Research Article

Psychometric analysis of the depression, anxiety and stress scale (DASS-21) in the Peruvian population

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ABSTRACT

Depression and anxiety are different constructs, however, in the clinical field and in research they tend to be related, because they appear simultaneously, affecting the mental health of the population. The psychometric properties of the depression, anxiety and stress scale (DASS-21) in the Peruvian population in general were analyzed. An instrumental methodology was used to establish the validity and reliability of the instrument through confirmatory factor analysis; A total of 2283 intentionally chosen people participated, the sample was made up of population groups (adolescents, youth, adults and older adults), the average age range was 39.2 years with a standard deviation of +- 18 years. The evaluation by confirmatory factor analysis of the original structure with the three-dimensional model shows a good fit of the data, ($\chi2(186) = 1163.392$; CFI = .986; TLI = .985, RMSEA = .052; SRMR = .023). Internal consistency showed values above .90, demonstrating high reliability. Therefore, the DASS scale for the Peruvian population in general shows good psychometric properties, providing a validated and reliable instrument.

Keywords: Psychometrics; depression; anxiety, stress; confirmatory factor analysis; internal consistency

1. Introduction

The high rates of mental disorders produced as a result of the pandemic have left serious consequences on the mental health of the Peruvian population, these alterations in emotional states such as anxiety, depression and stress are common, frequent and easy to suffer[1].

Although depression and anxiety are different constructs from a conceptual point of view, in clinical practice and in research they usually manifest themselves simultaneously. This overlap has made it difficult to accurately use traditional assessment tools, which led to the development of Depression, Anxiety, and Stress Scale (DASS). Therefore, this instrument seeks to differentiate these disorders based on physiological activation and tension[2].

Depression is characterized by a dysphoric mood, feelings of hopelessness, self-criticism, and a decrease in self-esteem and motivation, which affects the perception of personal achievement.

Anxiety, on the other hand, is associated with symptoms of physiological hyperactivation, panic episodes, and an exaggerated response to fear. And on the other hand, stress manifests itself through a high

level of reactivity to challenging situations, irritability and constant emotional activation[2].

The original structure of the DASS reported psychometric properties correlated with Beck's Depression inventory finding a correlation of .74, in addition, the model was corroborated by exploratory factor analysis that suggested three dimensions, this scale has been used and reviewed by other researchers, suggesting some specific and alternative solutions for a two-dimensional model prioritizing physiological activation and negativity in general[3].

Likewise, Szabó and Lovibond[4], in their adaptations, found that the dimensions of anxiety and stress are not differentiated, proposing a two-dimensional model unifying these variables; in addition, researchers such as Kyriazos et al.[5]; Lee et al.[6]; Moussa et al.[7], found high factor loads when relating the three dimensions (depression, anxiety, and stress), suggesting a general factor in the measurement of DASS[8].

For the Peruvian population, DASS validation was carried out specifically in the following samples: in adults[9]; in adolescents[10]; in young university students[11]; All these studies reported good fit rates for validity and reliability, however, the sample size in most of the studies cited is not significant.

Despite the existence of various instruments to assess anxiety, depression and stress in Peru, there is no validation of the DASS-21 in a representative sample of the general population that includes adolescents, young people, adults and older adults, with significant sample sizes, therefore, it is important to have a standardized tool for measurement in the general population that allows identifying these pathologies to intervene in their due time.

Therefore, it was proposed to analyze the psychometric properties of the depression, anxiety and stress scale (DASS-21) in the Peruvian population in general.

2. Methodology

2.1. Study design

An instrumental methodology was used to establish the validity and reliability of the instrument, considering its usefulness for measurement or evaluation in the Peruvian population, the data were collected in the last semester of 2024.

2.2. Participants

A total of 2283 intentionally chosen people participated, the inclusion criteria were being over 12 years old, being literate and not having severe sensory problems. The aim was to achieve a sufficiently large sample size to provide reliable estimates of the psychometric properties of the scale in the Peruvian population; since the DASS-21 scale measures three factors, with the sample size obtained it is expected to have a well-defined factor structure, as well as to perform the confirmatory factor analysis with adequate estimation.

The sample was made up of: population groups (adolescents, youth, adults and older adults), the average age range was 39.2 years with a standard deviation of +- 18 years (ages between 12 and 93 years); 39.9% were men and 60.1% women; 26.7% were married or cohabiting, 65.8% were single, 3.3% were separated from their partner and 4.2% were widowed; In relation to schooling, 2.1% did not study, 4.3% only studied at the primary level, 31.6% studied at the secondary level and 62.0% studied at the higher level (university, technical and postgraduate).

2.3. Instrument

The abbreviated version of the depression, anxiety and stress scales (DASS-21) was applied[2]. Three-dimensional self-report scales assess the presence and intensity of affective states of depression, anxiety, and stress. Each item is answered according to the presence and intensity of each symptom in the last week on a Likert-type response scale from 0 to 3 points, ranging from 0 ("It does not describe anything that happened to me or felt during the week") to 3 ("Yes, this happened to me a lot, or almost always") the use of this type of assessment avoids central response bias, it is more efficient and easier to respond to and improves the differentiation of the severity of the results. This instrument has the advantage of being a self-report scale, brief, easy to administer and answer, being simple to interpret. Each scale has seven items, and its total score is calculated with the sum of the items that belong to that scale and varies between 0 and 21 points.

2.4. Procedure

For the application of the instrument, the following steps were taken: in the case of adolescents, authorization was requested from their educational centers, explaining in detail the purpose of the research, who informed the students and relatives agreeing to participate voluntarily; and in the case of young people and adults, each of them was contacted in different public spaces such as recreational, commercial and supply centers, likewise, the strategy of contacting young people at the exit doors of the local universities, and the elderly in the medical care and leisure centers, was sought. The purpose of the study was explained to them, so they accepted and signed the informed consent.

The instrument was administered individually, with pencil and paper, and always with the presence of an applicator to resolve doubts or attend to any incident. Participation was voluntary and the absolute confidentiality of the responses was maintained.

2.5. Ethical considerations

The study was carried out with the ethical considerations of the Ministry of Health of Peru, where ethical guidelines for health research with human beings were developed according to Ministerial Resolution No. 233-2020-MINSA, published on April 27, 2020, which aims to promote health research in an ethical manner. In addition, the international ethical principles of the Declaration of Helsinki were considered important.

This study is part of the Multidimensional Study of Mental Health in Population Groups in Arequipa, Peru, which was reviewed and approved by the Ethics Committee of the National University of San Agustín de Arequipa, Peru. The study not only complies with national and international regulations but also emphasizes the importance of responsible mental health research.

2.6. Statistical and psychometric analysis

The data were digitized in a file with an exl. extension of Excel software. For the analysis of the data, the programming language R version 4.0.2[12] and its development environment RStudio version 1.3.959[13] were used. The following packages were used: haven for data import[14]; for the manipulation and cleaning of these, the Tidyverse package[15] was used, for the descriptive analysis the PSYCH package[16] was used, and the openXLSX package was used to export tables to Microsoft Excel[17]. For confirmatory factor analysis[18], lavaan[19] and semPlot packages were used, polychoric correlation matrices were calculated, and robust weighted least squares (WLSMV) were used as an estimation method. The original structure of the scale (three factors) was analyzed. For the evaluation of the adjustment indices, the following criteria were considered: values ≥.90 and ≥.95 in the CFI and TLI as an adequate fit and a good fit, respectively, values

≤.08 and ≤.05 in the RMSEA as an adequate fit and a good fit, respectively, and for the SRMR, the values ≤.08 and ≤.06 were considered as a good and ideal fit, respectively[20].

Reliability was evaluated with Cronbach's alpha and McDonald's omega coefficients using the MBESS[21] and psych[22] packages, considering values greater than .70 as high internal consistency. Finally, a proposal is developed to measure the scale with five categories or cut-off points according to percentile scores.

3. Results

Table 1 presents the descriptive statistics of the items, the number of records considered, the mean, the median, the standard deviation, the asymmetry and the kurtosis. The mean value ranged from 0.95 to 1.36 points with standard deviations between 0.89 and 0.99. On the other hand, the values of asymmetry and kurtosis are within the range ± 2[23], which means that the items follow approximate distributions to the normal distribution.

Table 1. Descriptive statistics of the items of the DASS-21.

Article	M	Mdn	OF	Asim.	Short.
1	1.2	1	0.96	0.3	-0.91
2	1.18	1	0.98	0.33	-0.95
3	1	1	0.92	0.52	-0.69
4	0.95	1	0.93	0.58	-0.69
5	1.25	1	0.93	0.27	-0.8
6	1.22	1	0.93	0.27	-0.83
7	1.08	1	0.96	0.48	-0.8
8	1.36	1	0.95	0.13	-0.92
9	1.26	1	0.97	0.25	-0.94
10	1.13	1	0.96	0.42	-0.82
11	1.24	1	0.93	0.26	-0.82
12	1.26	1	0.94	0.22	-0.87
13	1.21	1	0.95	0.33	-0.83
14	1.06	1	0.89	0.38	-0.76
15	1	1	0.95	0.55	-0.74
16	1.05	1	0.94	0.48	-0.74
17	1.04	1	0.98	0.56	-0.77
18	1.18	1	0.94	0.35	-0.78
19	1.11	1	0.97	0.41	-0.9
20	1.13	1	0.96	0.41	-0.84
21	1.03	1	0.99	0.53	-0.86

Table 2 shows the matrix of polychoric correlations between the items of the instrument analyzed. It is observed that the correlations range between .46 and .74. Correlations of varying magnitude are observed between the items, which suggests the existence of a multidimensional structure in the scale.

Table 2. Matrix of polychoric correlations between the items of the DASS-21.

Article	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	1																				
2	.57	1																			
3	.59	.56	1																		
4	.58	.55	.58	1																	
5	.57	.48	.55	.53	1																
6	.52	.51	.46	.51	.52	1															
7	.58	.58	.6	.65	.56	.51	1														
8	.57	.51	.5	.49	.54	.5	.55	1													
9	.57	.52	.56	.55	.56	.53	.59	.52	1												
10	.58	.52	.63	.57	.58	.51	.59	.55	.59	1											
11	.6	.55	.55	.57	.53	.55	.59	.54	.58	.57	1										
12	.65	.51	.56	.55	.56	.52	.57	.59	.56	.56	.6	1									
13	.59	.52	.64	.59	.55	.51	.62	.53	.62	.63	.61	.59	1								
14	.55	.51	.58	.53	.55	.55	.56	.52	.52	.57	.54	.54	.56	1							
15	.61	.53	.61	.67	.56	.56	.69	.49	.64	.62	.63	.6	.64	.59	1						
16	.58	.53	.66	.6	.6	.5	.57	.52	.54	.7	.56	.55	.62	.56	.61	1					
17	.61	.55	.63	.62	.58	.53	.61	.5	.59	.65	.59	.59	.66	.59	.64	.63	1				
18	.58	.51	.52	.53	.53	.61	.53	.5	.54	.53	.56	.53	.59	.57	.59	.55	.56	1			
19	.57	.57	.58	.67	.51	.51	.66	.51	.56	.55	.57	.56	.57	.52	.62	.54	.56	.52	1		
20	.56	.53	.55	.58	.54	.56	.62	.52	.6	.58	.57	.55	.62	.55	.65	.57	.64	.54	.6	1	
21	.58	.52	.65	.6	.57	.5	.59	.5	.55	.67	.58	.55	.66	.57	.65	.66	.73	.55	.53	.61	1

A confirmatory factor analysis was applied to the three-dimensional model: depression (items: 3, 5, 10, 13, 16, 17 and 21), anxiety (items: 2, 4, 7, 9, 15, 19 and 20) and stress (items: 1, 6, 8, 11, 12, 14 and 18). **Table 3** shows the fit indices of the model evaluated.

The three-dimensional model has a good data fit (good fit is achieved when the values are in the estimation ranges), $\chi2(186) = 1163.392$; CFI = .986; TLI = .985, RMSEA = .052; SRMR = .023[20]. This means that the results confirm the structure of the instrument being evaluated.

Table 3. Goodness of fit indices of the three-dimensional model.

Model	x^2	Gl	CFI	TLI	RMSEA	SRMR
Three dimensions	1163.39*	186	.986	.985	.052	.023

Note. *X^2 = Chi-squared, gl = degrees of freedom, CFI = Comparative fit index, TLI = Tucker Lewis index, RMSEA = squared mean approximation error, SRMR = standardized residual means square root. *p< .001.*

Figure 1 presents the factor loads of the model evaluated. All factor loads were greater than .70, indicating evidence of the suitability of the model studied.
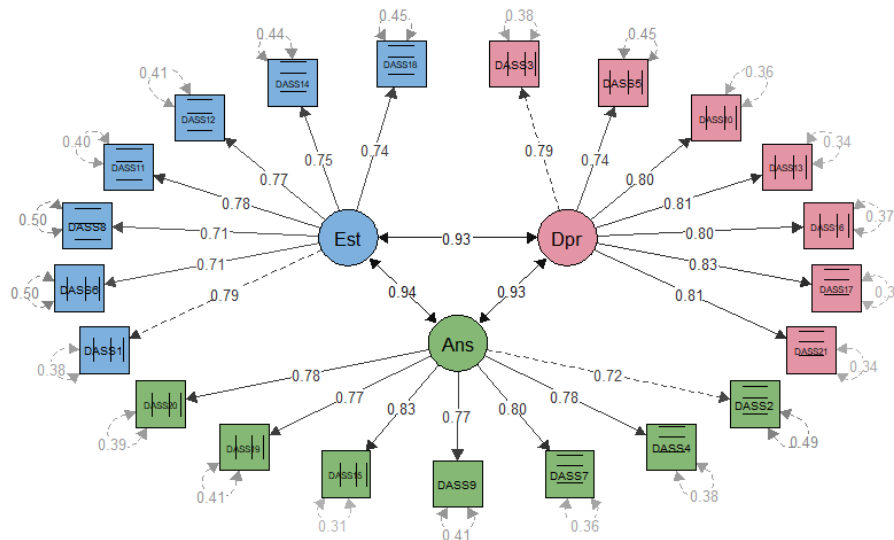
Figure 1. Factor loads of the three-dimensional model DASS-21.

Regarding reliability, the internal consistency of the instrument's dimensions was evaluated with Cronbach's Alpha and Omega coefficients (this coefficient has fewer constraints on the factor structure, allowing the differentiation of factor loads and is used when the scale measures a multidimensional construct)[24].

In the depression dimension, a Cronbach's alpha of .90 (95% CI: .89 - .90) and a McDonald's Omega of .90 (95% CI: .89 - .90) were obtained. In the anxiety dimension, a Cronbach's alpha of .89 (95% CI: .88 - .89) and a McDonald's Omega of .88 (95% CI: .88 - .90) were obtained. In the stress dimension, a Cronbach's alpha of .87 (95% CI: .86 - .88) and a McDonald's Omega of .87 (95% CI: .86 - .88) were obtained. These results indicate that the scale has a high internal consistency, therefore, good reliability.

Table 4 presents the percentiles of the DASS-21 scores. These reference values are derived from population studies according to the intensity of the symptoms; therefore, cut-off points are proposed for 5 categories ranging from low percentiles that mean very low; and high percentiles that mean very high. For interpretation, it should be considered that a higher score represents greater depression, anxiety and stress.

Table 4. Percentile rating for DASS-21 scale.

Percentiles	Depression	Anxiety	Stress	Levels
10	0 – 1	0 – 1	0 – 2	Very low
25	2 – 3	2 – 3	3 – 5	Low
50	4 – 7	4 – 7	6 – 8	Middle
75	8 – 11	8 – 12	9 – 12	High
90	12 – 21	13 – 21	13 – 21	Very high

5. Discussion

The aim of this study was to analyze the psychometric properties of the depression, anxiety and stress scale (DASS-21) in the Peruvian population in general; The results show that the three-dimensional model

presents a good fit of the data, that is, that the results confirm the original structure of the instrument evaluated.

The factor loads of the evaluated model were greater than .70, which indicates evidence of the suitability of the model studied. These results show values like the original scale[2].

Likewise, the evaluation of the confirmatory factor analysis of the original structure with the three-dimensional model shows a good fit of the data, (χ2(186) = 1163.392; CFI = .986; TLI = .985, RMSEA = .052; SRMR = .023); results that demonstrate the factorial power of the present study and contradict what was reported by Carlos-Colchado et al.[11], observing inadequate scores in the comparative fit index (CFI) .886; and in the Tucker Lewis Index (TLI) .89[10], values that are below the criteria established > .90. However, we found similar AFC results in the Tapullima study[9] in adult population with TLI and CFI scores greater than .90.

In the background of the instrument, a common characteristic of the reviewed works was found, they do not report the type of correlation and the estimator that has been used. Considering that the responses of the items are ordinal variables, it is very likely that approximately normal distributions are not met, so polychoric correlations between the items had to be used and then this matrix had to be used for factor analyses[25].

Since most of the studies reviewed have used the SPSS software, they may not have given much importance to the factor estimation method, using the default method, which is the maximum likelihood method, which is more appropriate in Pearson correlation matrices, which have roughly normal distributions[26]. In accordance with the above, it is best to use robust estimators, such as the ULS (Unweighted Least Squares) estimator, which is more robust in the face of violation of the assumption of normality[27].

Another aspect to take into account when comparing the results of factor analyses, is to consider the rotation used, whether orthogonal or oblique, since its choice will show different factorial solutions as a result, the choice of the rotation method implies important consequences in the factorial solution, since orthogonal rotations suppose the independence of the factors, while the oblique rotation method allows correlation between these. The current recommendation is to use oblique rotation regardless of the theoretical model of the construct[28], as used in the present study.

Another factor that could influence the differences in factor structures between previous and present psychometric studies could be the sample size and the characteristics of the participants. The sample sizes used in the reviewed background of previous studies range from 301 to 731 evaluated, in our case there were 2283 participants.

Information on how much is the minimum needed to study structure-based evidence using factor analysis is inconclusive and difficult to determine. Mundfrom et al.[29], conducted a simulation study on how much is the minimum needed to perform these analyses, concluding that the lower the similarity, the larger the sample size should be.

Harrington[26] explains that the larger the sample, the better for factor analysis, however, there is no universal agreement on how large it should be. Izquierdo et al.[28], recommends that the decision on sample size considers the complexity of the model (referring to the number of factors) and the commonalities of the items, but in no case should samples be smaller than the 200 evaluated. It should also be noted that studies have used different populations to analyze the structure of the scale.

The internal consistency showed values above .90, demonstrating high reliability. Previous studies have also evaluated the internal consistency of the scale, but using the Alpha coefficient, finding values ranging from .70 to .80. Although it is important to mention that none of the studies reviewed have reported confidence intervals, which is currently a good practice, as it improves the presentation in the empirical literature[30]. As for the Alpha coefficient, it has been seen that it is a coefficient with severe limitations, since it is susceptible to the number of items, the number of answer alternatives and the proportion of variance of the test, so the use of the Omega coefficient is suggested, which is a more accurate coefficient when measuring reliability[31], In addition, this coefficient has fewer restrictions on the factor structure, allowing the differentiation of factor loads and is used when the scale measures a multidimensional construct[24].

6. Limitations

Among the main limitations of the study we find that the use of non-probabilistic sampling can affect the ability to generalize the results to the population, however, considering the larger sample size compared to previous studies, we consider that the results provide important evidence on the psychometric properties in the Peruvian population.

Another limitation could be associated with the non-inclusion of children in the study. It is recommended that future research includes this group to test the population-based external validity of these results.

And another limitation is the lack of proportionality in the participants according to the stage of development, with the majority being adults (young and intermediate) and a smaller number of adolescents and older adults, which could bias the results.

7. Suggestions

It is suggested to deepen the study of the DASS-21, considering children to complete the general population in Peru, to contrast the results found in previous studies and understand the power of the measurement of the scale evaluated.

Future research should include gender invariance to understand whether the instrument is valid for application in men and women.

The DASS-21 studies must clinically identify the symptoms in due time, to apply the necessary interventions of health professionals, in addition, this must involve the continuous improvement of mental health policies and strengthen community mental health centers to serve the entire population and prevent misfortunes that may affect the population.

8. Conclusions

Therefore, we can conclude that the DASS scale for the Peruvian population in general shows good psychometric properties, providing a validated and reliable instrument.

Finally, the results of the study presented should serve as a basis and motivation for future research that addresses the difficulties that arise in mental health. The advancement of science should allow the identification of the real situation of people in order to provide timely care to the population, improving interventions and implementing mental health programs through prevention and health promotion in establishments of health. community mental health in Peru, contributing to the well-being of the entire population.

Conflict of interest

The authors declare that they have no conflict of interest.

Acknowledgment

References

1. Salinas-Muñoz, J., Livia Segovia, J., Campos-Uscanga, Y., Argüelles-Nava, V., Contreras-Alarcón, G., & Mota-Morales, M. (2024). Psychometric characteristics of the Depression, Anxiety and Stress Scale (DASS-21) in university students. Research in Medical Education, 13(50): 68-78. doi:10.22201/fm.20075057e.2024.50.23549
2. Lovibond, P. F., and Lovibond, S. H. (1995). The Structure of Negative Emotional States: Comparison of the Depression and Anxiety Scales (DASS) with the Beck Depression and Anxiety Inventories. Behavioral Research and Therapy, 33(3): 335–343. doi:10.1016/0005-7967(94)00075-U
3. Duffy, C. J., Cunningham, E. G., & Moore, S. M. (2005). Brief report: The factor structure of moods in a sample of early adolescents. Journal of Adolescence, 28(5): 677-680. doi:10.1016/j.adolescence.2005.08.013
4. Szabó, M., & Lovibond, P. F. (2006). Anxiety, depression, and tension/stress in children. Journal of Psychopathology and Behavioral Evaluation, 28(3): 195-205. DOI:10.1007/S10862-005-9008-3
5. Kyriazos, T. A., Stalikas, A., Prassa, K., & Yotsidi, V. (2018). Can the Depression, Anxiety, Stress Scales be shorter? Factor structure and measurement invariance of DASS-21 and DASS-9 in a non-clinical Greek sample. Psychology, 9(5): 1095-1127. doi:10.4236/psych.2018.95069
6. Lee, E. H., Moon, S. H., Cho, M. S., Park, E. S., Kim, S. Y., Han, J. S., & Cheio, J. H. (2019). The 21- and 12-item versions of the Depression, Anxiety, and Stress Scales: Psychometric Assessment in a Korean Population. Asian Nursing Research, 13(1): 30-37. doi:10.1016/j.anr.2018.11.006
7. Moussa, M. T., Lovibond, P., Laube, R., & Megahead, H. A. (2017). Psychometric properties of an Arabic version of the Depression, Anxiety and Stress Scales (DASS). Research on Social Work Practice, 27(3): 375-386. doi:10.1177/1049731516662916
8. D. Valencia, P. (2019). Depression, Anxiety, and Stress Scales (DASS-21): Do They Measure More Than a General Factor? Advances in Psychology, 27(2): 177–190. doi:10.33539/avpsicol.2019.v27n2.1796
9. Tapullima, C., & Chávez Castañeda, B. R. (2021). Stress, Anxiety and Depression Scale (DASS-21): psychometric properties in adults from the province of San Martín. PsycheMag, 11(1): 73–88. doi:10.18050/psychemag.v11i1.2575
10. Contreras-Mendoza, I., Olivas-Ugarte, L., & De la Cruz-Valdiviano, C. (2021). Abbreviated Depression, Anxiety and Stress Scales (DASS-21): Validity, Reliability and Equity in Peruvian Adolescents. Journal of Clinical Psychology with Children and Adolescents, 8(1): 24-30. doi:10.21134/RPCNA.2021.08.1.3
11. Carlos-Colchado, E., Chavez-Aburto, L., Dextre-Paye, K., Mallqui-García, S., & De la Cruz-Valdiviano, C. (2023). Depression, Anxiety and Stress Scales (DASS-21) psychometric evidence in university students. EUREKA, 20(1): 26-42.
12. R. (2020) Core Team. A: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/
13. RStudio Team. (2020). RStudio: Integrated Development Environment for R. RStudio, PBC, Boston, MA. https://rstudio.com/
14. Wickham, H., & Miller, E. (2020). haven: Importing and exporting SPSS, Stata, and SAS (2.3.1) [Computer Software] files. https://CRAN.R-project.org/package=haven
15. Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T. L., Miller, E., Bache, S. M., Müller, K., Ooms, J., Robinson, D., Seidel, D. P., Spinu, V., ... Yutani, H. (2019). Bienvenidos al Tidyverse. Revista de software de código abierto, 4(43): 1686. doi:10.21105/joss.01686
16. Revelle, W. (2020). Psych: Procedures for Psychological, Psychometric and Personality Research (2.0.8) [Computer Software]. https://CRAN.R-project.org/package=psych
17. Schauberger, P., Walker, A., Braglia, L., & Sturm, J. (2020). openxlsx: Reading, Writing, and Editing xlsx Files (4.2.2) [Computer Software]. https://CRAN.R-project.org/package=openxlsx
18. Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling. Journal of Statistical Software, 48(1): 1-36. DOI:10.18637/JSS.V048.I02

19. Epskamp, S., Stuber, S., Nak, J., Veenman, M., & Jorgensen, T. D. (2019). semPlot: Route diagrams and visual analysis of the output of various SEM packets (1.1.2) [Computer Software]. https://CRAN.R-project.org/package=semPlot

20. Keith, T. Z. (2015). Multiple Regression and Beyond: An Introduction to Multiple Regression and Structural Equation Modeling (2nd ed.). Routledge/Taylor & Francis Group. https://www.routledge.com/Multiple-Regression-and-Beyond-An-Introduction-to-Multiple-Regression-and/Keith/p/book/9781138061446

21. Kelley, K. (2020). MBESS: The MBESS R (4.8.0) [software] package. https://CRAN.R-project.org/package=MBESS

22. Revelle, W. (2024). psych: Procedures for psychological, psychometric, and personality research (2.4.6.26) [Software]. https://cran.r-project.org/web/packages/psych/index.html

23. George, D., Mallery, P. (2010). SPSS for Windows Step-by-Step: A Simple Guide and Reference, Update 17.0 (Tenth Edition)

24. McDonald, R.P. (1999). Test Theory of Tests: A Unified Treatment. Lawrence Erlbaum Association.

25. Lloret-Segura, S., Ferreres-Traver, A., Hernández-Baeza, A., & Tomás-Marco, I. (2014). Exploratory factor analysis of items: A practical, revised and updated guide. Annals of Psychology, 30(3): 1151-1169. doi:10.6018/analesps.30.3.199361

26. Harrington, D. (2009). Confirmatory factor analysis. New York: Oxford University Press.

27. Ferrando, P. J., & Lorenzo-Seva, U. (2014). Exploratory factor analysis of items: Some additional considerations. Annals of Psychology, 30(3): 1170-1175. doi:10.6018/analesps.30.3.199991

28. Izquierdo, I., Olea, J., & Abad, F. J. (2014). Exploratory factor analysis in validation studies: Uses and recommendations. Psychotheme, 26(3): 395-400. doi:10.7334/psicothema2013.349

29. Mundfrom, D. J., Shaw, D. G., & Ke, T. L. (2005). Recommendations for minimum sample size for factor analysis. International Journal of Evidence, 5(2): 159-168. doi:10.1207/s15327574ijt0502_4

30. Domínguez-Lara, S. A., & Merino-Soto, C. (2015). Why is it important to report Cronbach's alpha coefficient confidence intervals? Latin American Journal of Social Sciences, Childhood and Youth, 13(2): 1326-1328. http://revistaumanizales.cinde.org.co/rlcsnj/index.php/Revista-Latinoamericana/article/view/2030

31. Ventura-León, J. L., & Caycho-Rodríguez, T. (2017). The Omega coefficient: An alternative method for estimating reliability. Latin American Journal of Social Sciences, Childhood and Youth, 15(1): 625-627.