Validation, factorial invariance and latent mean differences across sex of the Depression, Anxiety and Stress Scales (DASS-21) in Ecuadorian university sample

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Abstract

The prevalence of stress, anxiety and depression is a topic of concern for general population, but also for the educational context. Consequently, due to the great rates of anxiety, depression and stress problems in undergraduates, the use of a standardised instrument to accurately detect these constructs in the university context is needed. As a result, the current study pretends to examine the psychometric characteristics of the online version of the short Depression, Anxiety and Stress Scales (DASS–21) in Ecuadorian university sample, including the validation, and the testing of factorial invariance and latent differences analyses based on sex. The total of individuals that formed the sample were 3,060 students (M_{age} = 22.7, SD = 2.46) from the Central University of Ecuador, and they participated via the internet, fulfilling the 21 items that formed the DASS-21. Regarding the results, the three-factor structure of the online version of the DASS-21 was confirmed by Confirmatory Factor Analysis, adequate internal consistency values and factorial invariance based on sex were confirmed, and no statistically significant latent mean differences in the scale across sex were found. In consequence, the results of the current investigation give a reliable, consistent and online measure of stress, anxiety and depression, which could help to assess and treat emotional problems originated among the Ecuadorian university population.

Keywords: DASS-21, online, Ecuadorian university sample, factorial invariance, latent mean differences.

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During the last years, research on educational and health fields have been focused on the investigation of depression and anxiety, not only by the prevalence of these symptoms on general population but also by their high prevalence in the educational context (Beiter et al., 2015; Mahmoud et al., 2012; Portellano-Ortiz et al., 2018).

In this sense, the World Health Organisation (WHO, 2018) alerts in their annual report about the mortality indexes in the world that suicide is one of the most frequent cause of mortality between adolescents from 15 to 29 years old, being the above-mentioned mental problems the most involved in these situations.

Among the different educational stages, higher education, by their characteristics, can be considered as a target stage for these emotional problems. Hence, university students must face increasingly challenges and demands that require many physical and psychological efforts, which may cause important stress, anxiety and depression sources in the pupils (Álvarez-Silva et al., 2018; Conley et al., 2015; Pérez & Montero-Sieburth, 2020; Tijerina-González et al., 2019; Vélez et al., 2010). For this reason, knowing the prevalence of these problems among students must be a priority, because it is important that their mental health is not affected by the level of exigency and development, and required competencies in their studies (Álvarez-Silva et al., 2018; Regehr et al., 2013; Tijerina-González et al., 2019).

Considering the existing valid and reliable instruments of clinical assessment for students who show symptoms of this kind of emotional problems, the empirical evidence suggests that the questionnaires that adequately distinguish between

depression and anxiety symptoms are the only that can diagnose and treat these students (Akin & Çetın, 2007; Cohen et al., 1994; Parkitny & McAuley, 2010; Román et al., 2016).

For that purpose, traditionally, different individual scales have been designed to measure stress, anxiety and depression. However, although these three constructs present clear conceptual limits in their definitions, the high existing overlapping between them hinders the fact of clearly distinguishing these disorders using the instruments, both in comorbidity of clinical diagnosis and adequate treatments (Akin & Çetın, 2007; Guillén-Riquelme & Buela-Casal, 2015; Lopez & Weisman de Mamani, 2020; Parkitny & McAuley, 2010; Román et al., 2016; Seteanu & Giosan, 2020; Yeung et al., 2020).

One of the proposals with most scientific acceptance for the identification of common and distinctive processes of depression and anxiety is the tripartite model (Clark & Watson, 1991). In relation with this model, anxiety and depression are shaped by two specific dimensions. On the one hand, depression is defined by low positive affect, which means decreased interest of the environment and lack of behavioural activation. On the other hand, anxiety reflets a dimension of physiologic hyperactivation, which increases the autonomous reactivity that can be seen in examples of anxiety manifestations, such the case of panic attack (Eysenck & Fajkowska, 2018). However, both depression and anxiety constructs share a common dimension called negative affect, which is characterized by a general tendency to experiment negative feelings and emotional distress (Eysenck & Fajkowska, 2018).

In order to clarify the existing overlapping between depression and anxiety, several questionnaires have been created to enhance the distinction between both of

them. A clear example of this fact would be the Depression, Anxiety and Stress Scales (DASS, Lovibond & Lovibond, 1995).

The authors of the mentioned scales (DASS, Lovibond & Lovibond, 1995) included clinical symptoms, and anxiety and depression diagnoses, along the growth process. Besides, they excluded from the scales symptoms that can appear in both constructs, such as appetite changes. However, the factor analyses of their first validations indicated the existence of a third construct (stress) that, in words of Lovibond and Lovibond (1995), includes symptoms associated with difficulties in relaxation, nervous tension, irritability, agitation and persistent tension, which are symptoms differentiated from depression and anxiety (Lovibond & Lovibond, 1995). As a result of this process, the first version of the instrument (DASS-42) was created, which is one of the most used questionnaires to assess affective symptoms. This test is formed by three sub-scales: the first one to detect depression (measuring helplessness, poor self-esteem and poor positive affect), the second one focused on anxiety (assessing autonomous excitation, muscle-skeletal symptoms, situational anxiety and the self-experience of anxious excitation) and a third one related to stress (measuring tension, agitation and negative affect). Afterwards, a short version of the DASS scale was validated, which was recognised as DASS-21 (Lovibond & Lovibond, 1995). This instrument is formed by seven elements from each of the three subscales, which present adequate psychometric properties with internal consistency values' ranging from Cronbach's alpha .70 to .95 (Antony et al., 1998; Apóstolo et al., 2006; Bados et al., 2005; Clara et al., 2001; González-Rivera et al., 2020; Lemieux-Cumberlege & Taylor, 2019; Mitchell et al., 2008; Obst et al., 2020; Román et al., 2016; Rossell et al., 2021; Ruiz et al., 2017; Wong et al., 2021).

Since the design of these scales, their proliferation has been extended to several countries: Spanish-speaking (Antony et al., 1998; Daza et al., 2002; González-Rivera et al., 2020; Román et al., 2016), Italian (Bottesi et al., 2015), Portuguese (Patias et al., 2016), Greek (Kyriazos et al., 2018), Russian (Scholten et al., 2017), and Korean (Jun et al., 2018), among others. It has been revealed in all these investigations that the DASS-21 presents robust internal consistency and allows distinguishing between depression and anxiety, in comparison with other existent tests (Lovibond & Lovibond, 1995).

With regard to the factorial structure of the scale, the existing literature is large and distinct, and it shows that factor structures can vary based on the social and cultural environment and the kind of community where the test is applied. For instance, in Latin American countries, the DASS-21 has properly fitted with the original structure of anxiety-depression-stress obtained by the original authors (Antony et al., 1998; Daza et al., 2002; González-Rivera et al., 2020; Román et al., 2016). This fact is also consistent with structures from other countries that identified a three-factor structure (Apóstolo et al., 2006; Bados et al., 2005; Gómez et al., 2014; González-Rivera et al., 2020; Kyriazos et al., 2018; Lee et al., 2019; Mitchell et al, 2008; Moussa et al., 2017; Ruiz et al., 2017).

Notwithstanding, other researchers defend that the original DASS-21 structure cannot be used in some countries different from the original. For example, Duffy et al. (2005) found that the model of two factors (physiological activation and general negativity) presented a more acceptable adjustment. In the same line, Szabó and Lovibond (2006) proposed a two-dimension model (depression and anxiety-stress) more adjusted for child population. For their part, examining the structure of the DASS-21 using a principal component analysis, other authors found support for the use of a unique component (Kia-Keating et al., 2018; Moore et al., 2017).

In parallel to his structure, and independently from the context and country, a question to consider in all psychological measures is the sensitivity to individual characteristics, such age (Szabó & Lovibond, 2006) or sex (Lu et al., 2018). Consequently, researchers must be sure about the fact that all the items of the measurement questionnaires are equivalently interpreted by the participants of the study, independently of the sex of them.

This problem, defined as measurement invariance, is a previous requirement for measuring psychological constructs in different groups. Measurement invariance, also known as analysis of differential items functioning, assesses whether the probability of answering to a specific item is the same in all the compared groups after controlling the determined construction of the instrument (Taylor, 2013). If this assumption is not achieved, the scores comparison in this construct between the individuals from the sample of the study is not valid and differences between groups cannot be interpreted in a significant way, because it could be caused by measurement bias. In this sense, there are some studies focused on examining the measurement invariance of the DASS-21 based on sex in undergraduate from diverse countries: Australia (Gómez et al., 2014), Iran (Jafari et al., 2017) and China (Lu, et al., 2018). However, there is a lack of research about the sex invariance of the DASS-21 in Spanish-speaking community.

Additionally, although it is true that there is an explosive proliferation of publications about the presence of emotional symptoms in different contexts, such as labour (Blanco-Álvarez & Thoen, 2017), clinical (Mena-Díaz et al., 2018), or educational, in the latter case, most authors have focused on Primary School Education students (Beiter et al., 2015) and High School Education students (Roman et al., 2016), being scarce the studies about Hispanic students of Higher Education (Conley et al., 2015). In this sense, although the DASS-21 has been validated in Spanish-speaking

countries, it exists a lack of investigations about the psychometric properties of the questionnaire in some countries, such the case of Ecuador. In the same way, there are no publications analysing the factorial invariance across sex of the DASS-21 in Spanish-speaking university students.

Finally, and independently from the different existent versions and the extension to diverse contexts, the traditional way of presenting this scale has been the on-site and there is no information about the psychometric properties of the online version of this test.

As a result, in order to provide other alternative ways of administration that contribute to the detection of these emotional problems in university students, the aim of this investigation consists in determining the psychometric characteristics of the online version of the DASS-21 (Lovibond & Lovibond, 1995) in Ecuadorian university students, testing its factorial invariance and the existence of latent mean differences based on sex, and analysing its relationship with similar scales. This objective is decomposed on the following specific targets:

1) To test through goodness-of-fit indexes which of the model distribution of the DASS-21 (with no factor, with one factor, with three uncorrelated factors and with three correlated factors) better adjusts to the online version in Ecuadorian university sample, which has not been studied yet.
2) To confirm that the reliability indexes (Cronbach's coefficient alpha and Omega) of the selected model are included in the acceptable range of values.
3) To examine the factorial invariance (through the analysis of metric, strong, strict and structural invariances) and the existence of latent mean differences across sex, because it is an issue that has not been studied yet and will provide helpful and novel information.

4) To analyse the relationship between the DASS-21 and a scale measuring similar constructs to confirm the convergent validity.

According to the empirical evidence about the current topic, the following hypotheses are exposed:

1) The Ecuadorian version of the DASS-21 will present a three-factor model, in accordance with previous studies (Apóstolo et al., 2006; Bados et al., 2005; Gómez et al., 2014; González-Rivera et al., 2020; Kyriazos et al., 2018; Lee et al., 2019; Mitchell et al, 2008; Moussa et al., 2017; Ruiz et al., 2017).
2) It will show adequate reliability indexes (Antony et al., 1998; Apóstolo et al., 2006; Bados et al., 2005; Clara et al., 2001; González-Rivera et al., 2020; Lemieux-Cumberlege & Taylor, 2019; Obst et al., 2020; Mitchell et al., 2008; Román et al., 2016; Ruiz et al., 2017; Rossell et al., 2021; Wong et al., 2021).
3) It will result invariant across sex (Gómez et al., 2014; Jafari et al., 2017; Lu, et al., 2018).
4) It will positively and significantly correlate with the scores of a scale measuring social anxiety (Social Anxiety Scale for Adolescents, La Greca & López, 1988).

Method

Participants

Participants were obtained from degrees offered in the Central University of Ecuador. The University was divided into the different faculties and a random proportional sampling was used to select the groups in each of the faculties. The final sample was formed by 3060 university students. Their participation was through the Internet. Their ages were comprised from 18 to 54 years old (M_{age} = 22.7, SD = 2.46). Regarding its distribution, 1,309 (42.8%) were men and 1,751 (57.2%) women; 260 were 18 years old (8.5%), 505 were 19 years old (16.5%), 701 were 20 years old

(22.9%), 713 were 21 years old (23.3%), 526 were 22 years old (17.2%), 288 were 23 years old (9.4%) and 67 were > 23 years old (2.2%); 240 (7.8%) were studying the first semester, 283 (9.2%) the second, 552 (18%) the third, 551 (18%) the fourth, 549 (17.9%) the fifth, 307 (10%) the sixth, 243 (7.9%) the seventh, 153 (5%) the eighth, 104 (3.4%) the nineth, 28 (0.9%) the tenth, 21 (0.7%) were graduates and 29 (0.9%) did not give this data. Besides, it was confirmed the homogeneous distribution sex by semester ($\chi 2 = 17.68$, $p = .09$).

Instruments

Short version of the Depression, Anxiety and Stress Scales (DASS-21): Dimensional and self-report scale which was created to measure negative emotional states of anxiety, depression and stress (Lovibond & Lovibond, 1995). Each item corresponds with the identification and strength of each symptom along last seven days measured by a Likert's scale from 0 to 3 points. Seven items integrate each scale, and its total score is obtained by adding the score of the seven items and it can vary between 0 and 21 points. In this sense, the stress scale (FI: 1, 6, 8, 11, 12, 14, 18) assesses no specific persistent activation, difficulty for relaxing, irritability and impatience (e.g.: "I found it hard to wind-down"). The anxiety scale (FII: 2, 4, 7, 9, 15, 19, 20) considers subjective and somatic symptoms of fear, autonomous activation, situational anxiety, and self-experience of anxious affect (e.g.: "I was worried about situations in which I might panic and make a fool of myself"). Finally, the depression scale (FIII: 3, 5, 10, 13, 16, 17, 21) measures dysphoria, lack of senses, self-depreciation, lack of interest and anhedonia (e.g.: "I felt that life was meaningless").

Social Anxiety Scale for Adolescents (SAS-A): This adapted version (La Greca & López, 1988) from the Social Anxiety Scale for Children Revised (La Greca & Stone, 1993) is formed of 22 items in a 5-Point Likert Scale. The questionnaire is divided into

three factors: fear of negative evaluation (FNE) that focuses on worries about negative peer evaluation (e.g.: “I feel that others make fun of me”), social avoidance and distress in new situations (SAD-N) that measures to what extent individuals are uncomfortable with new situations and unfamiliar peers (e.g.: “I feel nervous when I'm around certain people”) and social avoidance and distress-general (SAD-G) that focuses on feelings of avoidance in any social situation (e.g.: “I feel shy even with peers I know very well”). For the current study, the reliability values were acceptable: total scale (α = .96 / Omega = .95) and the three factors (α = .87-.93 / Omega = .88-.91).

Both scales were translated to Spanish through translation and back-translation process. Moreover, two Ecuadorian psychologist and an Ecuadorian university professor revised the translated versions and adapted some of the sentences to Ecuadorian common linguistic structures.

Procedure

Firstly, a session was convened with the dean team and/or degrees’ directors with the aim of explaining the aim of the study and ask for their permission and collaboration with the study. Once the collaboration was approved, the research team explained the aims of the study to the students and highlighted that participation was anonymous and voluntary. The fulfilment of the questionnaire was performed during class times in each of the degrees and the link to access to the scales was provided during the classes to make sure that the study subjects were the only ones filling in the tests. Questionnaires were answered through Google Drive platform, so each student independently used their computer or mobile phone. During the fulfilment, the research team solved doubts. The average time of administration was 20 minutes (10 minutes for each scale and they were available during the lessons in which they fulfilled them). Once they fulfilled the questionnaire, each student sent their responses to the data base.

The study followed the ethical standards established by the 1964 Declaration of Helsinki and the University of Alicante.

Data analysis

To determine the internal distribution of the DASS-21, four confirmatory factor analyses (CFAs) were launched: null model (Model 1), one-factor model (Model 2) three-factor uncorrelated model (Model 3) and three-factor correlated model (Model 4). Model 3 and Model 4 contained the items drafted by Lovibond and Lovibond, (1995). Previously to the analyses of model estimation, Mardia's coefficient was obtained to test whether it existed multivariate normality in data. The multivariate kurtosis coefficient of Mardia was 285.62 and no multivariate normality was observed because this result is bigger than the five fixed value to consider a multivariate normal distribution (Bentler, 2007). Consequently, Robust Maximum Likelihood (RML) and the Satorra-Bentler χ^2 scaled (S-Bχ^2) were used. Considering Brown's (2006) criteria, the goodness-of-fit of the model was performed through parsimonious indexes of adjustment (with these numbers as acceptable values): Robust Root Mean Square Error of Approximation (R-RMSEA): <.08; Standardized Root Mean Square Residual (SRMR): close to .08; as well as incremental indexes of adjustment: Robust Comparative Fit Index (R-CFI): ≥.90; Tucker Lewis Index (TLI): ≥.90 (Brown, 2006). Finally, the reliability values of the whole questionnaire and each of the factors was analysed using Cronbach's coefficient alpha and Omega (Ventura-León & Caycho-Rodríguez, 2017). Those values were considered acceptable when being equal or higher than .70.

After selecting the DASS-21 model which best adjusted to the data, the factorial invariance analysis across sex was performed. Due to the fact that Mardia's coefficients exceeded the established values (> 5), the S-Bχ^2 and the robust adjustment indexes

mentioned before were used. Firstly, the goodness-of-fit indexes were analysed for the CFAs of men and women to test whether the model also showed good adjustment indexes across sex. Once tested, the configural, measurement and structural invariance across sex was analysed using multigroup CFA (Byrne, 2010). To start with, following the hierarchical stepwise method of Samuel et al. (2015), a configural base model (Model 0) with no constraints was applied. Taking this model as reference, the factor loadings constraints were applied to analyse the metric invariance (Model 1). Subsequently, the strong or scalar invariance (Model 2) was analysed, adding the intercepts constraints to Model 1. Then, the error variances constraints were applied to obtain the strict invariance (Model 3). Lastly, taking Model 2 as reference, variances and covariances of factors were constrained to analyse structural invariance (Model 4). To test that nested models were accepted as invariants and the method could continue, robust adjustment indexes previously mentioned were analysed and the following criterion of invariance was used (ΔR-CFI > -.01) to accept that the model was invariant in comparison with the previous one (Byrne, 2010).

Finally, once factorial invariance was confirmed across sex, latent mean differences were analysed. As a result, the group of men were fixed to zero and it was used as reference to analyse the possible presence of differences. The Critical Ratio (CR) was used and statistically significant differences between both groups were identified when the results were higher than 1.96 or lower than -1.96 (Tsaousis & Kazi, 2013).

Additionally, Pearson's correlation coefficients were performed for establishing the relationship between DASS-21 and SAS-A, considering the following effect sizes, according to Cohen (1988): small correlations (.10-.30), moderate correlations (.30-.50) and large correlations (≥.50).

The SPSS 21 and EQS 6.1 statistical packages were employed to perform the mentioned statistical analyses.

Results

Hierarchical Confirmatory Factor Analyses

Goodness-of-fit indexes of the analysed models through CFAs can be seen in Table 1. Results establish that Model 4 (three-factor correlated model) of the DASS-21 shows the best adjustment to sample's scores. Factor loadings from this model ranged from .62 (Item 1) to .81 (Item 15). With regard to Cronbach's coefficient alpha/Omega for the whole questionnaire were: .97/.97, and for each dimension: .90/.90 (Stress), .91/.91 (Anxiety) and .91/.91 (Depression).

INSERT TABLE 1

Factorial Invariance Based On Sex

The results of the analysed models to analyse the factorial invariance based on sex of the three-factor correlated model of the DASS-21 can be seen in Table 2. Firstly, CFAs were performed to confirm the adequacy of the goodness-of-fit indexes both for male and female (TLI and R-CFI > .90; R-RMSEA < .08; SRMR < .05). Regarding the invariance test for the analysed models, it could be proved that all the models showed good robust adjustment indexes and good results for the criterion of invariance (TLI and R-CFI > .90; R-RMSEA < .05; SRMR < .08; ΔR-CFI values > -.01). Consequently, the measurement and structural invariance of the DASS-21 based on sex were confirmed.

INSERT TABLE 2

Latent Mean Differences Based On Sex

For the latent mean differences' analysis based on sex, firstly adequate values for the robust adjustment indexes were obtained in the analysed model (S-Bχ^2(408) =

2096.53, TLI = .965; R-CFI = .954; R-RMSEA = .037, 90% CI = .035, 0,038; SRMR = .036;, p <.001).

Regarding Table 3, the absence of significant differences between the participants of both sexes for none of the three factors was found because CR values were not located inside the range previously mentioned (>1.96 o <-1.96).

INSERT TABLE 3

Correlations Between the DASS-21 and the SAS-A

The three factors of the DASS-21 and the three factors of the SAS-A were positively and significantly correlated with a large magnitude (see Table 4).

INSERT TABLE 4

Discussion

The objective of the current investigation was to examine evidence of validity, reliability and factorial invariance across sex of the online version of the DASS-21 in Ecuadorian undergraduates. In this sense, it is expected to count with an instrument that could be used in research contexts.

Hence, the first central aim of the study was to validate the online version of the DASS-21 in Ecuadorian undergraduates. As it was stated in the first hypothesis, it has been confirmed, as a novel contribution in individuals with these characteristics, the three-factor model proposed by Lovibond and Lovibond (1995), which is consistent with samples from different countries (Alfonsson et al., 2017; Bottesi et al., 2015; González-Rivera et al., 2020; Jun et al., 2018; Kyriazos et al., 2018; Lee et al., 2019; Patias et al., 2016; Randall et al., 2017; Roman et al., 2016). In this sense, these results help to continue supporting the three-factor model as the most adaptable model to different sample, in opposition to the ideas of other authors (Duffy et al., 2005; Kia-Keating et al., 2018; Moore et al., 2017; Szabó & Lovibond, 2006).

With regard to the second aim, the results are in line with hypothesis 2 because the DASS-21 has shown adequate levels of reliability both for the whole of the questionnaire and for the three dimensions, confirming the suitability of the scale (Cho & Kim, 2015). This finding reflects consistency with the factor structure obtained in the original validation of the instrument (Lovibond & Lovibond, 1995). As a result, these findings are the expected for short measures for detection (Domínguez-Lara & Merino-Soto, 2018) and they are enough for using the scale in online research contexts, as well as contributing to detection, diagnostic and intervention inside the educational field (Netemeyer et al., 2003). This information is more useful nowadays because as it has been experienced during the last year, the COVID-19 pandemic has provoked several changes in our daily routine and the substitution of the paper questionnaires by online questionnaires is an important finding that must be kept for our present and future society (Raminah, et al., 2021),

Lastly, it is necessary to highlight that the current piece of research is the first to examine sex invariance of the online version of DASS-21 in Ecuadorian undergraduates (third objective). The necessity of obtaining a measurement instrument which distinguishes and assesses anxiety, stress and depression, and in which its characteristics are independent across sex (the three factors are equivalent for males and females) will help to avoid wrong and biased conclusions of its scores (Byrne, 2010). In this sense, the factorial invariance analysis is an important procedure inside the studies that compares between groups because it helps to test that the structural properties of the scales keep invariant among the analysed groups. This fact is reflected in this study, the online version of the DASS-21 has kept invariant its structural properties as the third hypothesis stated. These results are in line with other authors who have found similar data in very specific populations, such the case of Iranian Medicine students (Jafari et

al., 2017) and Chinese Economy students (Lu et al., 2018). As a result, the online version of the DASS-21 can be used without bias in Ecuadorian university sample.

With regard to the analysis of latent mean differences, the findings based on sex follow the same direction and in none of the factors statistically significant differences have been identified. Equally than in results obtained by other authors, this fact indicates that the observed variables (items) identically measure the same latent variables across sex (Gómez et al., 2014; Jafari et al., 2017; Lu et al., 2018). Besides, the results propose that the comparison of the scores of the DASS-21 across sex is not significant in the undergraduate's sample. As a result, the sample size of the current study, which is relatively big, endorses the lack of significant differences based on sex in the three dimensions. These results corroborate the obtained by Jafari et al., (2017) and Lu et al., (2018) in Higher education students and by Gómez et al., (2014) in adults, who indicated that the interpretation of the DASS-21 is not influenced by sex during its administration. Consequently, these results of no differences among the analysed sample across sex in the DASS-21 scores can help to consider that stress, depression and anxiety prevention programs for Ecuadorian university students do not need to be adapted across sex and both can benefit from the same type of programs (Feiss et al., 2019).

Lastly, the positive and significant correlation between the DASS-21 and the SAS-A (objective 4) confirms the similarity between the constructs that both scales assess, and it also confirms the convergent reliability of the online version of the DASS-21. In this sense, the relation between anxiety, depression, stress and social anxiety can be helpful for the promotion of health and educational campaigns to enhance the emotional well-being in our current society (Jiang et al., 2020).

Implications for Practice

Considering the findings of the current study, the analyses allow to identify the number of dimensions and the internal structure of the online version of the DASS-21 in Ecuadorian university sample. Additionally, the study has confirmed the invariance of its interpretation across sex. Consequently, the capacity of separately and jointly measuring these three emotional problems can be useful for researchers and clinicians who detect these psychological constructs, as part of a wide task of evaluation, and at the same time, it would allow the planification of interventions to prevent these problems among university population (Rith-Najarian et al., 2019).

Limitations and Future Research lines

However, the current work presents some limitations. The main limitations are focused on data collection, although the presented results are significant, it must be taken into account that the sample is formed by university students (who have similar ages and levels of education), which could provoke not having a highly emblematic sample. Future studies could also enhance the range of the sample and select individuals from other age groups and different education stages. Besides, the current sample comes from a particular country, and they are students with access to the Internet. Future pieces of research should be generalised to other countries and should consider the possible bias provoked by the digital division. In the same line, the study design presents a transversal nature, so it limits the possibility of testing the stability and evolution of the three-factor structure of the DASS-21 across sex and time. It would be useful that future longitudinal investigations would face this limitation in both sexes (Gao et al., 2020).

Conclusions

Despite the limitations, the current study provides important and solid information about the application without bias of the DASS-21 scale in Ecuadorian university population. Besides, since the literature revision, this is a pioneering work that has examined the factorial invariance of the instrument across sex, and it is also a pioneering investigation in analysing the psychometric properties of the online version of the DASS-21. Consequently, the results are an important contribution to the anxiety, depression and stress measurement in undergraduates. Specifically, the validation of the online version of the DASS-21 in Ecuadorian university sample across sex provides an opportunity for the University community to adapt this type of scales to the situation provoked by the COVID-19 pandemic and continue with the detection and intervention for stress, depression and anxiety issues.

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Table 1

Goodness-of-fit indexes for the analysed models of the DASS-21

	χ^2	S-Bχ^2	df	R-RMSEA 90% CI	SRMR	R-CFI	TLI
Model 1	48159.52	35867.33	210	.236 [.234, .238]	.547	.000	.000
Model 2	3343.47	1848.30	189	.054 [.051, .056]	.033	.953	.948
Model 3	13358.75	8270.97	189	.118 [.116, .120]	.455	.773	.748
Model 4	3177.37	1770.71	186	.053 [.051, .055]	.033	.956	.950

Note. Model 1 = null model; Model 2 = one-factor model; Model 3 = three-factor uncorrelated model; Model 4 = three-factor correlated model; S-Bχ^2 = Satorra-Bentler scaled χ^2; df = degrees of freedom; R-RMSEA = robust root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual; R-CFI = robust comparative fit index; TLI= Tucker Lewis Index;

$p < .001$ for S-Bχ^2 in all the cases.

Table 2

Goodness-of-fit indexes for the three-factor correlated model of the DASS-21 across sex

	χ^2	S-Bχ^2	df	TLI	R-CFI	R-RMSEA	SRMR	ΔR-CFI
Men	1342.84	731.72	186	.965	.969	.047 [.044, .051]	.030	
Women	2200.85	1253.30	186	.935	.942	.057 [.054, .060]	.037	
Model 0	3543.69	1973.52	372	.950	.956	.038 [.036, .039]	.034	
Model 1	3560.30	2033.44	390	.951	.954	.037 [.036, .039]	.036	-.002
Model 2	3606.78	2109.28	411	.948	.954	.037 [.035, .038]	.036	.000
Model 3	3649.98	2145.81	432	.948	.954	.036 [.034, .038]	.036	.000
Model 4	3619.97	2118.84	417	.948	.954	.037 [.035, .038]	.052	.000

Note. Model 0 = free model; Model 1 = Model 0 with factor loadings constraints; Model 2 = Model 1 with intercepts constraints; Model 3 = Model 2 with error variances constraints; Model 4 = Model 2 with factor variances and covariances constraints; S-Bχ^2 = Satorra-Bentler χ^2 escalado; df = degrees of freedom; TLI = the Tucker-Lewis Index; R-CFI = robust comparative fit index; R-RMSEA = robust root mean square error of approximation; SRMR = standarized root mean square residual; ΔR-CFI = robust comparative fit index difference test.

Table 3

Latent mean differences scores across sex for the online version of the DASS-21

	FI	FII	FIII
Men (reference)			
Women			
Mean estimate (ME)	.026	.012	-.005
Standard error (SE)	.021	.022	.023
Critical Ratio (CR)	1.276	.533	-.204
d	-	-	-

Note. FI = Stress subscale; FII = Anxiety subscale; FIII = Depression subscale.

Table 4

Correlations between the factors of the DASS-21 and the factors of the SAS-A

	FI	FII	FIII
FNE	.521**	.567**	.578**
SAD-N	.541**	.547**	.557**
SAD-G	.505**	.545**	.546**

Note. $p<.001$; FI = Stress subscale; FII = Anxiety subscale; FIII = Depression subscale; FNE = fear of negative evaluation; SAD-N = social avoidance and distress-new; SAD-G = social avoidance and distress-general.