ISSN online 1688-4221

Ciencias Psicológicas January-June 2025; 19(1), e-4257
DOI: 10.22235/cp.v19i1.4457

Factor structure, invariance, sensitivity and specificity of the DASS-13 in the Peruvian population

Estructura factorial, invarianza, sensibilidad y especificidad de la DASS-13 en población peruana

Estrutura fatorial, invariância, sensibilidade e especificidade da DASS-13 na população peruana

Betty Giovanna Peña-Tomas[1]
Antonio Serpa Barrientos[1]
Aaron Caycho-Caja[2]
Juan Carlos Escudero-Nolasco[1]

[1] Universidad Nacional Mayor de San Marcos
[2] Universidad de San Martín de Porres

Received: 09/09/2024
Accepted: 31/03/2025

Correspondence:
Betty Giovanna Peña-Tomas
bpenat@unmsm.edu.pe

How to cite:
Peña-Tomas, B. G., Serpa Barrientos, A., Caycho-Caja, A., & Escudero-Nolasco, J. C. (2025). Factor structure, invariance, sensitivity and specificity of the DASS-13 in the Peruvian population. *Ciencias Psicológicas*, *19*(1), e-4257. https://doi.org/10.22235/cp.v19i1.4257

Data Availability:
The dataset supporting the results of this study is available at Mendeley Data, doi: 10.17632/ybdn42693y.1.

Funding: This study did not receive any external funding or financial support.

Conflict of interest: The authors declare that they have no conflicts of interest.

Abstract: The Depression, Anxiety and Stress Scale (DASS-21) is a widely used instrument in the health field, although it is still debated whether its factorial structure corresponds to a one-dimensional or three-factor model, which may be relevant in relation to screening of anxiety, depression and stress as unique factors or to the use of a general measure of negative emotions. In this sense, a sample of 1010 Peruvians from various parts of the country was studied, an exploratory analysis of psychological networks was applied and a confirmatory and semi-confirmatory factor analysis of a brief bifactorial model of the DASS-21 was performed, which was complemented with the ROC curves. Among the most relevant findings is the equivalence of the short version DASS-13 with the DASS-21. Likewise, both the confirmatory and semi-confirmatory bifactorial model support its use as a unidimensional measure, although it shares variance with specific factors. In addition, evidence of the invariance of the DASS-13 was provided according to the gender of the participants, in the same way a specificity and sensitivity of 78.45 % and 52.25 % was found that suggest that the DASS-13 is a more useful tool to discard than for detection. It concludes by supporting the use of the DASS-13 as an essentially one-dimensional measure of negative affect.

Keywords: depression; anxiety; stress; negative emotions; DASS-21

Resumen: La Depression, Anxiety and Stress Scale (DASS-21) es un instrumento muy utilizado en el ámbito de la salud, aunque aún se discute si su estructura factorial corresponde a un modelo unidimensional o trifactorial, lo cual puede ser relevante con relación a la tamización de ansiedad, depresión y estrés como factores únicos o al empleo de una medida general de emociones negativas. En tal sentido, se estudió una muestra de 1010 peruanos provenientes de diversas partes del país, se aplicó un análisis de redes psicológicas de tipo exploratorio y se realizó un análisis factorial confirmatorio y semiconfirmatorio de un modelo bifactorial breve de la DASS-21 que se complementó con las curvas ROC. Dentro de los hallazgos más relevantes se señala la equivalencia de la versión breve DASS-13 con la DASS-21. Asimismo, el modelo bifactorial confirmatorio y semiconfirmatorio apoyan su uso como medida unidimensional, aunque comparte varianza con factores específicos. Además, se brindó evidencia de la invarianza de la DASS-13 según el género de los participantes, de igual manera se halló una especificidad y sensibilidad de 78.45 % y 52.25 %, que sugieren que la DASS-13 es una herramienta más útil para descarte que para detección. Se concluye en apoyo al uso de la DASS-13 como medida esencialmente unidimensional de afecto negativo.

Palabras clave: depresión; ansiedad; estrés; emociones negativas; DASS-21

Resumo: A Depression, Anxiety and Stress Scale (DASS-21) é um instrumento amplamente utilizado na área da saúde, embora ainda se discuta se sua estrutura fatorial corresponde a um modelo unidimensional ou trifatorial, o que pode ser relevante em relação à triagem de ansiedade, depressão e estresse como fatores únicos ou para o uso de uma medida geral de emoções negativas. Nesse sentido, foi estudada uma amostra de 1010 peruanos provenientes de diversas partes do país, aplicou-se uma análise de redes psicológicas de tipo exploratória, e realizou-se uma análise fatorial confirmatória e semiconfirmatória de um modelo bifatorial breve da DASS-21, complementada com as curvas ROC. Entre os achados mais relevantes, destaca-se a equivalência da versão breve DASS-13 com a DASS-21. Da mesma forma, tanto o modelo bifatorial confirmatório quanto o semiconfirmatório apoiam seu uso como medida unidimensional, embora compartilhe variância com fatores específicos. Além disso, foi apresentada evidência da invariância da DASS-13 de acordo com o gênero dos participantes, e foi encontrada uma especificidade e sensibilidade de 78,45% e 52,25%, o que sugere que a DASS-13 é uma ferramenta mais útil para exclusão do que para detecção. Conclui-se apoiando o uso da DASS-13 como uma medida essencialmente unidimensional de afeto negativo.
Palavras-chave: depressão; ansiedade; estresse; emoções negativas; DASS-21

Depression, anxiety and stress are the most frequent mental health problems in the population (World Health Organization [WHO], 2023); In turn, in Peru, the most prevalent problems in health services are: depression, anxiety, reaction to acute stress, among others, which indicates the importance of being detected and treated in time (Ministry of Health of Peru, 2023). According to Ipsos (2023), 34% of people affirm that stress has affected their lives several times in the last 12 months, with women being more likely to suffer from it. In relation to depressive disorders, the annual prevalence is 9.2%; and of anxiety disorders in general it is 2.5%, being more frequent in women (Saavedra Castillo et al., 2018).

Anxiety and depression have been classically considered as different diagnostic categories. However, over time there has been a complex debate regarding the differentiation of symptoms, since both present a high rate of comorbidity (Alonso et al., 2004; Wu & Fang, 2014). Likewise, the instruments that measure the symptoms of depression and anxiety usually show very strong correlations with each other (Agudelo et al., 2014; Iani et al., 2014). These two facts complicate the differential evaluation of depression and anxiety disorders (Cosci & Fava, 2021; Marey et al., 2024; Minea et al., 2022).

Faced with this situation, Lovibond and Lovibond (1995) designed the Depression, Anxiety and Stress Scale (DASS), with 42 items, in whose analysis a third factor called Stress was obtained. The DASS consists of three factors: depression defined as a low level of affectivity, sadness, hopelessness and difficulty in enjoyment; anxiety understood as physiological tension and agitation; and stress as the persistent state of over-activation that expresses the difficulty in coping with daily demands. This scale was based on the tripartite model of anxiety and depression proposed by Clark and Watson, (1991), which seeks to explain and differentiate the common and specific components of these two psychological disorders. Additionally, it identifies general distress as a common component and physiological hyperarousal (anxiety) and anhedonia (depression) as specific factors. It is added that the model provides a basis for a more precise diagnosis and more effective treatments.

Later, Antony et al. (1998) developed the reduced version of 21 items of the DASS (DASS-21). Their analyzes confirmed the three-factor structure of the DASS and the DASS-21 in clinical and non-clinical groups. This short version became well known and was used in various investigations assuming the proposal of measuring the aforementioned factors (Yeung et al., 2020). Although the scale has three theoretical dimensions, investigations of the instrument's psychometric properties have revealed certain peculiarities associated with its multifactorial or univariate structure in different countries (Yeung et al., 2020).

The DASS-21 has been extensively analyzed in various contexts, evaluating its factorial structure and reliability. In Asia, Chen et al. (2023) performed a confirmatory factor analysis (CFA) in Chinese students, identifying three- and four-dimensional structures with acceptable fit indices (CFI> .90, RMSEA < .05 SRMR < .05). Cao et al. (2023) applied the DASS-21 to Chinese teachers and confirmed support models for two and three dimensions. In South Korea, Lee, Moon et al. (2019) validated versions of 12 (DASS-12) and 21 items (DASS-21) with acceptable fit, although they added alternative hierarchical and one-dimensional models. In India, the DASS-21 was used with cancer patients and by exploratory factor analysis (EFA), Kumar et al. (2019) found four factors. Kakemam et al. (2022), in Iran, confirmed the version of correlated factors of the DASS-21. In Africa, Ali and Green (2019), in Egyptian patients, through an EFA, found five factors, but the use of parallel analysis suggested a one-dimensional

structure (DASS-17) although with respecifications. In Arabia, Ali et al. (2021) performed an EFA with three factors; while, with the CFA (DASS-8), they identified models with one, two or three dimensions, but with fit problems. Bibi et al. (2020), with a CFA, validated the three-factor structure of the DASS-21 in a sample from Pakistan and Europe; while in Spain, Malas and Tolsá (2022) supported a two-factor model of the DASS-21.

In America, Ali et al. (2022) analyzed the DASS-21 in students from the United States, Australia and Ghana, finding a short version (DASS-8) of correlated factors, although they also tested first, second order and bifactorial models. Gonzalez et al. (2019), in Brazil, supported a second-order model (DASS-21), while, in Puerto Rico, González-Rivera et al. (2020) proposed an EFA with a one-dimensional model (DASS-10).

In Peru, Valencia (2019) tested models of one, two and three factors, and bifactorial models of the DASS-21 in university students, finding an acceptable fit for the bifactorial model, but concluding the presence of a single factor. Contreras-Mendoza et al. (2021) evaluated one- and three-factor models and a hierarchical model in schoolchildren of the DASS-21, finding an acceptable fit for the second-order model and correlated factors, although they suggested analyzing each scale independently.

According to the following analysis, the studies regarding the DASS-21 have shown diverse results, which have tempted brief models with a variable number of items (DASS-8, DASS-10, DASS-12, DASS-17). It is striking to find that, in the EFA models, solutions of four (Ali et al., 2021; Kumar et al., 2019) or five factors (Ali & Green, 2019) have been found. Similarly, in the CFA of the DASS-21, it is frequent to consider one-dimensional scales (Valencia, 2019), two (Cao et al., 2023) or four factors (Chen et al. 2023), in addition to Items with factor loadings in factors other than the respective one. In addition, the high intercorrelations between the dimensions have led to the testing of bifactorial models that appear to have been the most successful (Ali et al., 2021; Ali et al., 2022; Valencia, 2019). Likewise, a meta-analysis of the DASS-21 (Yeung et al., 2020) in the period 1993-2018 found that EFAs have mainly proposed models of one, three or four factors, with questionable methods such as principal component analysis and orthogonal rotation. Since the CFA, one or two factor models have been proposed, but bifactorial models with three factors have shown a better fit than those with three correlated factors (Lee, Lee et al., 2019; Yeung et al., 2020).

As has been observed, bifactorial models are being used more frequently to identify the complex nature of DASS-21 (Yeung et al., 2020). These allow us to identify the variance of the specific factors of depression (D), anxiety (A) and stress (S) and also the variance of the general factor (negative affect). This technique has also been implemented from the exploratory modeling of structural equations (ESEM), with a less restrictive approach than the traditional one (Marsh et al., 2014) and places the analysis in an intermediate semi-confirmatory position between the CFA and the EFA, which which allows greater flexibility of analysis. In addition, this approach has already been used in DASS-21 (Malas & Tolsá, 2022) and may allow integrating the tripartite approach of Clark and Watson (1991) that assumes a component of negative affect common to depression and anxiety.

Likewise, the aspects mentioned related to the structural instability of the DASS-21 have led to the consideration of new analysis techniques. The analysis of psychological networks allows to identify the hypothesized constructs either as specific factors or a general factor by differentiating the present communities evaluated from weighted undirected networks identified considering the association between the items (edges) (Fonseca-Pedrero, 2017). The exploratory analysis of networks has even been compared with the EFA and it has been found that it is usually more precise to determine the number of factors (Christensen, 2020; Golino & Epskamp, 2017; Ouyang et al., 2020), which is very useful given the instability of the DASS-21. However, although it is a versatile tool, only one study has been found that applies to DASS-21 (Van den Bergh et al., 2021).

Studies have also been found that have identified that DASS-21 is invariant according to sex (Malas & Tolsá, 2022; Martins et al., 2019; Vaughan et al., 2020). However, the prevalence of depression, anxiety and stress is usually higher in women (Fentahun et al., 2023; WHO, 2023), which leads the present study to analyze the factorial invariance of the DASS-21.

Another important aspect to consider is the practical utility of the scale, this implies its ability to identify people who present relevant indicators of depression, anxiety and stress. The analysis of the ROC curves seeks to determine the accuracy of tests that use continuous scales from the determination of the cut-off point at which the highest sensitivity and specificity is reached, as well as the evaluation of the discriminative capacity of the test (Cerda & Cifuentes, 2012).

According to the above, the justification for this study is that there have been no studies in the Latino population that evaluate the DASS-21 from the analysis of psychological networks despite its superiority over other techniques (Christensen, 2020; Golino & Epskamp, 2017; Ouyang et al., 2020). Likewise, the analysis of a brief version of the DASS-21 allows to reveal the nature of the symptoms of depression and anxiety, given the referred overlap, which in clinical contexts could contribute to the differential diagnosis of the previous ones by means of brief and quick instruments to apply. Likewise, the invariance analysis can provide a useful instrument for both men and women.

From the review carried out, it is expected to find high correlations between the factors of the DASS-21, in addition to problems associated with the identification of the one-dimensional or multidimensional structure. In this context, the analyzes carried out seek to: a) identify a brief version of the DASS-21 through network analysis, b) test the unidimensionality or multidimensionality of the model, c) evaluate the confirmatory or semi-confirmatory bifactorial models, d) analyze the invariance of the short version and e) identify the cut-off points of sensitivity and specificity of the final short version.

Method

Participants

The 1110 participants are mostly women (64.4 %) and the remaining men, who come from the coast (71.2 %), sierra (18.4 %) and jungle (10.5 %) of Peru who do not report having symptoms of depression (81.2 %), while the others say yes (9.3 %) or maybe (9.5 %). The average age of the participants was 30.3 (*SD* = 10.8, min = 15, max = 74). It is also indicated that a significant proportion of them are single (69.8 %), and to a lesser extent are married (14.6 %), cohabiting (11.1 %), separated (3.3 %) and widowed (1.2 %). 50% of the sample indicates that they have undergraduate university studies, 19.2 % are graduate students, 17.7 % are technical studies, 12 % complete secondary and 0.4 % elementary.

Instruments

The instrument used is the DASS-21 (Lovibond and Lovibond, 1995), which is a short version of the DASS, prepared in a Likert response format with four response categories. The DASS-21 has three subscales that measure Anxiety, Depression and Stress, each of these with seven respective dimensions. The DASS was originally designed as a three-factor instrument, although later studies have found more parsimony in bifactorial models in which a general factor of negative emotions and the specific factors Depression, Anxiety and Stress are assumed (Yeung et al., 2020). In Peru, Valencia (2019) has found a bifactorial model and the study by Contreras-Mendoza et al. (2021) has preferred to consider each factor as an independent dimension, according to its original purpose.

Procedure

The project was reviewed and approved by the Ethics and Research Committee of the San Juan de Lurigancho Hospital belonging to the Ministry of Health of Peru, following the guidelines of the Declaration of Helsinki and the Code of Ethics of the College of Psychologists of Peru. Then, the information was collected through virtual forms that were disseminated by different social networks during the previous year. Likewise, the participants were asked to give their informed consent for the application of the instrument. Subsequently, the analyzes were carried out with the statistical software R Studio (RStudio Team, 2022) and FACTOR (Ferrando & Lorenzo-Seva, 2017).

Data analysis

Initially, the dimensionality of the DASS-21 was explored using *bootstrap* exploratory graph analysis (bootEGA), an advanced and robust approach in network psychometry that allows estimating the stability of communities and items in multivariate data (Christensen & Golino, 2021) and that it has been shown to be even more accurate than the EFA (Christensen, 2020; Golino & Epskamp, 2017; Ouyang et al., 2020). A parametric procedure was implemented to generate 500 initial replication samples, applying the GLASSO network estimation method (Graphical Selection Operator and Absolute Minimum Contraction) to estimate the Gaussian Graphical Model (GGM), in combination with the community detection algorithm. *Walktrap* (Christensen & Golino, 2021).

Descriptive statistics were calculated for the DASS-21 dimensions, including the median, standard deviation, confidence intervals, and quartiles, providing a comprehensive view of the stability

of these dimensions (Christensen & Golino, 2021). Structural consistency was used as a key measure to evaluate the stability of the dimensions, defined as the degree of interrelation and homogeneity between the items within the multidimensional structure of the questionnaire. This consistency is manifested in the coherent grouping of communities within a psychological network (Christensen et al., 2020). In this way, structural consistency is presented as an alternative to the traditional reliability coefficients (for example, α, ω) commonly used in factor analysis (Christensen et al., 2020; Christensen & Golino, 2021). Those items with a stability equal to or greater than .75 were considered acceptable, as well as those that presented significant average network loads for a small effect size (≥ 0.15) (Christensen & Golino, 2021).

With the unstable items eliminated and with the intention of contrasting with previous studies, a CFA was used. A first order model of three correlated factors was proposed considering the WLSMV estimator with the items chosen from the previous step. Then, considering the overlap between the factors of the DASS-21, the presence of the general factor of negative affect tested in previous models and the most relevant findings of a previous review (Yeung et al., 2020), a model was proposed bifactorial with a general negative affect factor and the specific factors (D, A, S), also with the same estimator and considering the suggested adjustment indices (RMSEA ≤ .07, SRMR ≤ .08, CFI ≥ .92, TLI ≥ .92) (Hair et al., 2014; Hu & Bentler, 1998). The bifactorial model includes a general factor that influences all the items of the DASS-13, while the specific factors (anxiety, stress and depression) directly affect their corresponding items (Figure 4).

Given that the confirmatory models are more restrictive, intermediate models between CFA and AFE were tested and that at the same time capture their complex structure either as a unidimensional or multifactorial measure. In this sense, a semi-confirmatory bifactorial analysis was added (Lloret-Segura et al., 2014). In the semi-confirmatory model, each specific factor has a direct effect on all the items of the DASS-13. That is, depression influences its items, but also those corresponding to anxiety and stress; in the same way for stress and anxiety. The general factor maintains its effect on all items. For this purpose, an objective matrix was elaborated with three columns corresponding to depression, anxiety and stress. In this matrix, each item is placed in a row in order and loads .90 on the main factor and .15 on the remaining factor. This approach allows us to assume some degree of association in the items that do not correspond to the main factor, unlike the simple structure of Thurstone (1947) in which the cross loads must be close to zero. To this was added a procustean rotation that guides the empirical data, according to the established theory. The FACTOR program (Ferrando & Lorenzo-Seva, 2017) allows incorporating this matrix and the choice of rotation for the indicated analysis. The analysis of the bifactorial model also considered the explained common variance (ECV), the percentage of uncontaminated correlations (PUC), the reliability of the construct or coefficient H, in addition to the calculation of the total, specific and hierarchical omega coefficient, as complementary indices of the bifactorial models (Dominguez-Lara & Rodríguez, 2017) since they show better fit indices compared to first-order models. PUC values> .70 and ECV> .70 (Rodriguez et al., 2016) were considered to consider the model as essentially one-dimensional, in the same way if a high hierarchical Omega is found (ω_h > .70) (Reise et al., 2013). Subsequently, the invariance of the DASS-13 was contrasted from a multigroup factor analysis approach (MGCFA) according to the sex of the participants. This model implies gradually restricting thresholds, intercepts, factor loads and residuals. If the difference between the consecutive models is not significant (ΔRMSEA <.015, ΔSRMR <.01, Δ CFI <.01), it can be concluded that the model remains invariant for both groups. Finally, the ROC curves were used, a method used to determine the diagnostic accuracy of the tests, by establishing the cut-off point at which the highest sensitivity and specificity are reached, as well as their discriminative capacity (Cerda & Cifuentes, 2012). In this way, a regular discriminative capacity of the test was defined starting from the value .6 in the area under the curve (AUC) (Martínez Pérez & Pérez Martin, 2023). In addition, the optimal cut-off points were chosen based on the Youden index, whose function is to identify the cut-off point that jointly determines the highest sensitivity and specificity (Cerda & Cifuentes, 2012).

Results

Affective symptoms

Figure 1 shows the dynamic composition of the bootEGA of the DASS21 scale, where the left part shows a representation of four possible dimensions, the red nodes group the following items: "de3", "de5", "es8", “An9”, “de13”, “es14”, “an15” and “an20”. In the same way, the other three dimensions also

group items but more precisely according to the domains of the theory, so the dimensions of stress (orange nodes: es1, es6, es11, es12 and es18), anxiety (nodes light blue: an2, an4, an7 and an19) and depression (green nodes: de10, de16, de21 and de17) are represented by the items that have been drawn up and designated to make up the said domain; these three dimensions are also shown in the figure "a" more peripheral to the group of items constituted topographically more centric.

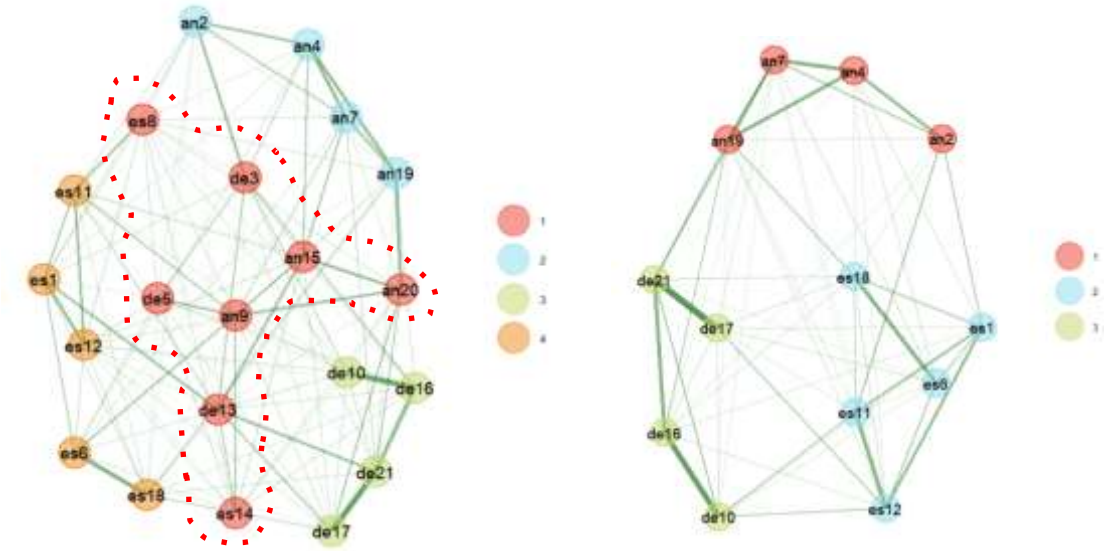
However, the visual analysis accompanied by the syntactic analysis of each of the items that supposedly would form a dimension other than what the DASS-21 consists of only three dimensions suggested that a new analysis be carried out; therefore, it was withdrawn. All the items are circumscribed in red for the corresponding analysis. That is, they presented low centrality and weak or redundant connections within their respective symptomatic communities. The parsimonious network, resulting from its exclusion, showed a clearer and more coherent organization, maintaining the differentiation between the domains of depression, anxiety and stress without compromising the conceptual structure of the instrument.

In addition to the structural criterion, syntactic and semantic aspects that reinforce the exclusion decision were considered. For example, item "de3" ("I could not feel any positive feelings") is ambiguous and difficult to interpret and may overlap with constructs such as anhedonia or alexithymia. The item "an9" ("I was worried about situations in which I could panic or in which I could make a fool of myself") is extensive and combines elements of social anxiety and panic, which hinders its diagnostic specificity. Likewise, "es14" ("I did not tolerate anything that would not allow me to continue with what I was doing") presents complex and elaborate wording that is not very accessible to the general population. These observations empirically and conceptually support the elimination of the items mentioned above, strengthening the structural validity and economy of the instrument.

The results (Figure 1, right) provide a more parsimonious dynamic network close to the conceptual domain of the DASS-21, which consists of three dimensions (stress, anxiety and depression) with 13 items.

Figure 1

Exploratory graphical analysis: dimensionality by bootEGA of the DASS-21



On the other hand, the description of the dimensions of the DASS-21 in all the start-ups (with 500 replications) specifies that it would also be represented as a one-dimensional model and not a multidimensional approach; that is, according to the results obtained in the starting replica samples of the DASS-21 model, all dimensions have a median of 1, which suggests that most of the responses are at the minimum level of intensity of the symptoms evaluated (Table 1). The standard error of the dimensions is 0, which indicates low variability in the scores of the dimensions in the replicates analyzed. Furthermore, the confidence interval of the dimensions is 0, which suggests that no significant differences were found in the scores of the dimensions in the starting replicates analyzed. The lower and upper limits of the confidence interval are also 1, indicating that the point estimate of the

dimensions is consistent across all the replicates. Finally, both the lower quartile and the upper quartile have a value of 1, which confirms the concentration of the scores at the minimum level of intensity of the symptoms. In summary, the results of the initial replicate samples of the model indicate that the dimensions of the DASS-21 present consistent and concentrated scores at the minimum level of intensity of the symptoms evaluated.

On the other hand, the start-up samples of the second model that groups groups 13 items was also analyzed. The results obtained from both initial replicate samples indicate that the DASS-21 and DASS-13 models yield identical values in all the statistical aspects analyzed (Table 1). These results suggest that the convergence in three dimensions is not optimal, on the contrary, the descriptive analysis of the network saturates in one dimension and to have a better understanding of one-dimensional stability, the structural consistency was calculated (see Table 2 and Figure 2).

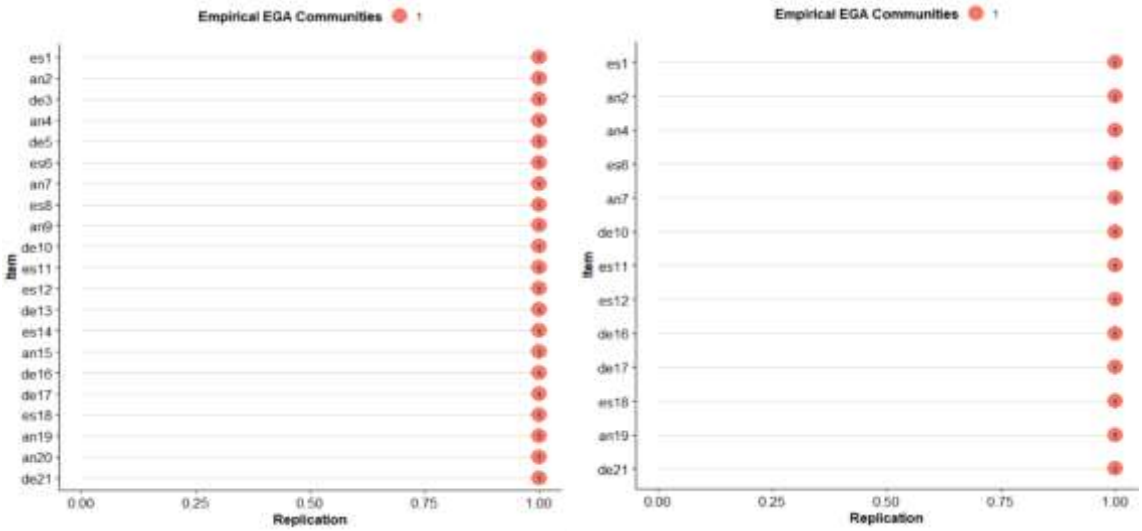
Table 1

Descriptive statistics for the dimensions in across all samples of initial replicates

	n.Boots	media n.dim	SE.dim	CI.dim	LowerCI	UpperCI	Lower Quantile	Upper Quantile
Model DASS-21	500	1	0	0	1	1	1	1
Model DASS-13	500	1	0	0	1	1	1	1

Figure 2

Stability of the questionnaire items



Regarding the analysis of the unidimensional stability of the items in the DASS-21 model, the average network load values ranged from λ = .163 for the item “an2” to λ = .258 for the item "De13". For its part, the DASS-13, comprises relatively higher parameters compared to the DASS-21 of having removed eight more items. For example, the item “an2” shows an increased load, with a revise λ value of .198 and for its part for item “de21” increased from .254 to .332 of average load. In sum, the removal of items that tried to be grouped to form a new dimension contributed to the unidimensional structural consistency of the scale with a total of 13 items (Table 2).

Table 2

One-dimensional stability for the items in all the initial replicate samples

DASS-21		DASS-13	
Item	Average network load	Item	Average network load
es1	.204	es1	.266
an2	.163	an2	.198
de3	.210	-	-
an4	.199	an4	.259
de5	.175	-	-
es6	.183	es6	.230
an7	.203	an7	.263
es8	.187	-	-
an9	.240	-	-
de10	.208	de10	.258
es11	.195	es11	.251
es12	.233	es12	.295
de13	.258	-	-
es14	.193	-	-
an15	.264	-	-
de16	.233	de16	.293
de17	.223	de17	.283
es18	.194	es18	.254
an19	.207	an19	.262
an20	.216	-	-
de21	.254	de21	.332

The analysis of the *bootEGA* revealed that the DASS-21, apparently, would not be supported solely as a multidimensional model composed of three dimensions (anxiety, stress and depression) but that it can also be justified by a general dimension called "affective symptoms". Notably, both models analyzed (DASS-21 and DASS-13) confirm unidimensionality, although the second model (DASS-13) presents more consistent and parsimonious parameters than the first model (DASS-21). This implies that no significant differences were found in the dimensions evaluated between the two models. However, it is important to consider that these results are based on a specific set of replications; therefore, to strengthen these results, they were analyzed via factorial techniques (CFA and bifactor).

Factor analysis

The interpretation of the fit parameters of the evaluated models reveals relevant information about the quality of the fit of each model. In the case of the DASS-21 model, X^2/df = 5.427 is observed, which indicates a reasonably unacceptable fit. The comparative fit indices CFI and TLI exceed the threshold of .90, which implies that the model fits better than the null model does. Furthermore, the SRMR has a low value of .034, which suggests a good fit in relation to the standardized residuals. However, the RMSEA = .079 indicates a moderate fit (CI 90% .074-.084) (Table 3).

On the other hand, the DASS-13 model (Figure 3) has X^2df = 4.843, indicating an acceptable fit of the model. The CFI and TLI indices exceed the threshold of .90. In addition, the SRMR has a low value of .028. However, the RMSEA = .076 indicates a moderate fit (CI 90% .067-.085). These results, in comparison with those of the DASS-21, were relatively superior, which indicates that the oblique model of three dimensions would be more precise in terms of its validity on the basis of the internal structure.

Consequently, we proceed to analyze a third model that allows us to make visible and specify the consistency of a general factor. The results of the bifactorial model (DASS-13) show X^2/df equal to 2,670, indicating an optimal fit. Compared with the other two models, the CFI and TLI indices, in addition to exceeding the threshold of .90, were the most accurate. The SRMR presents a low value of .026, and the RMSEA = .059 indicates a moderate adjustment (CI 90% .053-.066). In summary, the three models evaluated present an acceptable fit in general, but with differences in the values of the parameters, as the model that best represents the construct in the DASS-13 bifactor.

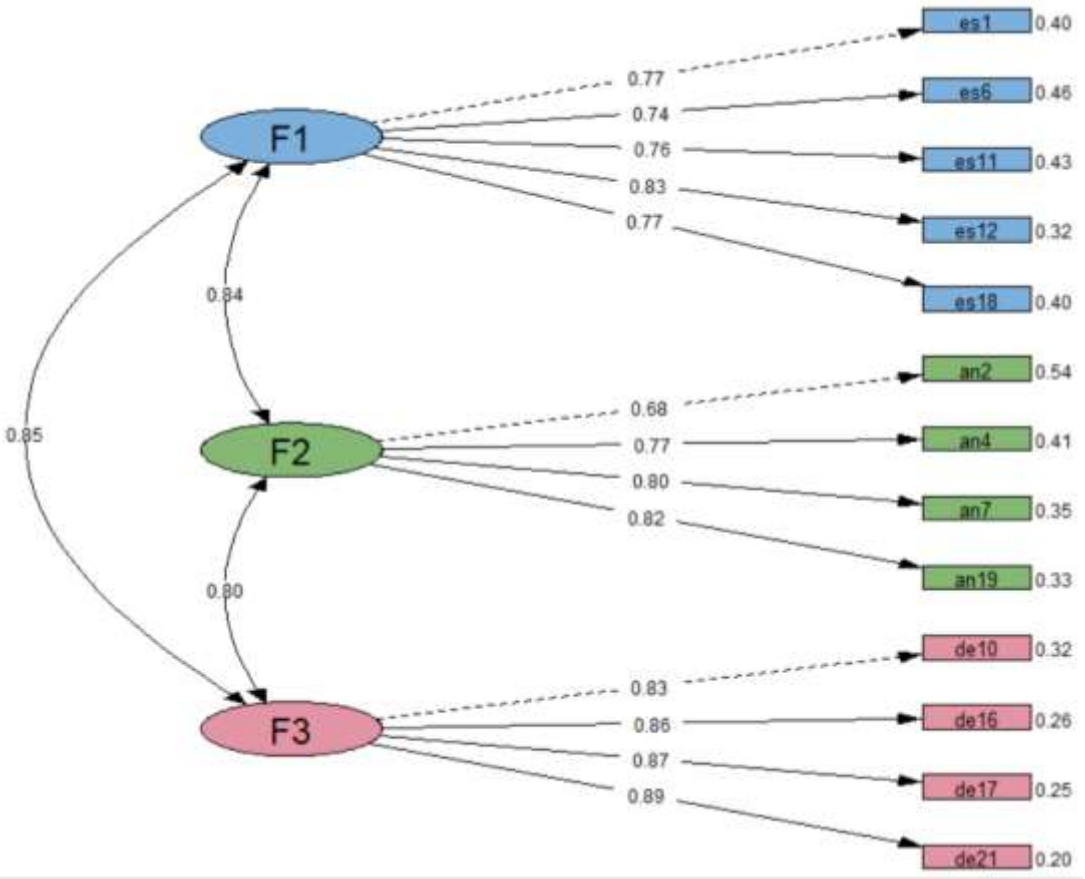
Table 3

Fit parameters of the evaluated models

Model	X^2	*df*	X^2/df	CFI	TLI	SRMR	RMSEA	90 % CI RMSEA	
								Inf.	Sup.
DASS-21	1009.364	186	5.427	.931	.922	.034	.079	.074	.084
DASS-13	300.248	62	4.843	.961	.951	.028	.076	.067	.085
Bifactor	138.833	52	2.670	.988	.983	.026	.059	.053	.066

Figure 3

Graphic representation of the DASS-13 measurement model



Note. F1: stress; F2: anxiety; F3: depression.

In order to have a greater precision in the reading of the bifactorial model, the estimates of the indices provide valuable information on the structure and quality of the measures used in the model (affective symptoms). Based on the results obtained, it can be concluded that the amount of common variance extracted (CVD) shows that approximately 83.2% of the variance in the observed variables is explained by the common variance of the bifactorial model. The percentage of uncontaminated correlations (PUC) reveals that around 71.8% of the correlations between the observed variables are not influenced by the specific factors. This suggests that the bifactorial model is able to effectively isolate the unique variance of each variable. Likewise, the hierarchical omega (ω_h) has a value of .899, which indicates that a significant proportion of the total variance in the observed variables is explained by the general factor of the bifactorial model. This suggests that the general factor is an important influence on the measures used (Table 4). On the other hand, the estimates of the specific hierarchical omega (ω_h .S1, ω_h .S2, ω_h .S3) show that the specific factors contribute differently to the explained variance. In particular, the specific factor ω_h .S1 has a low value, while ω_h .S2 and ω_h .S3 have higher values. The HH reliability coefficients indicate the reliability of the factors of the bifactorial model. The HH.G coefficient

shows high reliability in the general factor, with a value of .940. However, the coefficients HH.S1, HH.S2 and HH.S3 have lower values, which suggests a lower reliability in the specific factors. In summary, the results of the estimates of the bifactorial model indices indicate that the model has a good capacity to explain the common variance and the uncontaminated correlations in the observed variables. However, it is important to note that the reliability of the specific factors may be more limited. These findings provide valuable information for the interpretation and application of the bifactorial model in the corresponding study context (Figure 4).

Likewise, a semi-confirmatory bifactorial model (DASS-13) was added less restrictive than the confirmatory bifactorial model. This model was made through an objective matrix that serves as a guideline for the model. The findings show that the factor loadings of the specific Anxiety factor of items an19 and an2 are low (λ <.30) and only items an4 and an7 were maintained. Regarding the specific factors of Depression and Stress, these were maintained with the items es1, es6, es11, es12 and es18, for Stress and the remaining de10, de16, de17 and de21 for Depression, with factorial loads between .34 and .55, with a factorial load of .68 in item 21. Likewise, the factorial loads of the general factor are between .55 and .79. According to the above, and considering that PUC > .60 and ω_h > .70 (Reise et al., 2013), support would be found to consider the DASS-13 as mainly one-dimensional, even more so noting the low factorial loads in the specific factors and their internal consistency.

Table 4

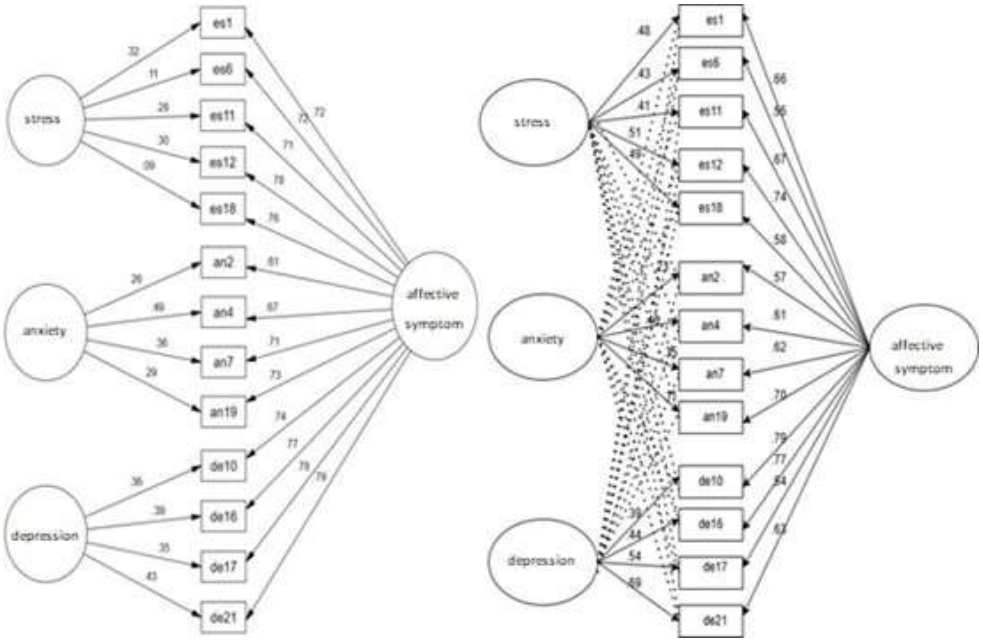
Estimates of the two-factor exploratory and confirmatory model indices

		CFA	EFA
	Statistical indices	Observed values	Observed values
	CVD	.832	.685
	PUC	.718	.718
	ω_h	.899	.821
S	ω_h.S1	.072	.309
A	ω_h.S2	.183	.163
D	ω_h.S3	.180	.315
	HH.G	.940	.915
S	HH.S1	.241	.583
A	HH.S2	.394	.340
D	HH.S3	.407	.625
	λp.G	.731	.655
S	λ.S1	.220	.464
A	λ.S2	.355	-.317
D	λ.S3	.381	.502

Note. ECV: amount of common variance; PUC: percentage of uncontaminated correlations; ω_h: total hierarchical omega; ω_h.S: omega of the specific factor; HH.S: coefficient H of specific factor; HHG: general H coefficient; λ.S: average factorial load of the specific factor; λp.G: average factorial load of the general factor; S: stress; D: depression; A: anxiety; CFA: confirmatory bifactor; EFA: exploratory bifactor.

Figure 4

Graphic representation of the confirmatory bifactorial (left) and semi-confirmatory (right) DASS-13 measurement model



Measurement invariance according to sex

This report presents the results of the measurement invariance tests according to sex in a confirmatory bifactor model (DASS-13) (Table 5). Different levels of invariance were evaluated, from the basic configuration to the strict invariance, to determine if there are significant differences in the measurement models between men and women. At the level of configural invariance, the bifactor model showed a good fit, which indicates that the basic structure of the model is similar between men and women. As we moved towards more restrictive levels of invariance (threshold, metric, scalar and strict), a general improvement in the fit indices was observed. The RMSEA gradually decreased, indicating greater precision of the model fit, while the CFI remained high, suggesting that the measurement models are comparable between men and women in terms of comparative fit. For its part, the SRMR remained constant at .033 at all levels of invariance, showing a good fit in relation to the standardized residuals for both groups. The findings suggest that the bifactor model of measurement is invariant according to gender at the threshold, metric, scalar and strict levels. These results are important to ensure that the comparisons and conclusions based on this model are valid and fair for both groups.

Table 5

Measurement invariance according to sex

	X^2	ΔX^2	df	Δdf	RMSEA	ΔRMSEA	CFI	ΔCFI	SRMR	ΔSRMR
configural	194.5		124		.054		.988		.033	
threshold	202.41	18.2562	137	13	.052	-.002	.988	.000	.033	.000
metric	207.86	5.9042	147	10	.048	-.005	.989	.001	.033	.000
climb	231.97	26.1687	157	10	.047	-.001	.989	.000	.033	.000
strict	256.68	19.5266	170	13	.042	-.005	.990	.001	.034	.001

Note. Δ: difference between models.

ROC curves

Given that the scale turned out to be invariant with respect to sex and in the presence of a bifactor model, it was considered convenient to propose cutoff points for the global dysphoric affective state and for the dimensions of stress, anxiety and depression in general for all the sample. This was done using the ROC curves, using as a gold standard the self-report given by those evaluated on the presence of a diagnosis of affective disorder, being 8.7% who indicated they presented it. These results are observed in Figure 5.

Figure 5

ROC curves, DASS-13

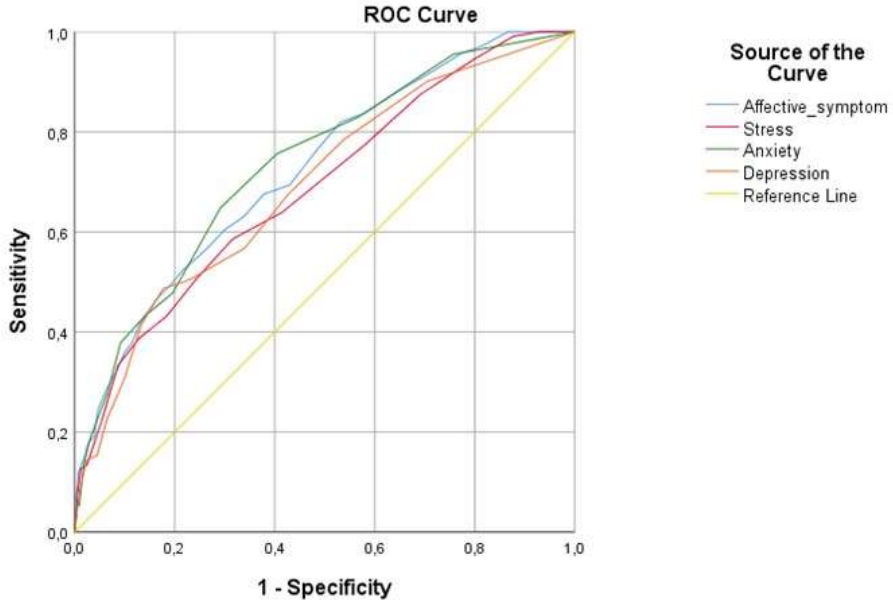


Table 6 shows that the area under the curve (AUC) is around .70, in all cases, the scale showing a regular global capacity for discrimination of the dysphoric affective state and the three dimensions. Regarding the dysphoric affective state, the Youden index establishes the cut-off point at score 17, which presents a capacity to detect true positives of 52.25 % (sensitivity), while a capacity to detect true negatives of 78.45 % (specificity). Results close to these values were observed in the dimensions of stress, anxiety and depression, with cut-off points of 8, 5 and 7 respectively.

Table 6

Performance of the DASS-13

	AUC	Youden	Sensitivity	Specificity	Cut-off point
EAD	.723	.307	52.25	78.45	17
Stress	.687	.27	58.56	68.41	8
Anxiety	.734	.357	64.86	70.82	5
Depression	.691	.31	48.65	82.32	7

Note. AUC: area under the curve; EAD: dysphoric affective state.

Discussion

The DASS-21 is a widely used scale in various contexts; however, the study of its complex structure is still necessary. In the present study, certain peculiarities have been identified that are related to the previous findings that indicate the DASS-21 as a measure according to bifactorial models (Yeung et al., 2020).

Through network analysis, the bootEGA initially reflects a model with a fourth dimension that is not clearly delimited in the DASS-21. Although four-dimensional models were found (Chen et al., 2023; Kumar et al., 2019), they have used discouraged techniques such as the elbow rule of the Kaiser sedimentation diagram and the analysis of principal components. In addition, what the network analysis

reflects is an overlap of unstable items rather than an additional dimension to the proposed model. A four-factor model is also not supported by the tripartite model (Clark & Watson, 1991).

By eliminating eight items from this, it was possible to reflect a three-dimensional model more consistent with theory and with other studies that use an EFA or CFA (Ali et al., 2021; Chen et al., 2023; Lee, Moon et al., 2019; Yeung et al., 2020). However, the unidimensionality hypothesis of the DASS-21 and DASS-13 was also plausible, although the stability of the model improves with the version of a general factor (DASS-13). It is noted that the items removed (es8, es14, an9, an15, an20, de3, de5, de13) are similar to those that were omitted in the dimensions of anxiety (an15, an9, an20), depression (de3, de5, de13) and stress from the Peruvian study of Valencia (2019) except for two items (de13, an20); Furthermore, other studies have also pointed out the irregularities in the composition of the dimensions of the DASS-21 (Ali et al., 2021; Cao et al., 2023; Gonzalez et al. 2019; Yeung et al., 2020).

It is highlighted that the one-dimensional proposal makes sense according to what is theoretically proposed as negative affect by Clark and Watson (1991) and goes according to the empirical evidence indicated by various studies (Yeung et al., 2020) that reflect models of high correlations interfactorial (φ> .80), in addition to the frequent comorbidity of the symptoms of anxiety, stress and depression mentioned (Alonso et al., 2004; Wu & Fang, 2014). In this sense, both the unidimensional proposal and the three correlated factors would reflect the bifactorial nature of the DASS-21, which has become evident in the network analysis observed and in the same way in the bifactorial models reviewed (Ali et al., 2021; Ali et al., 2022; Malas & Tolsá, 2022; Valencia, 2019; Yeung et al., 2020).

In relation to the bifactorial studies, in the Peruvian context, Valencia (2019), found that its bifactorial model is shown as more parsimonious compared to the model of three associated factors, although it concludes that the instrument is basically one-dimensional. At present, the complementary indices of the CFA of the exploratory or semi-confirmatory model (ECV, PUC, ωH) indicate it as basically one-dimensional, in the same way as the conclusion reached by Valencia (2019) (ECV, PUC> .70), but there is a proportion of variance that corresponds to the specific factors of anxiety, stress and depression that cannot be omitted, despite the instability of these items, which has become evident in the present and other investigations (Ali et al., 2021; Ali et al., 2022; Malas & Tolsá, 2022; Valencia, 2019; Yeung et al., 2020). The decision to assume a one-dimensional instrument is still controversial, which implies considering depression, anxiety and stress under the same undifferentiated nosological category, despite the fact that manuals such as the DSM-V or CIE refer to a differential diagnosis between them. This is not only a problem with the DASS-21, but also that of other scales such as the Hospital Anxiety and Depression Scale (HADS) (Iani et al., 2014). However, in the context of bifactorial models, the most prudent thing to do would be to integrate them into the broader category of negative affect.

Regarding the confirmatory and semi-confirmatory bifactorial models considered in the DASS-13, no notable differences have been found between their indices (ECV, PUC, ωH) to indicate the superiority of one approach over another, despite the lesser restrictions imposed on the second. However, the semi-confirmatory bifactorial model carried out maintained the depression scale with greater stability; while the rest had problems, which was also found in other bifactorial studies (Chen et al., 2023; Chin et al., 2019; Gomez et al., 2020). In this sense, the DASS-13 would be a somewhat more favorable measure for the identification of depression, but not of the other dimensions.

Likewise, in the first order model with three correlated factors, the internal consistency of the DASS-13 shows high values in the specific factors (ↄ > .85), which would favor the precision of the first order measurement. Consistency was also high in the confirmatory and semi-confirmatory bifactorial model (ↄ > .85) including its general scale. It is noted that the construct reliability of the specific factors of depression, anxiety and stress are low (H <.41), while in the general factor it is high (H> .80) both in the confirmatory and semi-confirmatory model, which It would again support the precision of the one-dimensional measurement when the specific factors are present. As has been pointed out, internal consistency would not support the use of the specific factors of the DASS-21, although it does support the general factor. In the case of the depression scale, the semi-confirmatory scale shows some degree of greater precision than the previous ones, although it is not satisfactory (H> .63).

The implications of the research are diverse. At the clinical level, it is emphasized that the use of the DASS-21 should be restricted for the screening of the symptoms of negative affect, but not of the specific factors. In addition, clinical decisions regarding anxiety and depression disorders must follow a rigorous evaluation that considers the differential diagnosis between them and not only self-report

measures. Likewise, it should be taken into account that any evaluation of depression must evaluate the presence of anxious symptoms and vice versa, for which the most prudent thing is to explore the negative affect present in the clinic. At a theoretical level, it would have to be assumed that the DASS-21 shows more complex models, for which the most coherent thing would be to assume an integrative position. Regarding the methodology used, the network analysis has made it possible to capture the distinction between the indicated dimensions; Furthermore, given the complexity of the DASS-21, it would be recommended to stop analyzing it as a measure of correlated factors and to continue its study from hybrid models such as bifactorial studies.

Another important aspect is that the final version of the DASS-13 with a bifactorial model maintains the invariance of thresholds, factor loadings, intercepts and residuals, which favors its use in men and women with the characteristics of the sample used. It is highlighted that other studies that have considered the gender of the participants have found the scalar invariance of a short version or DASS-13 (Ali et al., 2021) or residual invariance (Gonzalez et al., 2019; Malas & Tolsá, 2022), although it was not possible to compare with the Peruvian version of Valencia (2019) since it did not provide evidence of it. The aforementioned provides input from the DASS-21 and other versions since it has been shown to be invariant in longitudinal studies (Ali et al., 2022; Chen et al., 2023) and in different populations (Chen et al., 2023), although with some exceptions (Bibi et al., 2020).

A final aspect to mention is that, since the specificity (78.45%) or proportion of true negatives correctly identified by the scale is higher than the sensitivity (52.25%) or proportion of true positives correctly identified (Bravo-Grau & Cruz, 2015), and the latter is close to 50%, is that it can be assumed that this version of the DASS works better as a discard test than a detection test, since its greater effectiveness is found in the identification of true negatives.

As a limitation of the study, it is noted that, although network analysis has been used, its implementation in bifactorial or hierarchical models is still under development. Later studies will allow us to compare both methodologies to consider which of these is best adapted to identify the nature of complex models such as the one studied. Another important limitation to mention is the choice of the gold standard in the case of ROC curves, since the determination of the presence of a diagnosis of affective disorder is based on the self-report of the evaluated person with the difficulties that this entails, mainly related to the accuracy and veracity of said report. However, the use of some other criterion that implies the documentary accreditation of a diagnosis becomes highly complex, especially when working with a large number of evaluated, without mentioning the ethical aspects to be considered for this purpose. In this sense, the recommendation to evaluate the choice of another criterion for the gold standard remains for future studies, based on ethical considerations and pertinent resources.

Finally, it is possible to conclude with the favorable psychometric properties of the DASS-13 observed both in the exploratory and confirmatory bifactorial model, but as an essentially one-dimensional measure of negative affect. Likewise, this is invariant according to the sex of the participants and can be a more applicable instrument for discarding given its high specificity.

References

Agudelo, L. Z., Femenía, T., Orhan, F., Porsmyr-Palmertz, M., Goiny, M., Martinez-Redondo, V., Correia, J. C., Izadi, M., Bhat, M., Schuppe-Koistinen, I., Pettersson, A. T., Ferreira, D. M. S., Krook, A., Barres, R., Zierath, J. R., Erhardt, S., Lindskog, M., & Ruas, J. L. (2014). Skeletal muscle PGC-1α1 modulates kynurenine metabolism and mediates resilience to stress-induced depression. *Cell, 159*(1), 33-45. https://doi.org/10.1016/j.cell.2014.07.051

Ali, A. M., & Green, J. (2019). Factor structure of the Depression Anxiety Stress Scale-21 (DASS-21): Unidimensionality of the Arabic version among Egyptian drug users. *Substance Abuse: Treatment, Prevention, and Policy*, *14*(1). https://doi.org/10.1186/s13011-019-0226-1

Ali, A. M., Alkhamees, A. A., Hori, H., Kim, Y., & Kunugi, H. (2021). The Depression Anxiety Stress Scale 21: Development and validation of the depression anxiety stress scale 8-item in psychiatric patients and the general public for easier mental health measurement in a post COVID-19 world. *International Journal of Environmental Research and Public Health*, *18*(19). https://doi.org/10.3390/ijerph181910142

Ali, A. M., Hori, H., Kim, Y., & Kunugi, H. (2022). The Depression Anxiety Stress Scale 8-Items expresses robust psychometric properties as an ideal shorter version of the Depression Anxiety Stress Scale 21 among healthy respondents from three continents. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.799769

Alonso, J., Angermeyer, M.C., Bernert, S., Bruffaerts, R., Brugha, T.S., Bryson, H., de Girolamo, G., de Graaf, R., Demyttenaere, K., Gasquet, I., Haro, J.M., Katz, S.J., Kessler, R.C., Kovess, V., Lépine, J.P., Ormel, J., Polidori, G., Russo, L.J., Vilagut, G., … Vollebergh, W.A.M. (2004). Prevalence of mental disorders in Europe: Results from the European Study of the Epidemiology of Mental Disorders (ESEMeD) project. *Acta Psychiatrica Scandinavica, 109*(s420), 21-27. https://doi.org/10.1111/j.1600-0047.2004.00327.x

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment, 10*(2), 176-181. https://doi.org/10.1037/1040-3590.10.2.176

Bibi, A., Lin, M., Zhang, X. C., & Margraf, J. (2020). Psychometric properties and measurement invariance of Depression, Anxiety and Stress Scales (DASS-21) across cultures. *International Journal of Psychology*, *55*(6), 916-925. https://doi.org/10.1002/ijop.12671

Bravo-Grau, S., & Cruz, J. P. (2015). Estudios de exactitud diagnóstica: Herramientas para su interpretación. *Revista Chilena de Radiología*, *21*(4), 158-164. https://doi.org/10.4067/s0717-93082015000400007

Cao, C. H., Liao, X. L., Jiang, X. Y., Li, X. D., Chen, I. H., &; Lin, C. Y. (2023). Psychometric evaluation of the Depression Anxiety and Stress Scale-21 (DASS-21) among Chinese primary and middle school teachers. *BMC Psychology, 11*(1). https://doi.org/10.1186/s40359-023-01242-y

Cerda, J., & Cifuentes, L. (2012). Uso de curvas ROC en investigación clínica: Aspectos teórico-prácticos. *Revista Chilena de Infectología, 29*(2), 138-141. https://doi.org/10.4067/S0716-10182012000200003

Chen, I. H., Chen, C. Y., Liao, X. ling, Chen, X. mei, Zheng, X., Tsai, Y. C., Lin, C. Y., Griffiths, M. D., & Pakpour, A. H. (2023). Psychometric properties of the Depression, Anxiety, and Stress Scale (DASS-21) among different Chinese populations: A cross-sectional and longitudinal analysis. *Acta Psychologica, 240*. https://doi.org/10.1016/j.actpsy.2023.104042

Chin, E. G., Buchanan, E. M., Ebesutani, C., & Young, J. (2019). Depression, anxiety, and stress: How should clinicians interpret the total and subscale scores of the 21-item Depression, Anxiety and Stress Scales? *Psychological Reports, 122*(4), 1550-1575. https://doi.org/10.1177/0033294118783508

Christensen, A. P. (2020). *Towards a network psychometrics approach to assessment: Simulations for redundancy, dimensionality, and loadings* [Unpublished doctoral dissertation]. University of North Carolina at Greensboro. https://doi.org/10.31234/osf.io/84kgd

Christensen, A. P., & Golino. H. (2021). Estimating the stability of psychological dimensions via Bootstrap Exploratory Graph Analysis: A Monte Carlo simulation and tutorial. *Psych, 3*(3), 479-500. https://doi.org/10.3390/psych3030032

Christensen, A. P., Golino, H., & Silvia, P. J. (2020). A psychometric network perspective on the validity and validation of personality trait questionnaires. *European Journal of Personality, 34*(6), 1095-1108. https://doi.org/10.1002/per.2265

Clark, L. A., & Watson, D. (1991). Tripartite model of anxiety and depression: Psychometric evidence and taxonomic implications. *Journal of Abnormal Psychology, 100*(3), 316-336. https://doi.org/10.1037/0021-843X.100.3.316

Contreras-Mendoza, I., Olivas-Ugarte, L. O., & De La Cruz-Valdiviano, C. (2021). Escalas abreviadas de Depresión, Ansiedad y Estrés (DASS-21): validez, fiabilidad y equidad en adolescentes peruanos. *Revista de Psicología Clínica con Niños y Adolescentes*, *8*(1), 24-30. https://doi.org/10.21134/rpcna.2021.08.1.3

Cosci, F., & Fava, G. A. (2021). When anxiety and depression coexist: The role of differential diagnosis using clinimetric criteria. *Psychotherapy and Psychosomatics, 90*(5), 308-317. https://doi.org/10.1159/000517518

Domínguez-Lara, S., & Rodríguez, A. (2017). Índices estadísticos de modelos bifactor. *Interacciones*, *3*(2), 59-65. https://doi.org/10.24016/2017.v3n2.51

Fentahun, S., Takelle, G. M., Rtbey, G., Andualem, F., Tinsae, T., Nakie, G., Melkam, M., & Tadesse, G. (2024). Prevalence of depression and its associated factors among Ethiopian students: a systematic review and meta-analysis. *BMJ Open, 14*(6). https://doi.org/10.1136/bmjopen-2023-076580

Ferrando, P. J., & Lorenzo-Seva, U. (2017). Program FACTOR at 10: development and future directions. *Psicothema*, *29*(2), 236-240. https://doi.org/10.7334/psicothema2016.304

Fonseca-Pedrero, E. (2017). Análisis de redes: ¿una nueva forma de comprender la psicopatología? *Revista de Psiquiatría y Salud Mental, 10*(4), 206-215. https://doi.org/10.1016/j.rpsm.2017.06.004

Golino, H. F., & Epskamp, S. (2017). Exploratory graph analysis: A new approach for estimating the number of dimensions in psychological research. *PloS One, 12*(6), e0174035. https://doi.org/10.1371/journal.pone.0174035

Gomez, R., Stavropoulos, V., & Griffiths, M. D. (2020). Confirmatory factor analysis and exploratory structural equation modelling of the factor structure of the Depression Anxiety and Stress Scales-21. *PLoS ONE, 15*(6), e0233998. https://doi.org/10.1371/journal.pone.0233998

Gonzalez, B., da Silva, W. R., Maroco, J., & Campos, J. A. D. B. (2019). Depression, Anxiety, and Stress Scale: Psychometric properties and affectivity prevalence. *Jornal Brasileiro de Psiquiatria*, *68*(1), 32-41. https://doi.org/10.1590/0047-2085000000222

González-Rivera, J. A., Pagán-Torres, O. M., & Pérez-Torres, E. M. (2020). Depression, Anxiety and Stress Scales (DASS-21): Construct validity problem in Hispanics. *European Journal of Investigation in Health, Psychology and Education*, *10*(1), 375-389. https://doi.org/10.3390/ejihpe10010028

Hair, J., Black, W., Babin, B., & Anderson, R. (2014). *Multivariate data analysis*. Pearson.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods, 3*, 424-453. https://doi.org/10.1037/1082-989X.3.4.424

Iani, L., Lauriola, M., & Costantini, M. (2014). A confirmatory bifactor analysis of the hospital anxiety and depression scale in an Italian community sample. *Health and Quality of Life Outcomes, 12*(1). https://doi.org/10.1186/1477-7525-12-84

Ipsos. (2023). *Día Mundial de la Salud Mental 2023: Una encuesta Global Advisor.* https://acortar.link/b49kCt

Kakemam, E., Navvabi, E., Albelbeisi, A. H., Saeedikia, F., Rouhi, A., & Majidi, S. (2022). Psychometric properties of the Persian version of Depression Anxiety Stress Scale-21 Items (DASS-21) in a sample of health professionals: a cross-sectional study. *BMC Health Services Research*, *22*(1). https://doi.org/10.1186/s12913-022-07514-4

Kumar, K., Kumar, S., Mehrotra, D., Tiwari, S., Kumar, V., & Dwivedi, R. (2019). Reliability and psychometric validity of Hindi version of Depression, Anxiety and Stress Scale-21 (DASS-21) for Hindi speaking head neck cancer and oral potentially malignant disorders patients. *Journal of Cancer Research and Therapeutics*, *15*(3), 653-658. https://doi.org/10.4103/jcrt.JCRT_281_17

Lee, E. H., Moon, S. H., Cho, M. S., Park, E. S., Kim, S. Y., Han, J. S., & Cheio, J. H. (2019). The 21-item and 12-item versions of the Depression Anxiety Stress Scales: Psychometric evaluation in a Korean population. *Asian Nursing Research*, *13*(1), 30-37. https://doi.org/10.1016/j.anr.2018.11.006

Lee, J., Lee, E. H., & Moon, S. H. (2019). Systematic review of the measurement properties of the Depression Anxiety Stress Scales–21 by applying updated COSMIN methodology. *Quality of Life Research*, *28*(9) 2325-2339. https://doi.org/10.1007/s11136-019-02177-x

Lloret-Segura, S., Ferreres-Traver, A., Hernández-Baeza, A., & Tomás-Marco, I. (2014). El análisis factorial exploratorio de los ítems: Una guía práctica, revisada y actualizada. *Anales de Psicologia*, *30*(3), 1151-1169. https://doi.org/10.6018/analesps.30.3.199361

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy, 33*(3), 335-343. https://doi.org/10.1016/0005-7967(94)00075-u

Malas, O., & Tolsá, M. D. (2022) Depression, Anxiety and Stress Scales (DASS21): Factor structure, reliability, invariance and validity of the Catalan. *Anuario de Psicología, 52*(3), 228-240. https://doi.org/10.1344/ANPSIC2022.52/3.37406

Marey, M., Salem, D., Rashidy, N. E., & ELBakry, H. (2024). Enhancing the diagnosis of depression and anxiety through explainable machine learning methods. *International Journal of Advanced Computer Science and Applications, 15*(4). https://doi.org/10.14569/ijacsa.2024.0150481

Marsh, H. W., Morin, A. J. S., Parker, P. D., & Kaur, G. (2014). Exploratory structural equation modeling: An integration of the best features of exploratory and confirmatory factor analysis. *Annual Review of Clinical Psychology, 10*, 85-110. https://doi.org/10.1146/annurev-clinpsy-032813-153700

Martínez Pérez, J. A., & Pérez Martin, P. S. (2023). La curva ROC [ROC curve]. *Semergen, 49*(1), 101821. https://doi.org/10.1016/j.semerg.2022.101821

Martins, B. G., Da Silva, W. R., Maroco, J., & Campos, J. A. D. B. (2019). Escala de Depressão, Ansiedade e Estresse: propriedades psicométricas e prevalência das afetividades. *Jornal Brasileiro de Psiquiatria, 68*(1), 32-41. https://doi.org/10.1590/0047-2085000000222

Minea, G., Mititelu-Ionuş, O., Gyasi-Agyei, Y., Ciobotaru, N., & Rodrigo-Comino, J. (2022). Impacts of grazing by small ruminants on hillslope hydrological processes: A review of European current understanding. *Water Resources Research, 58*(3), e2021WR030716. https://doi.org/10.1029/2021WR030716

Ministerio de Salud del Perú. (2023, 10 de octubre). *La depresión es uno de los trastornos de salud mental más frecuentes en el país.* https://www.gob.pe/institucion/minsa/noticias/892900-la-depresion-es-uno-de-los-trastornos-de-salud-mental-mas-frecuentes-en-el-pais

Ouyang, X., Cai, Y., & Tu, D. (2020). Psychometric properties of the short forms of the Social Interaction Anxiety Scale and the Social Phobia Scale in a Chinese college sample. *Frontiers in Psychology, 11*, 2214. https://doi.org/10.3389/fpsyg.2020.02214

Reise, S. P., Scheines, R., Widaman, K. F., & Haviland, M. G. (2013). Multidimensionality and structural coefficient bias in Structural Equation Modeling: A bifactor perspective. *Educational and Psychological Measurement*, *73*(1), 5-26. https://doi.org/10.1177/0013164412449831

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016). Applying bifactor statistical indices in the evaluation of psychological measures. *Journal of Personality Assessment*, *98*(3), 223-237. https://doi.org/10.1080/00223891.2015.1089249

RStudio Team. (2022). *RStudio: Integrated Development for R. RStudio*. PBC.

Saavedra Castillo, J. E., Paz Schaeffer, V., Robles Arana, Y., Luna Solís, Y., Zevallos Bustamante, S., Cruz Campos, V., & Huamán Pineda, J. (2018). Estudio epidemiológico de salud mental en hospitales generales y centros de salud de Lima Metropolitana 2015. *Anales de Salud Mental, 34*(1).

Thurstone, L. L. (1947). *Multiple factor analysis*. University of Chicago Press.

Valencia, P. (2019). Las Escalas de Depresión, Ansiedad y Estrés (DASS-21): ¿miden algo más que un factor general? *Avances en Psicología*, *27*(2), 177-189. https://doi.org/10.33539/avpsicol.2019.v27n2.1796

van den Bergh, N., Marchetti, I., & Koster, E. H. W. (2021). Bridges over troubled waters: Mapping the interplay between anxiety, depression and stress through network analysis of the DASS-21. *Cognitive Therapy and Research, 45*(1), 46-60. https://doi.org/10.1007/s10608-020-10153-w

Vaughan, R., S., Edwards, E., J., & MacIntyre, T., E. (2020). Mental health measurement in a Post Covid-19 world: Psychometric properties and invariance of the DASS-21 in athletes and non-athletes. *Frontiers in Psychology, 11*. https://doi.org/10.3389/fpsyg.2020.590559

World Health Organization. (2023, 27 de septiembre). *Trastornos de ansiedad*. https://www.who.int/es/news-room/fact-sheets/detail/anxiety-disorders

Wu, Z., & Fang, Y. (2014). Comorbidity of depressive and anxiety disorders: challenges in diagnosis and assessment. *Shanghai Archives of Psychiatry, 26*(4), 227-231. https://doi.org/10.3969/j.issn.1002-0829.2014.04.006

Yeung, A. Y., Yuliawati, L., & Cheung, S. H. (2020). A systematic review and meta-analytic factor analysis of the Depression Anxiety Stress Scales. *Clinical Psychology: Science and Practice, 27*(4). https://doi.org/10.1037/h0101782

Authors' contribution (CRediT Taxonomy): 1. Conceptualization; 2. Data curation; 3. Formal Analysis; 4. Funding acquisition; 5. Investigation; 6. Methodology; 7. Project administration; 8. Resources; 9. Software; 10. Supervision; 11. Validation; 12. Visualization; 13. Writing: original draft; 14. Writing: review & editing.

B. G. P.-T. has contributed in 7, 12, 13, 14; A. S. B. in 5, 6, 7, 8; A. C.-C. in 1, 2, 3, 6; J. C. E.-N. in 9, 10, 11, 12.

Scientific editor in charge: Dra. Cecilia Cracco.