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Psychometric evidence of the academic stressors scale in Peruvian university students in the context of COVID-19

Evidencias psicométricas de la escala de estresores académicos en universitarios peruanos en contexto del COVID-19

在 COVID-19 的背景下秘鲁大学生学业压力量表的心理测量学证据

Психометрические данные шкалы академических стресс-факторов у студентов перуанских университетов в контексте COVID-19

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Abstract

Introduction: The COVID-19 has generated a series of problems such as that of the education sector that allowed the use of digital platforms in order not to lose the school year, this has produced in teachers and students the challenge of adapting to a new reality of teaching and learning, therefore, it is worth adapting instruments that assess the academic stress produced. The objective was to evaluate the psychometric properties of the academic stressors scale (ECEA) in the context of COVID-19.

Method: The sample consisted of 300 participants in the first study and 566 students from public and private universities between 18 and 30 years of age (M_{age}=21.34;SD_{age}=2.926) in the second study. In the first study, the internal structure of the construct was verified through exploratory factor analysis, while in the second study it was verified through confirmatory factor analysis.

Results: The results of the first study indicated a factorial structure equivalent to the theoretical conceptualization; however, the empirical recommendation consisted of removing some items because their factorization was complex. With respect to the second study, four models were obtained, of which the seven-factor oblique model is the most significant ($\chi 2$=2393.181; gl=608; $\chi 2$/gl= .121; CFI= .999; TLI= .999; SRMR= .022; RMSEA= .020). Likewise, the reliability of the scale and the scores were significant.

Conclusions: Finally, the ECEA is an instrument that has adequate psychometric properties and is suitable for research purposes and for describing Peruvian university groups in the context produced by COVID-19.

Keywords: validity, reliability, academic stressors, university students.

Resumen

Introducción: La COVID-19 ha generado una serie de problemáticas como la del sector educación que permitió utilizar plataformas digitales para no perder el año escolar, esto ha producido en docentes y estudiantes el desafío de adaptarse a una nueva realidad de enseñanza y aprendizaje, por lo tanto, amerita adaptar instrumentos que evalúen el estrés académico producido. El objetivo fue evaluar las propiedades psicométricas de la escala estresores académicos (ECEA) en el contexto de la COVID-19.

Método: La muestra estuvo conformada en el primer estudio de 300 participantes y en el segundo estudio se logró evaluar a 566 estudiantes de universidades públicas y privadas con edades entre los 18 y 30 años . En el primer estudio se verificó la estructura interna del constructo a través del análisis factorial exploratorio, en tanto, en el segundo estudio se verificó mediante el análisis factorial confirmatorio.

Resultados: Los resultados del primer estudio indicaron una estructura factorial equivalente a la conceptualización teórica, no obstante, la recomendación empírica consistió en retirar algunos ítems, debido a que su factorización fue compleja. Con respecto al segundo estudio, se obtuvieron cuatro modelos, del cual el modelo oblicuo de siete factores es el más significativo ($\chi 2$=2393.181; gl=608; $\chi 2$/gl= .121; CFI= .999; TLI= .999; SRMR= .022; RMSEA= .020). Asimismo, la fiabilidad de la escala y de las puntuaciones estuvieron valores significativos.

Conclusiones: Finalmente el ECEA es un instrumento que cuenta con adecuadas propiedades psicométricas, es apto para fines de investigación y descripción de grupos universitarios peruanos bajo el contexto producido por la COVID-19.

Palabras clave: validez, confiabilidad, estresores académicos, universitarios.

概要

引言：COVID-19 已经产生了一系列问题，例如教育部门允许使用数字平台以免错过学年，这给教师和学生带来了适应新现实的挑战教学和学习，因此，我们认为应该调整评估学术压力的工具。研究目的是在 COVID-19 的背景下评估学术压力量表 (ECEA) 的心理测量特性。

研究方法：样本由第一项研究中的 300 名参与者组成，在第二项研究中，接受评估者来自公立和私立大学的 566 名年龄在 18 至 30 岁之间的学生(M_age=21.34;SD_age=2.926) 。第一项研究通过探索性因素分析验证了建构的内部结构，而在第二项研究中通过验证性因素分析对其进行了验证。

结果：第一项研究的结果表明因子结构与理论概念化等效，但是，经验建议是删除一些项目，因为它们的因子分解很复杂。关于第二项研究，获得了四个模型，其中七个因素的倾斜模型最显着 ($\chi2$=2393.181; gl=608; $\chi2$/gl= .121; CFI= .999; TLI= .999; SRMR= .022; RMSEA= .020)。同样，量表和分数的可靠性也很重要。

结论：最后，ECEA 是一种具有足够心理测量特性的工具，适用于 COVID-19 背景下的对秘鲁大学群体的研究和描述。

关键词: 效度、信度、学业压力源、大学生。

Резюме

Введение: COVID-19 породил ряд проблемных вопросов в секторе образования, которые позволили использовать цифровые платформы, чтобы не потерять учебный год. Это поставило учителей и студентов перед необходимостью адаптироваться к новой реальности преподавания и обучения, поэтому стоит адаптировать инструменты, оценивающие академический стресс. Целью исследования было оценить психометрические свойства шкалы академических стресс факторов (ECEA) в контексте COVID-19.

Метод: Выборка состояла из 300 участников в первом исследовании и 566 студентов государственных и частных университетов в возрасте от 18 до 30 лет (M=21.34;SD=2.926) во втором исследовании. В первом исследовании внутренняя структура конструкта была проверена с помощью эксплоративного факторного анализа, а во втором - с помощью подтверждающего факторного анализа.

Результаты: Результаты первого исследования показали факторную структуру, эквивалентную теоретической; однако эмпирическая рекомендация заключалась в удалении некоторых элементов шкалы, поскольку их факторизация была сложной. Что касается второго исследования, было получено четыре модели, из которых семифакторная косая модель является наиболее значимой ($\chi2$=2393,181; gl=608; $\chi2$/gl= .121; CFI= .999; TLI= .999; SRMR= .022; RMSEA= .020). Кроме того, надежность шкалы и переменных были значительными величинами.

Выводы: В заключение, ECEA - это инструмент с адекватными психометрическими свойствами, он подходит для исследовательских целей и описания перуанских университетских групп в контексте COVID-19.

Ключевые слова: валидность, надежность, академические стрессоры, студенты университета.

Introduction

The world's educational training process has been disrupted by the effects of COVID-19 (Murillo & Duk, 2020). In this context, in order not to lose continuity, many countries were forced to implement e-learning education on the fly (Marquina, 2020). Thus, practically all governments began to generate policies, systems, and models of synchronous and asynchronous education (Brítez, 2020; El Peruano, 2020), creating new alternatives for acquiring knowledge (Gutiérrez-Rubi, 2020). Thus, all educational centers, and universities, in particular, have had to modify their pedagogical models in order to continue with their mission of training professionals through various digital platforms, collaborative virtual learning methodologies, and promoting interactive and dynamic classes that allow them to maintain the attention of their students.

Universities continue to educate while their students continue to learn, even though such changes affect some more than others (Marquina, 2020; Murillo & Duk, 2020). Virtual education is a challenge for teachers and students because both must adapt to a new learning environment with intensive information and communication technologies (ICTs). If prior to the pandemic (COVID 19), research on stress was a concurrent concern for many researchers (Alania et al., 2020; Karnes, 2020; Marquina, 2020; Murillo & Duk, 2020; Ozamiz-Etxebarria et al., 2020); now, in the context of the pandemic, researching the consequences of stress becomes an imperative need, because it affects the workplace, family, academia, among others.

Academic stress has become a significant line of work for psychiatry within the field of human medicine and clinical and even organizational psychology (Moussavi et al., 2007; Tanaka et al., 2011). In the present century and the current context, stress, like anxiety and depression, according to the World Health Organization (WHO), are diseases with the most significant impact on the future of humanity, which demand concrete and forceful responses from academia (Lozano-Vargas, 2020; WHO, 2013).

Stress, a term frequently used nowadays, describes the emotional imbalances people experience due to everyday life's burdens, tensions, and worries. Since Selye (1960), who conceives it as the adaptive response of the organism to environmental stressors, we have positions (García-Herrero et al., 2013; Levi, 1998; Lu et al., 2015) who conceive it as the pattern of responses of the human organism, in the face of external demands. In turn, Lazarus and Folkman (1986) mention that change or novelty, lack of information, ambiguity, and imminence, among others, determine the stressful state in people. This situation makes it difficult for them to establish links between their abilities and expectations (Pasca & Wagner, 2012).

In the case of academic stress, the subject of this study, despite the existence of countless research studies, is still a broad and complex field (Ortega-Marlasca, 2015), as it encompasses not only the academic environment itself but also aspects related to job uncertainty when graduating, especially if we take into account the gap between what is taught and what the labor market demands.

Studies on academic stress are diverse. According to Souto-Gestal et al. (2019), students who perceive a stressful academic environment, in terms of academic overload and the exams they are subjected to show a greater predisposition to depression. Similarly, Castillo et al. (2016) identify that the main academic stressors are academic overload, time to complete academic activities, and exams. Cabanach et al. (2014) found that academic stress can obstruct students' basic cognitive processes, especially concentration, information retrieval in memory, and decision-making. These findings are further corroborated by Pozos-Radillo et al. (2014), who states that interventions in classes, compulsory work, and exams predict high chronic stress, mainly in female students between 18 and 25 years.

On the other hand, students with high capacities to control and accept their emotional states, according to Pozos-Radillo et al. (2014), tend to adapt better and experience lower stress responses, given that their abilities to adequately manage their emotions favor a better adaptation to stressful stimuli (Cabanach, Souto-Gestal, et al., 2017). In that order of ideas, students with high emotional clarity present low levels of perception of stressors, while students with low emotional clarity value the conditions of the academic environment as more stressful (Cabanach, Souto-Gestal, González, et al., 2016). Hence, timely identification of stressors could help better understand the stress and its effects on students (Pozos-Radillo et al., 2014).

Considering the relevance of measuring academic stressors in university students in complex global health situations (COVID-19) and the need for measurement instruments that meet the standards for educational and psychological testing (American Educational Research Association et al., 2018), it is worth studying the psychometric properties of the Academic Stressors Scale (ECEA) in young Peruvian university students.

Retrospective of the Academic Stressors Scale (ECEA)

Academic stress has been researched since the 1980s Cohen et al. (1983). Instruments have been developed to measure stress in various academic contexts (Barraza, 2007; Cabanach, Valle, et al., 2010; Malo et al., 2010). Not all instruments measure stress in academic contexts per se; some measure academic stressors related to the work context.

The present research was conducted in an atypical context, with the primary purpose of finding psychometric evidence of the academic stressors scale in Peruvian university students in the context of COVID-19, given that mental health professionals do not have validated instruments according to the Peruvian reality. Therefore, it is considered of utmost importance to demonstrate the psychometric properties of the Academic Stressors Scale (ECEA) proposed by Cabanach et al. (2008). Along these lines, a recent study of the psychometric properties of the ECEA by Chavez et al. (2019) does not guarantee conclusive results due to its practicality and usefulness for future research (American Educational Research Association et al., 2018; Ferrando & Anguiano-Carrasco, 2010).

It should be noted that the same authors have applied this instrument in different academic contexts (Cabanach et al., 2014; Cabanach, Fernández-Cervantes, et al., 2010; Cabanach, Souto-Gestal, & Franco, 2016; Cabanach, Souto-Gestal, et al., 2017; Cabanach, Souto-Gestal, González-Doniz, et al., 2018; Cabanach, Souto-Gestal, González, et al., 2016; Cabanach, Valle, et al., 2010). Hence, to have a complete idea of the evidence reported in different contexts of the ECEA instrument (Cabanach et al., 2008), Table 1 presents various studies applied mainly by the same authors, as well as the evolution of the instrument over time.

Table 1

Retrospective implementation and adaptation of the ECE

Autor	Manuscript title	Sample
Cabanach, Fernández-Cervantes, et al. (2010)	Academic stressors perceived by university health science students.	258
Casuso (2011)	Study of stress, engagement and academic performance in university students of Health Sciences.	504
Souto-Gestal (2013)	Emotional regulation and academic stress in physiotherapy students.	504
Taboada (2015)	The measurement of stress in academic contexts in university students.	468
Vizoso & Gundín (2016)	Academic stressors perceived by university students and their relationship with burnout and academic performance.	532
Cabanach, Souto-Gestal, & Franco (2016)	Academic Stressors Scale for the assessment of academic stressors in university students.	1196
Cabanach, Souto-Gestal, González, et al. (2016)	Differential effects of mindfulness and emotional clarity on the perception of academic stressors and stress responses of physiotherapy students.	500
Cabanach, Souto-Gestal, et al. (2017)	Emotional regulation profiles and academic stress in physiotherapy students.	504
Cabanach, Franco, et al. (2017)	Does academic goal orientation mediate stress in university students?	468
Chavez Anaya et al. (2019)	Psychometric analysis of the academic stressors scale (ECEA) in Catholic University of Santa Maria students.	150
Souto-Gestal et al. (2019)	Depressive symptomatology and perception of academic stressors in physiotherapy students.	485

Methods

Type of study

An instrumental study was developed because it was oriented toward the analysis of the psychometric properties of an instrument (Ato et al., 2013).

Participants

A Google Form survey was administered for both studies and distributed via social media and email to all participants on a judgmental sampling basis. The first study covered a period from 6 to 15 June 2020. During this period, 304 students from different levels of study at public and private Peruvian universities taking virtual classes were surveyed, which, when some of the data were cleaned, left 300 participants surveyed (Table 2). The four purged respondents were identified as high school students who did not meet the profile.

Table 2

Participants by subject area - test 1

Areas of study	Participants	Percentage	Careers
Economics and Business Studies	194	65	9
Social and Human Sciences	9	3	6
Health Sciences	42	14	9
Engineering and Architecture	55	18	14
Total	300	100	38

In the first study, it was verified that of the 100% of the respondents, 54.7% were women and 45.3% were men, aged between 18 and 30 years , from the first to the tenth semester. This group includes 38-degree courses grouped into four areas of study (Table 2).

For the second study and with the same criteria, the survey was carried out from 20 June to 2 July, obtaining 570 responses. In the same way, the quality control of the data obtained was carried out, reducing the data to 562 participants, where eight respondents did not meet the required profile (Table 3).

Table 3

Participants by subject area - test 2

Areas of study	Participants	Percentage	Careers
Economics and Business Studies	366	65	11
Social and Human Sciences	15	3	7
Basic sciences	2	.4	2
Health Sciences	72	13	8
Engineering and Architecture	107	19	19
Total	562	100	47

In this second test, it was confirmed that 56.4% are women and 43.6% are men, with ages ranging from 18 to 30 years who belong to 47 university careers, grouped into five areas of study, with the area of Economics and Business Studies having the highest participation (65%), followed by Engineering and Architecture (19%). There were also participants from the area of basic sciences in this test.

Instrument

The Academic Stressors Scale (ECEA) developed by Cabanach et al. (2008) was used, and according to Table 1, there were several subsequent studies. The original instrument was constructed with 54 items, a Likert-type scale with 5 alternatives (1 = never; 2 = sometimes; 3 = quite often; 4 = almost always; 5 = always), initially made up of 9 factors. Subsequently, it was reduced into eight factors: public speaking (PI), examinations (EE), teacher methodological deficiencies (DMP), lack of content value (CVC), beliefs about academic performance (CSRA), student overload (SE), participation difficulties (PD) and negative social climate (CSN). In this study, all authors used the instrument in a face-to-face educational setting.

In the present study, given the situation of the COVID-19 pandemic, it was necessary to adapt the instrument to a virtual teaching scenario, and it was verified through a focus group of 22 university students in a virtual meeting via Google Meet, where the clarity and understanding of each of the ECEA items were reviewed. It is there where it was decided to exclude items 3 and 9 because the meaning of these questions responds exclusively to the face-to-face format, i.e., item 3: "I get nervous or uneasy when I go to the blackboard" and item 9: "I get nervous or uneasy if I have to present an opinion in public." In the remaining 52 items, it was not necessary to modify the meaning of the questions because the students stated that the questions were understandable and perfectly suited to the e-learning format. However, the deletion of such questions does not detract from the seriousness and purpose of the research but, on the contrary, allows for adapting and finding new evidence in a different educational setting than the one in which the ECEA instrument was applied.

Procedure and data analysis

This research started with the search for documentary information on the ECEA instrument in different databases and digital repositories, where the adaptation of the ECEA in different scenarios and countries was rigorously monitored. Next, the instrument items were adapted, and their adaptation and clarity were verified through a focus group. By the recommendations, the research group then considered carrying out two studies.

The first consisted of analyzing the structure of the construct through exploratory factor analysis (EFA) in a sample of 300 university students, followed by a second study using CFA in 562 participants. In that sense, according to the criteria established regarding the evidence of validity based on internal structure (American Educational Research Association et al., 2018), both the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were obtained using the FACTOR program for the EFA (Ferrando & Lorenzo-Seva, 2018), and the R Studio software version 4.0.2, specifically the Lavaan library for the CFA (Rosseel, 2012).

The criteria used for the AFE were sample adequacy assessed through the KMO ≥ .80 (Kaiser, 1974), which, when higher, is considered an adequate index (Costello & Osborne, 2005; Ferrando & Anguiano-Carrasco, 2010); in addition, the rotation was oblique and with unweighted least squares estimation (Jöreskog, 1977) because this method is the most recommended (Flora et al., 2012). Concerning factor extraction, the method used was parallel analysis because selecting the necessary common factors presents higher eigenvalues than what would be obtained if analyzed randomly (Horn, 1965). Finally, concerning the AFE, the factorial simplicity index (Kaiser, 1974) was also checked to obtain a simple structure (Bentler, 1977), where the value 0 represents a very complex structure and 1.0 as a straightforward structure; in addition, the minimum value of .80 was considered as the cut-off point (Kaiser, 1974).

Regarding the analysis criteria of the CFA, the estimation of the factors was considered through the weighted least squares mean and variance adjusted (Muthén, 1984; Muthén et al., 1997), which is a robust procedure when there are categorical variables (Brown, 2015; Lei, 2009; Raykov, 2012) and the non-compliance with multivariate normality (Kyriazos, 2018). Model fit was contrasted through the X2 and its degrees of freedom, the comparative fit index and Tucker Lewis (CFI and TLI ≥ 95) (Hu & Bentler, 1999), the root mean squares error approximation index, and the standardized residual root means square (RMSEA and SRMR ≤ .05) (Hu & Bentler, 1999). Values of factor loadings >. Forty were considered acceptable (Brown, 2015; Tabachnick & Fidell, 2019).

The estimation of the AFC was carried out in four phases: In the first, the original model was evaluated (Cabanach et al., 2008). In the second phase, a second-order hierarchical structural model was obtained to determine the factor loadings of the general factor (GF) on the specific factors (SFs). In the third phase, the bifactor model was evaluated to contrast the degree of influence of the variance explained in each of the items by the GF and SFs, to determine whether the items are significantly influenced by the GF or SFs, or both. Furthermore, informative indices such as: extracted common variance (ECV ≥ .80) (Sijtsma, 2009; Ten & Sočan, 2004), percentage of uncontaminated correlations (PUC > .80) (Reise et al., 2013), Hh coefficient (Hh > .70) (Raykov & Hancock, 2005) and hierarchical omega (ωH > .70) (Zinbarg et al., 2006), recommend that the construct, would have a unifactorial behaviour. Finally, a unifactorial model was analyzed in the last phase, with the values previously obtained in phase three.

The reliability of the ECEA was analyzed at the construct level and observed scores. For this, it was estimated through the α (Cronbach, 1951) and omega (ω) coefficients, with the congeneric model (this process is understood when the same construct significantly influences the items) being considered more robust (Dunn et al., 2014), compared to the alpha coefficient, so values >.70 were taken as acceptable (Hunsley & Marsh, 2008; Ponterotto & Ruckdeschel, 2007).

Results

Descriptive statistics

The values obtained for the skewness and kurtosis for each item of the ECEA are in the established range [-1.5, 1.5], indicating a modest variation in the univariate distribution of the data. Therefore, it contributes to the assumptions of normality that must be met for the respective execution of factor analysis (Gravetter & Wallnau, 2013; Pérez & Medrano, 2010). In addition, multivariate normality was obtained using Mardia's distance with values distant (G2=146.976) from the established ones (G2<5.0) (see Table 4), which were considered in obtaining the AFC.

Table 4
Analysis of distribution statistics

Items	M	SD	Asymmetry	r.c	Kurtosis	r.c
IP1	2.70	1.128	.679	8.138	- .607	-3.640
IP2	2.49	1.168	.668	8.008	- .495	-2.967
IP3	2.68	1.156	.572	6.861	- .595	-3.567
EE1	2.51	1.175	.643	7.707	- .403	-2.416
EE2	2.89	1.195	.355	4.251	- .876	-5.249
EE3	2.63	1.206	.449	5.378	- .762	-4.565
EE4	2.94	1.193	.297	3.556	- .907	-5.437
DMP1	2.94	1.208	.197	2.357	- .944	-5.655
DMP2	2.69	1.208	.354	4.246	- .841	-5.042
DMP3	2.99	1.189	.163	1.953	- .928	-5.559
DMP4	2.98	1.175	.229	2.750	- .884	-5.299
DMP5	2.92	1.196	.226	2.704	- .911	-5.458
DMP6	3.15	1.199	.038	.453	-1.016	-6.087
DMP7	2.99	1.202	.148	1.772	- .938	-5.621
DMP8	2.92	1.201	.265	3.182	- .917	-5.493
DMP9	3.24	1.225	- .057	- .686	-1.039	-6.224
DMP10	3.24	1.198	- .110	-1.316	- .971	-5.820
DMP11	3.24	1.240	- .130	-1.552	-1.047	-6.275
DMP12	3.07	1.206	.033	.400	- .990	-5.935
CVC1	2.87	1.161	.232	2.781	- .854	-5.118
CVC2	2.78	1.153	.328	3.926	- .719	-4.312
CVC3	2.80	1.202	.245	2.935	- .891	-5.341
CVC4	2.89	1.204	.259	3.103	- .906	-5.432
CSRA1	3.11	1.236	.049	.593	-1.080	-6.471
CSRA2	3.17	1.226	- .010	- .115	-1.048	-6.282
CSRA3	2.87	1.234	.224	2.687	- .969	-5.808
CSRA4	2.71	1.263	.355	4.258	- .908	-5.442
CSRA5	2.69	1.262	.373	4.467	- .952	-5.706
CSRA6	2.85	1.247	.303	3.633	- .945	-5.664
CSRA7	2.75	1.253	.377	4.515	- .932	-5.585
CSRA8	2.76	1.273	.370	4.430	- .961	-5.761

Items	M	SD	Asymmetry	r.c	Kurtosis	r.c
CSRA9	2.74	1.261	.365	4.380	- .932	-5.587
CSRA10	2.66	1.285	.401	4.807	- .934	-5.600
SE1	2.73	1.257	.409	4.902	- .869	-5.208
SE2	3.04	1.282	.136	1.629	-1.119	-6.707
SE3	3.11	1.291	.078	.941	-1.141	-6.838
SE4	3.13	1.259	.067	.800	-1.165	-6.981
SE5	3.11	1.268	.068	.813	-1.122	-6.725
SE6	3.09	1.265	.092	1.101	-1.134	-6.794
SE7	3.03	1.264	.111	1.329	-1.072	-6.426
SE8	3.16	1.263	.064	.764	-1.154	-6.919
SE9	2.94	1.281	.196	2.347	-1.084	-6.499
SE10	3.01	1.269	.148	1.768	-1.077	-6.454
DP1	2.72	1.256	.419	5.028	- .888	-5.323
DP2	2.68	1.261	.434	5.206	- .885	-5.303
DP3	2.73	1.264	.373	4.466	- .915	-5.484
CSN1	2.42	1.258	.618	7.403	- .687	-4.120
CSN2	2.62	1.255	.444	5.323	- .841	-5.042
CSN3	2.53	1.225	.558	6.692	- .696	-4.172
CSN4	2.47	1.232	.623	7.469	- .636	-3.812
CSN5	2.72	1.314	.365	4.374	-1.047	-6.273
CSN6	2.44	1.320	.609	7.302	- .818	-4.904
Multivariate					750.300	146.976

Note. M: mean, SD: standard deviation, c.r.: critical ratio or Z-score.

Evidence of validity based on the internal structure using the AFE

As a first step, sample adequacy indices were calculated, reporting that the factor indices were concentrated in adequate values (KMO=.987, χ^2 =58874 Bartlett, gl=1326 and p<.001), with commonalities >.40 considered adequate (Bandalos & Finney, 2010). Consequently, its execution through exploratory factor analysis has been justified. In addition, the estimates of factor loadings were large>. 40, considered appropriate (Bandalos & Finney, 2010); furthermore, the presence of significant correlations between factors with the absence of multicollinearity (φ < .80, see Table 5) was highlighted. To strengthen these results, we obtained a factorial simplicity index (FSI; Fleming & Merino, 2005) being evaluated with criteria >. 80 (Fleming & Merino, 2005), where it was observed that the items “SE1”, “CSRA1”, “CSRA2”, “CSN2”, “DP1”, “DP2”, “DP3”, “DMP1”, “DMP2”, “DMP3”, “DMP6”, “DMP7”, “DMP8”, “DMP9”, “DMP11” and “DMP12” registered values below the permitted threshold. These items that failed to pass the criterion were removed from the CFA; in other words, the extracted items (“DP1”, “DP2”, “DP3”) were removed from the participation difficulty (PD) dimension.

Table 5

Factor loadings of Exploratory Factor Analysis (EFA)

	Factors								h2	ISF
	F1	F2	F3	F4	F5	F6	F7	F8		
SE3	.878	-.009	-.030	.015	.010	.020	.041	.022	.84	.99
SE8	.866	-.043	.027	.058	.017	.009	-.065	.057	.82	.98
SE6	.850	.014	-.022	.001	.054	.022	.005	.025	.83	.99
SE4	.843	.088	-.063	.010	-.062	.045	.065	.017	.82	.97
SE7	.807	.055	.046	.040	.073	-.033	-.077	.032	.83	.97
SE2	.759	.075	-.054	.033	.052	.078	.088	-.076	.82	.94
SE10	.746	-.058	.161	.060	-.029	.034	.034	.080	.85	.92
SE9	.688	-.085	.184	.059	.091	.013	-.004	.001	.76	.89
SE5	.658	.107	.014	.002	.067	.002	.065	.085	.79	.93
SE1	.583	.192	.092	.029	.092	.042	.054	-.164	.76	.77*
CSRA7	.014	.837	.029	.001	.006	.081	.009	.000	.86	.99
CSRA5	-.031	.828	.009	.062	.053	.040	.011	-.008	.85	.98
CSRA4	.030	.814	.011	.023	.011	.036	.036	-.023	.80	.99
CSRA6	.026	.735	-.008	.053	.066	.066	.031	.029	.82	.97
CSRA8	.090	.692	.116	.023	-.002	.041	.049	.018	.84	.94
CSRA9	.070	.677	.144	.020	-.012	.059	.046	.036	.84	.92
CSRA3	.054	.634	.005	.117	.131	-.068	-.034	.141	.76	.85
CSRA10	.064	.632	.199	.037	-.015	.040	.057	-.002	.81	.88
CSRA1	.061	.416	-.108	.125	.339	.010	-.044	.190	.73	.51*
CSRA2	.109	.354	-.004	.105	.206	-.022	.004	.295	.74	.48*
CSN4	-.050	.083	.674	.113	.138	.054	-.035	.009	.76	.90
CSN3	.022	.021	.669	.072	.080	.075	.091	.043	.81	.93
CSN1	.060	.117	.632	.041	.084	.018	.063	-.017	.77	.92
CSN6	-.007	.106	.586	.109	.106	.029	.015	.004	.68	.89
CSN5	.131	.024	.576	.098	.068	.045	-.023	.091	.71	.87
CSN2	.118	.163	.501	.072	.017	.138	-.074	.096	.74	.73*
DP2	.242	.183	-.083	.481	.037	.000	.182	-.014	.78	.60*
DP1	.232	.193	-.019	.437	.006	.054	.149	.004	.78	.60*
DP3	.272	.153	-.006	.421	.005	.048	.142	.018	.77	.59*

	Factors								h2	ISF
EE3	-.029	.073	.055	.000	.827	.010	.012	-.023	.79	.98
EE4	.091	.033	-.011	.012	.821	-.062	.034	.038	.82	.97
EE2	.021	.011	-.019	-.010	.810	.073	.018	.048	.81	.99
EE1	.050	-.061	.128	.039	.620	.206	.047	-.105	.73	.81
CVC2	.026	.012	.044	-.012	.070	.851	.017	-.025	.87	.99
CVC3	.032	.063	.049	.057	.002	.693	.067	-.012	.75	.97
CVC1	.096	-.032	.082	.014	.047	.652	.086	.085	.81	.92
CVC4	.056	.123	.031	.041	.016	.615	.036	.033	.71	.93
DMP12	.082	.002	.087	.029	.016	.372	.204	.307	.80	.51*
IP2	-.017	-.030	.029	-.026	.030	-.004	.951	-.022	.85	1.0
IP1	.017	.050	-.027	.019	-.023	.017	.836	.031	.78	.99
IP3	.024	.058	-.023	.064	.009	-.046	.786	.033	.75	.98
DMP5	.060	.063	.082	.063	.145	.022	.028	.599	.81	.89
DMP4	.086	.174	-.011	.120	.034	.040	.068	.545	.78	.81
DMP2	.005	-.042	.100	.177	.160	.065	.000	.537	.72	.78*
DMP7	.017	.015	.080	.055	.153	.051	.210	.525	.80	.75*
DMP6	.074	.073	.006	.081	.117	.077	.208	.467	.80	.70*
DMP3	.044	.139	-.023	.250	.048	.019	.106	.443	.73	.65*
DMP1	.189	-.017	-.019	.261	.085	.165	.053	.293	.69	.41*
DMP8	.092	.188	.045	.095	.084	.127	.199	.270	.74	.36*
DMP10	.115	.062	.061	.083	.047	.139	.105	.558	.85	.82
DMP9	.102	.097	.083	.050	.016	.149	.154	.512	.82	.75*
DMP11	.139	.010	.003	.033	.174	.060	.255	.416	.78	.58*
% variance explained	17.16	14.50	9.78	8.70	9.09	7.04	8.05	4.95		
% cumulative variance	79.30									
F1	1.000	.735***	.686***	.720***	.721***	.608***	.633***	.582***		
F2		1.000	.696***	.724***	.699***	.668***	.555***	.470***		
F3			1.000	.552***	.654***	.527***	.479***	.250**		
F4				1.000	.650***	.730***	.652***	.509***		
F5					1.000	.555***	.727***	.629***		
F6						1.000	.503***	.394**		
F7							1.000	.642***		
F8								1.000		

	Factors			h2	ISF
KMO	.987				
Bartlett's test of sphericity	χ^2=58874	gl =1326	p< .001		

Note. h2: communalities, FSI: factorial simplicity index, KMO: master adequacy [Kaiser Mayer Olkin], *: FSI values below the allowed values.

Evidence of the validity of internal structure using the CFA

The M1 model was analyzed, considering the exploratory factor structure proposed by Cabanach et al. (2016), which follows the internal structure of the construct, except for one factor that was removed entirely because it did not meet the factor simplicity criterion (FSI). This allowed us to find fit indices with appropriate values: χ2/gl= .121, CFI=.999, TLI=.999, SRMR=.022, and RMSEA=.020 (Table 6). Likewise, M2 consisted of checking the second-order model, whose index values were robust: χ2/gl= .151, CFI=.998, TLI=.998, SRMR=.029, and RMSEA=.027, although their differences with M1 appear insignificant in terms of the magnitudes of their fit indices.

Table 6

Goodness-of-fit index of the proposed models using the CFA

Model	χ2	df	χ2/gl	CFI	TLI	SRMR	RMSEA	RMSEA IC 90%	
								Inferior	Superior
M1	2393.181	608	.121	.999	.999	.022	.020	.019	.033
M2	3282.605	622	.151	.998	.998	.029	.027	.026	.054
M3	2905.516	592	.144	.999	.998	.027	.026	.025	.062
M4	12963.722	629	.165	.991	.991	.061	.061	.060	.075

Note. χ2: Chi-square, df: degree of freedom, CFI: comparative fit index, TLI: Taker Lewis index, SRMR: standardized root mean square, RMSEA: standardized root means a square error of approximation, M1: oblique model, M2: second-order model, M3: bifactor model, M4: one-factor model.

The M3 consisted of looking at the degree of influence of the general factor on the specific ones, achieving goodness-of-fit index values that were better than the two models described; however, if interpretations were based only on those fit indices, less accurate interpretations could be made. In that sense, a descriptive analysis of the configuration coefficients evidenced that the factor loadings, on average, about the general factor (mean FGλaverage=.788) are higher in comparison to the specific factors, which on average reported mean FEλaverage=.42. Furthermore, the values of the ωH =.931, PUC with estimates of .848, the coefficient Hh=.985 and ECV=.783 would be favoring the unifactorial condition (Table 7). Consequently, the M4 responded to verify the one-dimensionality proposition, obtaining very similar fit indices to the other models (χ2/gl= .165, CFI=.991, TLI=.991); however, fit indices such as SRMR=.061 and RMSEA=.060 obtained values slightly above .05 and in comparison, to the rest of the model which reported fit indices lower than the .05 threshold. In sum, the factor solution that best represents the data would be the seven-factor oblique M1 for the study sample.

Table 7

Estimates of the fit indices of the Bifactor Model

Statistical indices of bifactor models		Observed values	Expected values
Common stratified variance amount (ECV)	ECV	.783	≥ .80
Percentage of untainted correlations (PUC)	PUC	.848	≥.70
Hierarchical Omega (ωH)	ωH	.931	≥.70
Specific hierarchical Omega (ωH Si)	ωH S1	.413	≥.30
	ωH S2	.240	
	ωH S3	.123	
	ωH S4	.162	
	ωH S5	.180	
	ωH S6	.195	
	ωH S7	.197	
The hierarchical (Hh G) and specific (Hh Si) coeficient	Hh G	.985	≥.70
	Hh S1	.633	
	Hh S2	.509	
	Hh S3	.283	
	Hh S4	.571	
	Hh S5	.648	
	Hh S6	.489	
	Hh S7	.455	
Average factor loadings (G) and specific factor loadings (λaverage Si)	λpromedio G	.788	≥.30
	λpromedio S1	.597	
	λpromedio S2	.447	
	λpromedio S3	.319	
	λpromedio S4	.369	
	λpromedio S5	.384	
	λpromedio S6	.396	
	λpromedio S7	.406	

Note. HF: hierarchical factor, SF: specific factor.

As for the reliability of the scores obtained, the M1 model of the proposed seven-factor version, composed of 37 items with acceptable values closer to the construct, was evaluated; therefore, the internal consistency through α and ω recorded values above .80 in all its dimensions (Table 8).

Table 8
Reliability

Dimensions	Items	M	DS	ritc	α	ω
Dimension 1	IP1	2.7	1.13	.83	.92	.92
	IP2	2.49	1.17	.86		
	IP3	2.68	1.16	.82		
Dimension 2	EE1	2.51	1.18	.80	.93	.93
	EE2	2.89	1.19	.87		
	EE3	2.63	1.21	.85		
	EE4	2.94	1.19	.86		
Dimension 3	DMP4	2.98	1.17	.81	.89	.90
	DMP5	2.92	1.2	.81		
	DMP10	3.24	1.2	.75		
Dimension 4	CVC1	2.87	1.16	.85	.94	.94
	CVC2	2.78	1.15	.89		
	CVC3	2.8	1.2	.84		
	CVC4	2.89	1.2	.81		
Dimension 5	CSRA3	2.87	1.23	.84	.97	.97
	CSRA4	2.71	1.26	.88		
	CSRA5	2.69	1.26	.90		
	CSRA6	2.85	1.25	.89		
	CSRA7	2.75	1.25	.91		
	CSRA8	2.76	1.27	.91		
	CSRA9	2.74	1.26	.91		
	CSRA10	2.66	1.29	.88		
Dimension 6	SE1	2.73	1.26	.83	.98	.98
	SE2	3.04	1.28	.89		
	SE3	3.11	1.29	.90		
	SE4	3.13	1.26	.89		
	SE5	3.11	1.27	.87		
	SE6	3.09	1.26	.90		
	SE7	3.03	1.26	.90		
	SE8	3.16	1.26	.89		
	SE9	2.94	1.28	.85		
	SE10	3.01	1.27	.90		

Dimensions	Items	M	DS	ritc	α	ω
Dimension 7	CSN1	2.42	1.26	.83	.94	.94
	CSN3	2.53	1.23	.88		
	CSN4	2.47	1.23	.85		
	CSN5	2.72	1.31	.82		
	CSN6	2.44	1.32	.80		

Note. M: mean, SD: standard deviation, ritc: total corrected item ratio, α: alpha coefficient, ω: omega coefficient.

Discussion

This research aimed to evaluate the psychometric properties of the academic stressors scale (ECEA) in the context of COVID-19 and its internal construct structure and internal consistency in Peruvian university students.

Concerning the evidence of validity based on the internal structure of the first study, relevant results were found; however, some items presented factorial simplicity indices below the established threshold (Kaiser, 1974). Therefore, the psychometric criterion based on the ISF recommended, for the second study, removing items that did not meet the established threshold; in this sense, it was decided to remove all items belonging to the participation difficulty (PD) dimension. It seems that these items could be part of the dimensions of student overload (SE), beliefs about academic performance (CSRA) or public speaking (PI), results that differ from the studies conducted by Cabanach et al. (2008), Cabanach, Souto-Gestal, & Franco (2016), Cabanach, Souto-Gestal, González, et al. (2018), Chavez et al. (2019) and Taboada (2015). This difference in the structure of the construct is probably explained by the fact that the level of perception of academic stressors in Peruvian university students is not manifested in eight dimensions, as has been reported in other contexts (Cabanach, Franco, et al., 2017; Cabanach et al., 2016; Cabanach, Valle, et al., 2010; Casuso, 2011; Chavez et al., 2019; Souto-Gestal et al., 2019; Souto-Gestal, 2013; Taboada, 2015; Vizoso & Gundín, 2016). Furthermore, the items removed can be represented by the dimensions mentioned above when analyzing their content. Finally, it should be noted that the process of adapting a psychological instrument from one culture to another probably requires some changes because we live in an increasingly multicultural and multilingual environment (Muñiz et al., 2013). There are arguments enough to justify the removal of some items, as well as the atypical scenario of virtual teaching in times of pandemic whose items are addressed to the specialty environment (e.g., items 3= “when going out to the blackboard” and items 9= “if I have to expose in public an opinion”).

Consequently, to demonstrate validity, the PD dimension was not considered in the second study; of course, the arguments that would support it are not only psychometric aspects but also the process of adaptation to reality, such as the Peruvian one, which has diverse cultural and idiosyncratic characteristics that make adaptation more complex. However, in the second study, four models were obtained, of which the seven-factor oblique model is the one that best represents the construct, not to mention the other proposed models (second order, bifactor, and unifactorial) that also provide relevant information to the psychometric analysis, in comparison with the previous studies, where no hierarchical model analysis was found (Cabanach, Fernández-Cervantes, et al., 2010; Cabanach, Souto-Gestal, et al., 2017; Chavez et al., 2019).

Regarding the reliability of the ECEA, the α and ω coefficients reported excellent values (α and ω >.90). This result, in comparison with the statements of Souto-Gestal (2014), Franco (2015), and Cabanach et al. (2016) are very similar. Therefore it could be considered that the instrument ensures stability in the interpretation of the scores and a decrease in false negatives (Ponterotto & Ruckdeschel, 2007). Another benefit of having the α coefficient as an estimator of the reliability of the observed estimates is its usefulness in the elaboration of normative data (Livingston, 1972) or even in longitudinal research, where the assessment of transient [test-retest] error is of utmost relevance (Green, 2003). Consequently, the reliability values obtained in this research were as follows.

Like many instrumental research studies, some limitations were identified that should be avoided in future research. A clear example would be obtaining measurement invariance, given that it is a preliminary analysis to compare groups because academic stressors can manifest themselves differently depending on gender, profession studied, and curricular experience, among others. As for the sample, the selection procedure of participants in this research may represent a risk factor for the external validity of the research since generalization is the main objective of quantitative research (Ato et al., 2013); in this sense, the values of interpretation as adequate in this research will be mostly punctuated for the research sample; for this reason, it is recommended to expand the sample size and include studies with a probability sample.

Despite the limitations, it can be concluded that the ECEA is an instrument that shows excellent psychometric properties for the study sample of university students in the Peruvian context during the COVID-19 pandemic, with an internal structure that reflects a total explained variance of significant magnitude, empirical equivalence with theoretically linked variables and fairly reliable observed scores; which supports the inferences to be made from the ECEA scores, as an alternative in future research and group description.

Future research is recommended to expand the scope of the assessment in other Peruvian cities and to develop normative data based on a significant sample, which will allow diagnostic conclusions to be drawn regarding academic stressors in Peruvian university students.

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