TLI, Tucker–Lewis index.

TABLE 1 Descriptive statistics of normality and proportion for each level of response by item

Item	Descriptive information					Proportion for each level of response			
	Mean	SD	Median	Skew	Kurtosis	Not at all	Sometimes	Occasionally	Always
1 "Bothered"	1.0	1.1	1.0	0.67	−0.92	0.46	0.24	0.18	0.13
2 "Trouble concentrating"	1.5	1.1	2.0	−0.02	−1.26	0.023	0.26	0.30	0.21
3 "Depressed"	0.8	0.9	0.5	1.00	−0.03	0.50	0.30	0.13	0.07
4 "Effort"	1.8	1.1	2.0	−0.30	−1.21	0.16	0.24	0.28	0.32
5 "Hopeful"	1.5	0.9	1.5	0.00	−0.92	0.16	0.34	0.34	0.16
6 "Fearful"	1.2	1.0	1.0	0.14	−1.22	0.32	0.25	0.34	0.08
7 "Restless sleep"	1.4	1.0	1.0	0.16	−1.09	0.22	0.34	0.27	0.17
8 "Happy"	1.4	0.8	1.0	−0.07	−0.56	0.13	0.40	0.41	0.07
9 "Lonely"	0.8	1.0	0.0	1.03	−0.28	0.56	0.21	0.14	0.09
10 "Get going"	1.0	1.1	0.0	0.57	−1.24	0.51	0.13	0.24	0.13

TABLE 3 Parameter estimates to CFA and reliability indexes of the CES-D 10 items

			Estimated parameter					Reliability		
Factor	OP	Item	λ_j	CI lower	CI upper	SE	*p* Value	α	α_{Ord}	ω_{u-cat}
Depressive affect (DA)	=~	1 "Bothered"	0.527	0.412	0.642	0.059	<0.001	0.77	0.82	0.78
	=~	2 "Trouble concentrating"	0.860	0.755	0.964	0.053	<0.001			
	=~	3 "Depressed"	0.807	0.702	0.913	0.054	<0.001			
	=~	4 "Effort"	0.811	0.704	0.918	0.055	<0.001			
Somatic retardation (SR)	=~	6 "Fearful"	0.449	0.317	0.582	0.068	<0.001	0.53	0.59	0.56
	=~	7 "Restless sleep"	0.662	0.516	0.808	0.075	<0.001			
	=~	9 "Lonely"	0.527	0.390	0.663	0.070	<0.001			
	=~	10 "Get going"	0.509	0.377	0.642	0.068	<0.001			
Positive affect (PA)	=~	5 "Hopeful"	0.574	0.424	0.725	0.077	<0.001	0.54	0.61	0.55
	=~	8 "Happy"	0.768	0.567	0.968	0.102	<0.001			
Depressive affect	~~	Somatic retardation	0.866	0.685	1.047	0.092	<0.001	—	—	0.87 (ω_{ho})
Depressive affect	~~	Positive affect	0.617	0.445	0.789	0.088	<0.001			
Somatic retardation	~~	Positive affect	0.382	0.167	0.598	0.110	0.001			

Abbreviations: α, Cronbach's α value; ω_{ho}, omega-ho from a higher-order model for the Psychological CESD-10 Scale; α_{Ord}, ordinal α value; ω_{u-cat}, omega categorical value; CES-D, Center for Epidemiologic Studies Depression Scale; CFA, confirmatory factor analyze; CI, confidence interval; OP, operators that are allowed in the *lavaan* model syntax; SE, standard error.

cut-off establishing adequate fit. On the other hand, RMSEA = 0.049 (95% CI = 0.000–0.095), where an RMSEA < 0.06–0.08 indicates an adequate fit.[49] Item loadings on the factors were statistically significant ($\lambda_j \geq 0.449$; $p < 0.001$), indicating that the items loaded correctly on the corresponding factors and the relationship between factors ($\phi \geq 0.382$; $p \leq 0.001$; Table 3 and Figure 1A). The second-order model fit showed equal estimation values to the three-factor correlated model fit (Figure 1B).

Finally, the reliability indices were as follows: depressive affect factor ($\alpha_{Ord} = 0.82$; $\omega_{u-cat} = 0.78$), somatic retardation factor ($\alpha_{Ord} = 0.59$; $\omega_{u-cat} = 0.56$), and positive affect factor ($\alpha_{Ord} = 0.61$; $\omega_{u-cat} = 0.55$). The second-order model fit showed good Omega reliability ($\omega_{ho} = 0.87$).

4 | DISCUSSION

The main objective of this study was to determine CES-D 10 validity and reliability in a sample of individuals with persistent COVID-19 from Navarre, Spain. The results showed that both the three-factor correlated model and its second-order factor model had an adequate goodness of fit, with no significant differences between the goodness of fit for these models. Our results support the notion of a common latent variable, depression, and thus, the interpretation of total score and subscale scores on CES-D 10.

The majority of previous studies have shown that the two-factor model is the most adequate fit for CES-D 10,[15,23,24] although other model fits have been reported, such as the one-factor model.[25] Other researchers have identified three latent factors, suggesting that the differences between those studies and the ones that identified three factors were in the type of factors; for example, a two-factor structure of the CES-D, reported in a sample of the Iranian population ($n = 600$), including positive affect and interpersonal problems, somatic symptoms.[13,50] Similar to Cheng et al.,[27] in this study, although depressive affect, somatic retardation, and positive affect factors were loaded on the latent variable of depression, the contribution of the positive affect factor was lower compared to the other two. We agree with Cheng et al.[27] suggestion of keeping the positive factor items to avoid symptomatic perspective direction through all CED-S 10 items.

Regarding reliability, the CES-D 10 total items (high-order model), depressive affect, and somatic retardation factors showed adequate reliability, while the positive affect factor presented low reliability. These findings are similar to Bradley et al.,[24] who also found low reliability for positive affect. This may be because only two items load within the factor, reducing its reliability. Bradley et al.[24] suggested that "Happy" and "Hopefulness" feelings that composed the positive affect factor may be considered conceptually different and even that "Hopefulness" might not be grouped with "Happy" due to its low factor loading in their study ($\lambda = 0.274$). However, in this study, although the "Hopefulness" factor loading was lower than "Happy", it was still acceptable ($\lambda = 0.574$).

Looking at the proportion of response for each level, 60% of participants responded "Occasionally" to "Always" for Item 4 "I felt that everything I did was an effort," while 64%–80% responded "Not at all" to "Sometimes" in Items 1 "I was bothered by things that usually do not bother me," Item 3 "I felt depressed," Item 9 "I felt lonely," and Item 10 "I could not "Get going." Effort can be

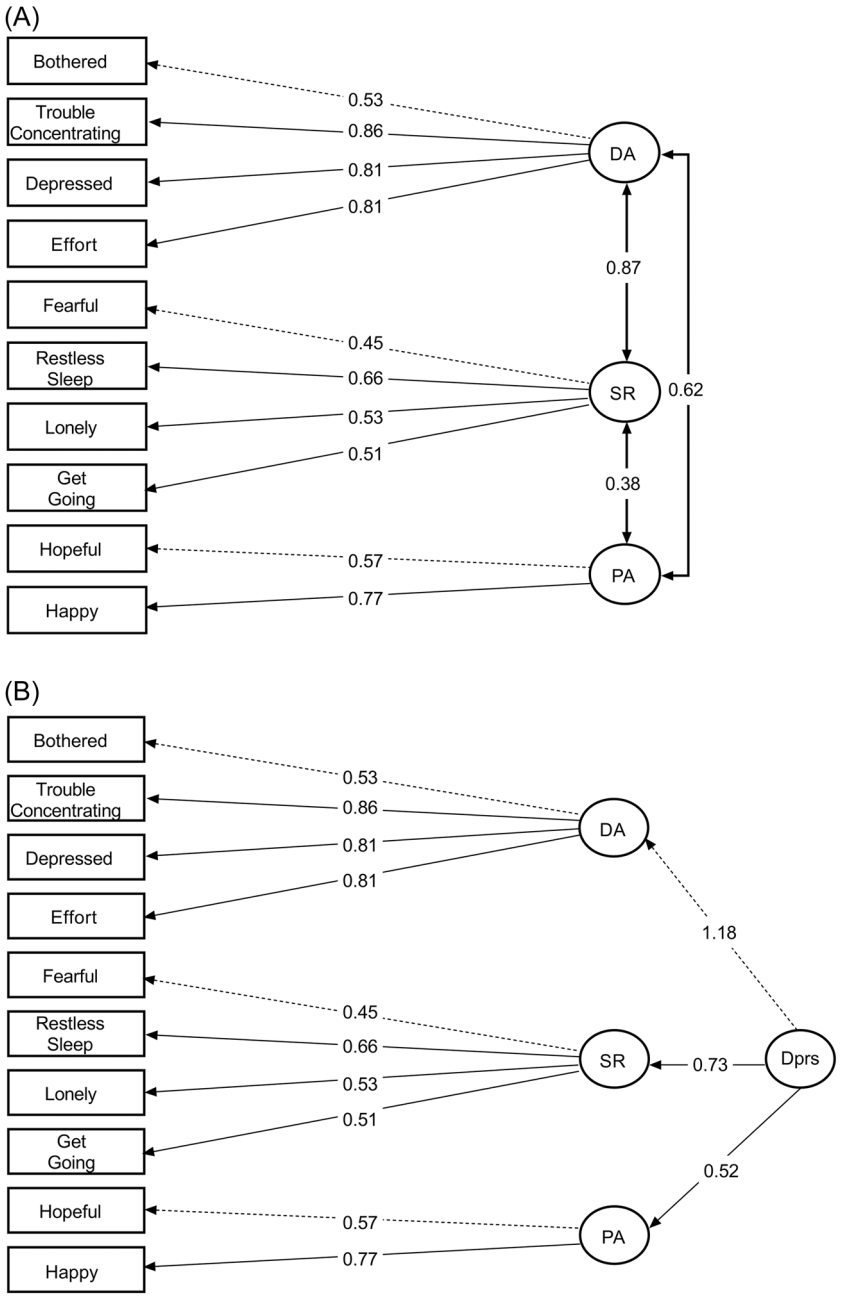

FIGURE 1 Graphical representation of the item loadings in each factor in the CFA model. Panel (A) shows a model where symptoms are explained by a three-factor correlated: depressive affect (DA), somatic retardation (SM), and positive affect (PA). Panel (B) shows a second-order model where a latent variable named depression (Dprs) is composed of three no-correlated factors (DA, SM, and PA).

understood as a physical or mental struggle and can be related to fatigue, a symptom associated with COVID-19.[40] This item may overestimate CES-S 10 scores in this population since depressive symptomatology after COVID-19 infection has been significantly associated with persistent fatigue.[40] In this sample, feeling bothered, depressed, alone, or unmotivated was rarely reported in the CES-D 10. This may be because these patients had not been hospitalized, so they could be supported by their families, reducing the chance of these symptoms. The prohibition of visiting affected relatives during hospitalizations might enhance patients' feelings of isolation and loneliness, and these may induce depressive symptoms.[35]

Interestingly, Item 4, "I felt that everything I did was an effort," is the second item with the greatest item loading ($\lambda = 0.811$) in the depressive affect factor, followed by Item 2, "I had trouble keeping my mind on what I was doing." It could be that for patients with the post-COVID-19 syndrome who have not been hospitalized, fatigue, and brain fog problems (common symptoms in this syndrome)[38] are strongly linked to depressive symptomatology rather than to other symptoms.

This study has some limitations that should be considered. First, the sample comes from the EXER-COVID project, which may lead to the participation of people with a high interest in exercise, and therefore, with a particular post-COVID-19 syndrome profile. Second, even though we found good reliability and validity indicators consistent with the literature, the sample size was small. A larger sample size may allow exploration and confirmation of factors not

based on previous studies. Third, the data were collected in the context of a larger protocol that was not designed to validate CES-D 10. Therefore, related psychological/psychiatric measures were not collected, which would have helped to further validate the CES-D 10. Moreover, we could not confirm self-reported depressive symptom severity detected by CES-D 10 with confirmation by a clinician or a structured clinical interview. Fourth, it is a study from a single clinical site and includes patients with a diverse range of experiences of acute COVID-19 infection. Fifth, the CES-D 10 questionnaire is self-report and thus the extent to which it is applicable in patients with severe fatigue or who have impairments affecting communication remains to be determined. Finally, to be part of the study, subjects could not be hospitalized. This may limit the generalization of the results to people who have been hospitalized due to COVID-19 since studies have shown that anxiety and depression levels were lower when family members were with patients during treatment.[36]

In future validations, as cases accumulate, the researcher will seek outpatients whose circumstances and perspectives provide a contrast to those already included to achieve maximum variety in clinical, social, ethnic, and personal circumstances and health/digital literacy. The CES-D 10 may patients and health care staff to monitor these aspects over the course of the condition, potentially capture post-COVID-19 syndrome fluctuations and assess the impact of rehabilitation interventions for the condition.

5 | CONCLUSION

To our knowledge, this is the first study to provide validity and reliability to CES-D 10 in a persistent COVID-19 Spanish patient sample. The results support its use in both research and clinical settings to screen for depressive symptoms among these patients. The validation and reliability of this short screening tool allow us to increase the chance of obtaining complete data in a particular patient profile with increased fatigue and brain fog that limits the patient's capacity to complete questionnaires.

AUTHOR CONTRIBUTIONS

Robinson Ramirez-Velez is the project lead and conceptualized the study. Robinson Ramirez-Velez and Mikel Izquierdo obtained institutional approvals. Robinson Ramirez-Velez and Mikel Izquierdo developed the data collection tool and gathered data. Laiene Olabarrieta-Landa and Diego Rivera undertook the main analysis. All authors contributed to the working group involved in the validation of CES-10 items. Robinson Ramirez-Velez, Laiene Olabarrieta-Landa, and Diego Rivera wrote the first draft of the manuscript, and all authors revised the manuscript. All authors read and approved the final manuscript.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data sets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Approval was obtained from the Ethics Committee on Human Research (CEIH, Procotol No. PI_2020/140) of the HUN (Pamplona, Spain). All participants consented for their data to be used for evaluation and research purposes.

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