



Psychometric evaluation of DASS versions among Spanish and Chinese teachers using exploratory structural equation modeling (ESEM)

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ABSTRACT

Background: Teachers in demanding work environments are prone to anxiety, depression, and stress. Validated measures across different cultural contexts are required. The present study evaluated the psychometric properties of the 21-item Depression, Anxiety and Stress Scale (DASS-21) and DASS-12 and DASS-8 among Spanish and Chinese primary school teachers.

Methods: A total of 3930 primary school teachers were recruited, comprising samples from Spain ($n = 1350$) and China ($n = 2580$). Scale structure was analyzed using confirmatory factor analysis (CFA) and exploratory structural equation modeling (ESEM). Model comparisons were conducted to identify the best-fitting factor structure. Convergent and discriminant validity were examined, and concurrent validity was assessed using emotional exhaustion as a criterion variable. Optimal diagnostic thresholds were established through latent profile analysis (LPA) and receiver operating characteristic (ROC) analysis.

Results: Among the tested factor structures (unidimensional, oblique three-factor, ESEM, bifactor, and bifactor ESEM models), the ESEM model demonstrated superior fit indices, supporting acceptable factorial validity among both Spanish and Chinese samples. The DASS versions in the ESEM structure exhibited strong convergent, discriminant, and concurrent validity in the Spanish sample, while showing relatively weaker validity indices among the Chinese sample. Notably, the empirically derived cutoff scores for DASS-21 sub-dimensions among teachers were substantially higher than the originally recommended thresholds.

Conclusion: The three DASS versions effectively assessed three types of psychological distress among Spanish teachers, while among the Chinese teachers, the DASS instruments appeared useful for assessing distress, though caution is recommended when using individual subscale scores.

1. Introduction

Schoolteachers play a crucial role in educational systems worldwide, yet they face heightened risks of psychological distress, including

depression, anxiety, and stress (Cao, Liao, Jiang, et al., 2023; Frenzel et al., 2021; Lizana & Lera, 2022). Teachers' psychological well-being is fundamental not only to their personal health and professional development but also to their students' academic and psychological growth

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(Liu, 2024a, 2024b). Therefore, valid assessment tools are essential for monitoring and supporting teachers' mental health effectively. Importantly, the appropriate use of such tools requires careful consideration of cultural factors that may influence how psychological distress manifests and is reported (Bibi et al., 2020; Zanon et al., 2020).

Indeed, the expression and interpretation of psychological symptoms are deeply influenced by cultural context (Bibi et al., 2020; Kirmayer, 1984; Oei et al., 2013). Research has demonstrated that Asian populations tend to express psychological distress through somatic symptoms, while Western populations more readily report psychological symptoms (Dere et al., 2013; Parker et al., 2001; Ryder et al., 2008). This cultural variation in symptom presentation underscores the need for assessment tools that are both psychometrically sound and culturally appropriate for diverse populations.

Among available assessment tools, the Depression, Anxiety and Stress Scale (DASS) has emerged as a prominent instrument for assessing psychological distress (Bibi et al., 2020; Oei et al., 2013; Zanon et al., 2020). The DASS-21, a shortened version of the 42-item DASS, has gained widespread acceptance for its brevity and applicability among both clinical and general populations (Bibi et al., 2020). More recently, briefer versions—the 12-item (DASS-12) and 8-item (DASS-8)—have been developed, offering increasingly efficient approaches to mental health assessment. However, these shortened versions have undergone minimal evaluation, primarily by their developers (see Ali et al., 2021; Ali, Alameri, et al., 2022; Ali, Hendawy, et al., 2022; Ali, Hori, et al., 2022; Lee et al., 2019).

While the DASS-21 has been employed in several studies examining teachers' mental health, comprehensive psychometric validation in this population remains limited. A recent study by Cao, Liao, Jiang, et al. (2023) provided the first detailed psychometric evaluation of the DASS-21 among Chinese schoolteachers, employing multiple approaches including classical test theory, Rasch analysis, and network analysis. Their findings confirmed the factorial validity of an oblique three-factor structure but reported concerns regarding discriminant validity due to high inter-factor correlations. To the best of the authors' knowledge, this represents the only comprehensive psychometric investigation of any DASS version among a population of schoolteachers, highlighting a significant gap in the literature, particularly regarding the shortened versions (DASS-12 and DASS-8).

To address these limitations and examine cross-cultural measurement properties, the present study aimed to validate all three DASS versions among schoolteachers in Spain and China. This comparison between Western European and East Asian educational contexts provides a unique opportunity to establish the cross-cultural validity of these instruments while contributing valuable evidence about their psychometric properties in the teaching profession. With a focus on comprehensive psychometric evaluation, the following sections review the literature regarding inconsistent findings in DASS factor structures, introduce a novel approach for determining diagnostic thresholds, and present the rationale for selecting Spain and China as comparative contexts.

1.1. Factor structure and methodological considerations

Factorial validity, a facet of construct validity, has been extensively examined for the DASS-21 across various demographics in separate studies conducted in Western or Eastern contexts (e.g., Cao, Liao, Jiang, et al., 2023; Chen, Chen, et al., 2023; Lee & Kim, 2022; Naumova, 2022; Zanon et al., 2020). Studies using confirmatory factor analysis (CFA) have shown several competing factor structures of the DASS. The tested models include one-factor (Jiang et al., 2020), oblique two-factor models (either depression and combined anxiety-stress, or physiological arousal and combined generalized negativity and lack of positive affect) (Brown et al., 1997; Duffy et al., 2005), in addition to the original three-factor structure proposed by Lovibond and Lovibond (1995a,b). Moreover, a bifactor model has been applied based on the tripartite

model, which assumes three components: a depression-type factor (characterized by lack of positive affect), a physiological hyperarousal factor (capturing anxiety symptoms such as dryness of mouth), and a negative affectivity factor (encompassing common mood states associated with depression and anxiety) (Naumova, 2022; Zanon et al., 2020). The bifactor model applied in the DASS incorporates a general psychological distress factor and three specific factors (depression, anxiety, and stress), with items loading simultaneously on both the general factor and their respective specific factors.

While the bifactor model of the DASS-21 has shown favorable results (Naumova, 2022; Zanon et al., 2020), the expected oblique three-factor structure has not consistently demonstrated acceptable fit across studies, prompting researchers to explore alternative statistical approaches (e.g., Chen et al., 2024; Jovanović et al., 2021). Traditional CFA's stringent requirement for zero cross-loadings presents methodological limitations that may compromise model fit, potentially failing to capture the true complexity of data patterns (Asparouhov & Muthén, 2009; Fu et al., 2021; Gu et al., 2023; Marsh et al., 2011). This limitation also contributes to inflated correlations among the three factors (Marsh et al., 2010; Marsh & Alamer, 2024), a critical concern in DASS factor structure analysis (Cao, Liao, Jiang, et al., 2023).

To address these inconsistencies, researchers have recently turned to exploratory structural equation modeling (ESEM), which combines the benefits of both exploratory factor analysis (EFA) and CFA (Marsh & Alamer, 2024). By permitting cross-loadings among conceptually relevant factors (Marsh et al., 2014), ESEM achieves improved goodness of fit, less exaggerated factor correlations, and more accurate representations of factor structures (Marsh et al., 2010; Marsh et al., 2011; Morin & Maïano, 2011; Sánchez-Carracedo et al., 2012). These advantages position ESEM as a more suitable approach for examining the construct validity of various DASS versions. Moreover, recent methodological advances have introduced a more sophisticated approach that integrates ESEM with bifactor elements (Morin et al., 2016), offering a novel theoretical framework for representing the multidimensional structure of DASS data (Jovanović et al., 2021).

To date, neither the ESEM nor the ESEM bifactor model (which combines ESEM with bifactor elements) has been tested among schoolteacher populations. Moreover, while the newer DASS-12 and DASS-8 versions have demonstrated initial robust reliability and validity in specific populations (Ali et al., 2021; Ali, Alameri, et al., 2022; Ali, Hendawy, et al., 2022; Ali, Hori, et al., 2022; Lee et al., 2019), their psychometric properties among schoolteachers require further investigation, particularly through rigorous ESEM/ESEM bifactor examinations.

1.2. Establishing optimal diagnostic thresholds

Determining optimal cutoff points is crucial for effectively utilizing the DASS to diagnose mental health issues among schoolteachers across different cultural contexts. Culturally appropriate thresholds enable the DASS instruments to differentiate between teachers experiencing clinical distress and those functioning within normal parameters, thereby facilitating timely intervention and treatment. While several studies have established cutoff scores using receiver operating characteristic (ROC) curve analysis based on external diagnostic criteria (e.g., Ali et al., 2023; Evans et al., 2021, 2022), obtaining such criteria often presents significant challenges.

Latent profile analysis (LPA) offers a promising alternative approach for establishing reference groups in ROC analysis, gaining recognition for its effectiveness, precision, and versatility (Bauer, 2022; van Smeden et al., 2014). This method has been successfully employed to establish optimal cutoff points for various psychological measurement tools (see Fu et al., 2022; Peng et al., 2023), yet its application to DASS instruments remains unexplored. To address this gap, the present study employed LPA as a reference framework for ROC curve analysis to determine optimal diagnostic thresholds for the DASS-21, DASS-12, and

DASS-8 among Spanish and Chinese primary schoolteachers.

1.3. Cross-cultural validation: a Spain-China comparison

Mental health issues are understood and expressed through culturally specific norms and circumstances (Bhugra et al., 2021; Ogundare, 2019). Therefore, extending comprehensive psychometric evaluation of all the DASS versions across cultures among schoolteachers from different countries is crucial for ensuring measurement accuracy and reliability, particularly for cross-national comparisons. The comparison between schoolteachers from Spain and China presents a valuable opportunity to examine the DASS's psychometric properties across distinct cultural and educational contexts.

Spain and China represent different cultural contexts in their approaches to education and psychological well-being. The Spanish context reflects Western individualistic cultural values (Hofstede et al., 2010), emphasizing direct communication styles and individual expression (Gudykunst et al., 1988; Mak, 1998), with psychological support and mental health resources increasingly recognized in professional frameworks (Ministerio de Sanidad, 2022). In contrast, China's context is deeply rooted in Confucian traditions and collectivistic values (Hofstede et al., 2010), where teachers operate within a highly structured system that emphasizes hierarchical relationships and emotional restraint (Feng & Jia, 2024; Yin & Lee, 2012; Zheng et al., 2021), often bearing additional responsibilities beyond academic instruction that may increase their psychological burden (Tang, 2023; Yang et al., 2019).

Moreover, cultural differences in expressing and managing psychological distress are significant. Western cultures typically favor direct emotional expression, while Eastern cultures often emphasize emotional restraint and social harmony (Bibi et al., 2020; Chang et al., 2017; Kitayama & Salvador, 2024; Yang et al., 2019). These distinct approaches to emotional expression and psychological well-being may significantly influence how individuals experience, interpret, and report psychological symptoms (Bibi et al., 2020; Oei et al., 2013). The substantial differences in educational philosophies, cultural values, and approaches to psychological well-being between Spanish and Chinese schoolteachers make the comparison in the present study particularly valuable for establishing the cross-cultural validity of the DASS, while also contributing to the understanding of how cultural contexts shape the manifestation and measurement of psychological distress among educators.

In summary, measurement validity may be population-dependent. While the DASS-21 has undergone extensive examination across diverse samples, from general populations (Bibi et al., 2020; Scholten et al., 2017) to various age and professional groups (Kakemam et al., 2022; Lee & Kim, 2022; Naumova, 2022; Zanon et al., 2020), a significant gap exists in research among schoolteachers, particularly from a cross-cultural perspective. By applying recently developed statistical approaches, such as ESEM and ESEM bifactor models, how psychological symptoms manifest differently among schoolteachers across these two distinct cultural contexts can be better understood. The innovative ESEM type approach offers new opportunities to address this research gap while accounting for cultural variations in psychological measurement.

1.4. Research questions

Building on the established research needs, and considering the distinct cultural contexts of Spain and China, the present study addressed three primary research questions (RQs): (i) What is the optimal factor structure of the DASS (21-, 12-, and 8-item versions) for Spanish and Chinese schoolteachers, using traditional CFA and ESEM type approaches? (RQ1). Additionally, the convergent and discriminant validity within the identified best-fitting factor structure for both countries were assessed; (ii) What are the optimal diagnostic thresholds for different DASS versions when applied to Spanish and Chinese

schoolteachers, using a novel methodological approach combining LPA and ROC curve analysis? (RQ2); and (iii) What are the relationships between emotional exhaustion and DASS components, supporting concurrent validity in teaching populations? (RQ3). Emotional exhaustion was selected as a key concurrent variable because it is a well-documented occupational risk among teachers (Donker et al., 2020; Olivier et al., 2024; Schulze-Hagenest et al., 2023). Moreover, emotional exhaustion, characterized by feelings of being emotionally overextended and depleted (Klusmann et al., 2021; Maslach et al., 2001), shares significant theoretical and empirical overlap with DASS components through its established associations with depression (shared features of fatigue), anxiety (physiological arousal), and stress (workplace demands) (Cao, Liao, Gamble, et al., 2023; Johnson et al., 2020; Koeske & Koeske, 1993).

2. Methods

2.1. Participants and procedures

During the peak of the Omicron variant's spread in early 2022, a comparative study was conducted on primary schoolteachers in Spain and China. The survey was conducted from January to February 2022 in Spain and January 2022 in China. Spain's effective vaccination campaign allowed primary schools to continue in-person teaching, while China's strict zero-COVID policy led to immediate lockdowns and significant movement restrictions.

In Spain, data were gathered through convenience sampling using an online survey sent to primary schools in the Catalonia region. Participation was voluntary, and eligibility was limited to currently active primary schoolteachers without diagnosed mental health conditions. The study included 1350 Spanish schoolteachers, with an average age of 42.86 years (SD = 10.18) and a majority being female (n = 1151, 85.3 %).

In China, the survey was part of a larger study on schoolteachers' mental health during the pandemic, focusing on the impact of the sudden shift to online teaching due to lockdowns. Convenience sampling was used to select participants in cooperation with the local education department. The survey resulted in 2580 responses from the 2764 surveys distributed. The average age of Chinese schoolteachers was 34.72 years (SD = 9.95), with a predominance of female schoolteachers (n = 1962; 76.0 %).

Ethical approval was obtained from the Institutional Review Board (IRB) in China, approved by the Jiangxi Psychological Consultant Association. In Spain, it was considered exempt by the IRB of its institution (CEIM IRJV). Informed consent was obtained from all participants before conducting the study.

2.2. Measures

To evaluate the factorial validity of different versions of the DASS, the Spanish and simplified Chinese versions of the DASS-21 were used as the primary instruments. Concurrent validity was assessed using appropriate versions of a measure for emotional exhaustion administered to schoolteachers in both countries.

2.2.1. Depression, Anxiety, and Stress Scale (DASS-21)

The DASS-21 is a 21-item self-report questionnaire that assesses the severity of symptoms across three dimensions: depression, anxiety, and stress. Each dimension comprises seven items, and scores for each dimension range from 0 to 21. The overall psychological distress score, obtained by summing all 21 items, ranges from 0 to 63 (Lovibond & Lovibond, 1995b). Higher scores indicate greater severity. The developers (Lovibond & Lovibond, 1995b) recommended cutoff scores of 10 for depression, 8 for anxiety, and 15 for stress to discern between normal and non-normal cases.

The Spanish version of the DASS-21 (Malas & Tolsá, 2022) was used

for Spanish participants, while the Simplified Chinese version (Chan et al., 2012) was used for Chinese participants. The Chinese version has been widely used across diverse demographic groups and is recognized for its consistent internal consistency reliability (e.g., Cao, Dang, Zheng, et al., 2023; Cao, Liao, Jiang, et al., 2023; Chen, Chen, et al., 2023).

Additionally, two alternative versions of the DASS were employed: an 8-item version (Ali, Alameri, et al., 2022) and a 12-item version (Lee et al., 2019). These versions were examined to explore their applicability and reliability within the context of the study's diverse participant base.

2.2.2. Emotional exhaustion

For the Spanish sample, emotional exhaustion was assessed using an adaptation of the emotional exhaustion subscale of the Maslach Burnout Inventory for school teachers (Aluja et al., 2005). This comprises six items rated on a seven-point scale, with total scores ranging from 0 to 42. The scale showed a high level of internal consistency (McDonald's $\omega = 0.877$).

For the Chinese sample, emotional exhaustion was assessed using the emotional exhaustion subscale from the Primary and Secondary School Teachers' Job Burnout Questionnaire (CTJBO) (Wu et al., 2016). This tool, tailored for the educational sector in China, includes eight items rated on a seven-point scale. The scale showed a high level of internal consistency (McDonald's $\omega = 0.954$).

2.3. Data analysis

The comprehensive analysis of the DASS versions followed several systematic steps across both national contexts.

2.3.1. Descriptive statistics and internal reliability

Initial analyses examined item-level descriptive statistics and internal consistency of the DASS-21 and its subscales across both national contexts. McDonald's omega coefficients were calculated to assess reliability.

2.3.2. Factorial validity

For testing factorial validity, systematic guidelines for factor structure comparison were followed (Alamer & Alrabai, 2024; Swami et al., 2023). Five models were tested, comprising a unidimensional model and four core models: the oblique three-factor model, ESEM, bifactor model, and bifactor ESEM model. Following recent methodological recommendations (Alamer et al., 2023; Alamer & Alrabai, 2024), first the oblique three-factor model was compared with ESEM after establishing the baseline unidimensional model. If both models demonstrated acceptable fit, bifactor and bifactor ESEM models were then examined. However, if only ESEM showed adequate fit, the bifactor ESEM model was exclusively considered. Higher-order structures were not examined because the global factor in bifactor models provides direct effects on indicators, offering more meaningful representation and model fit indices (Alamer & Alrabai, 2024). The CFA and ESEM analyses were conducted using the robust maximum likelihood (MLR) estimation method, which provides robust standard errors and test statistics that are less sensitive to violations of multivariate normality (Li, 2016).

For bifactor-based models, two additional indices were calculated to evaluate dimensionality: explained common variance (ECV) and omega hierarchical (ω_H). ECV indicates the proportion of common variance explained by the general factor relative to all the specific factors combined, providing insight into the relative strength of the general factor. ω_H indicates the proportion of total score variance that can be attributed to the general factor alone, thereby indicating the extent to which total scores reliably reflect the general construct. Within these models, both ECV and ω_H were computed for the general factor. Following Reise et al.'s (2012) guidelines, ECV values above 0.60 suggest that the general factor accounts for the majority of common variance across items, while ω_H values above 0.70 indicate that total scores predominantly reflect

variation in the general factor rather than the specific factors. These thresholds help determine whether the construct can be treated as essentially unidimensional for practical purposes.

Model fit assessment utilized multiple indices: comparative fit index (CFI), non-normed fit index (NNFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) with 90 % confidence intervals. Acceptable fit criteria were established as CFI and NNFI > 0.90 , and RMSEA and SRMR < 0.10 (Kline, 2016). Following van Zyl and Ten Klooster's (2022) recommendations, the incremental improvement in model fit was evaluated when comparing bifactor ESEM to other models, using change indices (Δ CFI, Δ NNFI, Δ RMSEA, and Δ SRMR). Meaningful improvements were defined by changes exceeding 0.015 for RMSEA and SRMR, and 0.01 for CFI and NNFI.

2.3.3. Convergent and discriminant validity

Convergent and discriminant validity were assessed using CFA-derived indices. For convergent validity, composite reliability (CR) and average variance extracted (AVE) were calculated, with thresholds of CR > 0.70 and AVE > 0.50 (Fornell & Larcker, 1981). Discriminant validity was established when the AVE for each factor exceeded their squared inter-factor correlations (Hair et al., 2019).

2.3.4. Concurrent validity

The relationship between DASS versions and emotional exhaustion was examined using structural equation modeling (SEM), applying the best-fitting model across countries and DASS versions. Model fit was evaluated using the previously established criteria (CFI and NNFI > 0.90 , RMSEA and SRMR < 0.10). After confirming adequate model fit, the path coefficients between each DASS dimension and emotional exhaustion were analyzed to assess concurrent validity through the strength and significance of these relationships.

2.3.5. Cutoff score determination

A two-step approach was used to establish diagnostic thresholds. First, Latent Profile Analysis (LPA) identified distinct groups based on psychological distress patterns, with model selection using statistical indicators (Spurk et al., 2020) and the elbow criterion (Morin & Wang, 2016). Second, Receiver Operating Characteristic (ROC) analysis determined optimal cutoff scores using the Youden Index, which maximizes both sensitivity and specificity.

3. Results

3.1. Descriptive and internal reliability

Table 1 shows the mean scores and standard deviations for each item of the DASS, along with the observed mean scores for the entire scale and the three subscales for participants from both countries. The internal consistency was examined using McDonald's omega coefficients (ω) at three levels: the complete scale, its subscales, and the scale reliability if individual items were removed. All omega values exceeded 0.85 across both Spanish and Chinese schoolteacher samples, indicating robust reliability at all three levels.

3.2. Factorial validity, convergent, and discriminant validity

Table 2 presents the model fit indices for different structural models across the different versions of the DASS and the two countries. The unidimensional and oblique three-factor models demonstrated inadequate fit in both countries, while the ESEM model showed acceptable fit across all versions. Given that only the ESEM model demonstrated acceptable factorial validity, subsequent analysis focused exclusively on the bifactor ESEM model, without examining the bifactor model. The bifactor ESEM models showed generally acceptable fit, although convergence issues were encountered with the DASS-8 among the

Table 1
Descriptive statistics of DASS-21 items for Spanish and Chinese schoolteachers.

	Spanish schoolteachers			Chinese schoolteachers		
	Mean	SD	ω or ω if items dropped	Mean	SD	ω or ω if items dropped
Depression	3.72	4.51	0.91	3.25	4.17	0.92
Item 3	0.50	0.78	0.89	0.62	0.79	0.92
Item 5	0.66	0.83	0.91	0.49	0.72	0.91
Item 10	0.54	0.85	0.89	0.57	0.80	0.91
Item 13	0.93	0.97	0.90	0.54	0.76	0.91
Item 16	0.46	0.76	0.89	0.45	0.71	0.90
Item 17	0.41	0.78	0.90	0.26	0.61	0.91
Item 21	0.22	0.61	0.91	0.32	0.65	0.91
Anxiety	3.79	4.33	0.88	3.80	4.21	0.91
Item 2	1.02	1.06	0.88	0.88	0.88	0.92
Item 4	0.54	0.83	0.86	0.53	0.77	0.90
Item 7	0.27	0.61	0.87	0.37	0.68	0.90
Item 9	0.58	0.86	0.86	0.69	0.79	0.90
Item 15	0.32	0.68	0.86	0.44	0.71	0.89
Item 19	0.64	0.93	0.85	0.48	0.73	0.89
Item 20	0.42	0.75	0.86	0.40	0.69	0.89
Stress	7.18	5.06	0.90	4.37	4.34	0.91
Item 1	1.25	1.03	0.88	0.73	0.78	0.91
Item 6	0.76	0.80	0.89	0.49	0.73	0.89
Item 8	1.34	1.03	0.88	0.86	0.88	0.90
Item 11	1.27	0.95	0.88	0.53	0.76	0.88
Item 12	1.30	1.00	0.87	0.60	0.78	0.88
Item 14	0.44	0.71	0.89	0.59	0.75	0.90
Item 18	0.83	0.87	0.88	0.57	0.76	0.89
DASS-21	14.70	12.79	0.96	11.41	12.30	0.97
Total						

Chinese sample. Notably, the improvement in model fit from ESEM to bifactor ESEM did not exceed the established criteria (Δ RMSEA and Δ SRMR >0.015 , and Δ CFI and Δ NNFI >0.01), suggesting that the additional complexity of the bifactor ESEM model may not offer substantial advantages over the ESEM model.

As shown in Table 3, the oblique three-factor models showed high interfactor correlations among the three types of psychological distress, ranging from 0.73 to 0.86 among the Spanish sample and 0.93 to 0.99 among the Chinese sample. The ESEM analysis reduced these inflated correlations to more moderate levels, ranging from 0.48 to 0.58 among the Spanish sample and 0.52 to 0.73 among the Chinese sample.

Table 2
Results of confirmatory factor analysis (CFA) model fit across various factor structures.

	DASS-21					DASS-12					DASS-8				
	χ^2 (df)	CFI	NNFI	RMSEA	SRMR	χ^2 (df)	CFI	NNFI	RMSEA	SRMR	χ^2 (df)	CFI	NNFI	RMSEA	SRMR
One-factor															
Spain	1892.69 (189)	0.859	0.843	0.082	0.053	790.43 (54)	0.890	0.866	0.101	0.050	431.87 (20)	0.895	0.853	0.124	0.051
China	2559.45 (189)	0.890	0.878	0.070	0.044	956.86 (54)	0.916	0.897	0.081	0.044	295.90 (20)	0.957	0.940	0.073	0.030
Three-factor															
Spain	1095.13 (186)	0.925	0.915	0.060	0.047	303.64 (51)	0.962	0.951	0.061	0.033	137.33 (17)	0.969	0.950	0.072	0.026
China	2547.72 (186)	0.890	0.876	0.103	0.044	910.76 (51)	0.920	0.896	0.081	0.044	258.54 (17)	0.963	0.939	0.074	0.030
Bifactor															
Spain	768.70 (168)	0.950	0.938	0.051	0.033	168.15 (42)	0.981	0.970	0.047	0.024	61.67 (12)	0.987	0.971	0.055	0.019
China	1928.49 (168)	0.918	0.902	0.064	0.039	759.08 (42)	0.933	0.895	0.081	0.042	184.80 (12)	0.973	0.938	0.075	0.027
ESEM															
Spain	590.11 (150)	0.964	0.949	0.047	0.023	114.03 (33)	0.988	0.976	0.043	0.015	24.65 (7)	0.996	0.982	0.043	0.008
China	956.25 (150)	0.963	0.948	0.046	0.020	292.31 (33)	0.976	0.952	0.055	0.018	37.98 (7)	0.995	0.981	0.041	0.007
ESEM Bifactor															
Spain	475.95 (132)	0.972	0.955	0.044	0.019	76.36 (24)	0.992	0.979	0.041	0.010	0.08 (2)	0.999	0.999	0.000	0.001
China	679.39 (132)	0.975	0.960	0.040	0.015	102.88 (24)	0.993	0.980	0.036	0.009	The model cannot converge				

CFI = comparative fit index; NNFI = non-normed fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

The aforementioned results indicated that the ESEM factor structure achieved a superior fit across different DASS versions in both countries and effectively mitigated the issue of excessively high factor correlations. As shown in Table 4, the factor loadings from the ESEM model showed substantial differences between the Spanish and Chinese schoolteacher cohorts. In the DASS-21, Spanish schoolteachers demonstrated higher factor loadings within their designated factors, while Chinese schoolteachers showed this pattern mainly in the stress subscale, with substantial cross-loadings in the depression and anxiety subscales.

Similar patterns were observed in the shortened DASS versions. In the DASS-12, Spanish schoolteachers showed no significant cross-loadings, with nearly all items having distinctly higher factor loadings within their respective factors, except for Item 2 of the anxiety subscale. In the DASS-8, Spanish schoolteachers had no cross-loadings, with factor loadings above 0.45 within their respective factors and almost all non-associated factor loadings below 0.30. In contrast, Chinese schoolteachers displayed cross-loadings in the depression and anxiety subscales in both the DASS-12 and DASS-8, with fewer instances in the stress subscale.

The high cross-loading among Chinese schoolteachers suggested a potential overlap between the factors of depression and anxiety. Table S1 in the Supplementary Materials shows the ECV and OH values

Table 3
The factor correlations among the three types of psychological distress.

	Traditional oblique three-factor model			Exploratory structural equation modeling		
	Factor correlations			Factor correlations		
	D-A	D-S	A-S	D-A	D-S	A-S
DASS-21						
Spanish schoolteachers	0.86	0.83	0.82	0.58	0.49	0.51
Chinese schoolteachers	0.99	0.98	0.99	0.54	0.63	0.58
DASS-12						
Spanish schoolteachers	0.81	0.84	0.78	0.54	0.51	0.49
Chinese schoolteachers	0.97	0.99	0.95	0.53	0.55	0.63
DASS-8						
Spanish schoolteachers	0.83	0.78	0.73	0.54	0.49	0.48
Chinese schoolteachers	0.99	0.96	0.93	0.73	0.52	0.64

Note. D-A = The relationship between depression and anxiety; D-S = The relationship between depression and stress; A-S = The relationship between anxiety and stress.

Table 4
Standardized factor loadings in ESEM for DASS-21, DASS-12, and DASS-8 among Spanish and Chinese schoolteachers.

	DASS-21						DASS-12						DASS-8					
	Spanish			Chinese			Spanish			Chinese			Spanish			Chinese		
	Dep	Anx	Stress	Dep	Anx	Stress	Dep	Anx	Stress	Dep	Anx	Stress	Dep	Anx	Stress	Dep	Anx	Stress
Depression																		
Item 3	0.54	0.15	0.24	0.69	0.08	0.12	0.58	0.21	0.16	0.66	0.20	0.08	0.81	0.08	0.08	0.35	0.30	0.29
Item 5	0.32	0.24	0.24	0.62	0.25	0.03	0.79	0.11	0.08	0.20	0.21	0.53	0.46	0.13	0.40	0.16	0.34	0.52
Item 10	0.77	0.04	0.12	0.25	0.20	0.50	0.52	0.17	0.40	0.15	0.23	0.62	0.66	0.20	0.09	0.21	0.63	0.13
Item 13	0.48	0.09	0.42	0.13	0.25	0.62	0.60	0.22	0.05	0.02	0.71	0.11						
Item 16	0.72	0.13	0.08	0.19	0.46	0.33												
Item 17	0.59	0.26	0.01	0.14	0.79	-0.03												
Item 21	0.58	0.23	-0.06	0.09	0.79	0.05												
Anxiety																		
Item 2	0.02	0.22	0.41	0.55	-0.10	0.25	0.04	0.48	0.38	0.64	-0.06	0.17						
Item 4	0.09	0.51	0.20	0.67	0.20	0.06	0.12	0.62	0.10	0.53	0.40	0.03						
Item 7	0.06	0.63	0.04	0.42	0.40	0.09	0.14	0.43	0.03	0.21	0.60	0.09						
Item 9	0.22	0.52	0.13	0.28	0.09	0.52												
Item 15	0.23	0.60	0.07	0.14	0.44	0.44												
Item 19	0.01	0.67	0.20	0.15	0.49	0.31	0.07	0.75	0.17	0.12	0.50	0.31	0.15	0.63	0.13	0.12	0.63	0.26
Item 20	0.17	0.66	0.03	0.08	0.65	0.25							0.09	0.71	0.09	0.16	0.55	0.21
Stress																		
Item 1	0.12	0.07	0.71	0.57	0.03	0.13	0.17	0.18	0.70	0.60	0.05	0.12						
Item 6	0.21	0.19	0.37	0.52	0.26	0.15												
Item 8	0.04	0.14	0.64	0.34	-0.09	0.56												
Item 11	0.10	0.13	0.68	0.14	0.26	0.61	0.13	0.21	0.66	0.12	0.24	0.65	0.11	0.10	0.59	0.54	-0.05	0.33
Item 12	0.07	0.10	0.78	0.17	0.11	0.69	0.07	0.15	0.86	0.20	0.07	0.72	0.04	0.08	0.84	0.16	0.08	0.74
Item 14	0.36	0.27	0.19	0.17	0.19	0.47												
Item 18	0.23	0.16	0.46	0.11	0.36	0.43	0.25	0.22	0.42	0.12	0.35	0.42						

Note. Dep = depression, Anx = anxiety.

calculated from factor loadings obtained through bifactor ESEM. These analyses verified a significant general factor within the DASS-21 among Chinese schoolteachers, with an OH value of 0.70 and an ECV of 0.66, indicating a prominent unidimensional construct. However, an OH value of 0.63 and an ECV of 0.45 among Spanish schoolteachers suggested the DASS-21's multidimensional characteristics.

Table 5 shows the CR and AVE values for constructs across different DASS versions, determined by factor loadings derived from ESEM. CR values consistently exceeded 0.65, with most exceeding 0.70 in the Spanish schoolteacher sample, supporting convergent validity. Although AVE values were below the 0.50 threshold, a sufficient CR can independently substantiate convergent validity. AVE values for each construct predominantly exceeded the squared inter-construct correlations (Table 3), affirming discriminant validity among Spanish schoolteachers for all DASS versions. In contrast, low CR and AVE values among Chinese schoolteachers indicated a lack of support for both convergent and discriminant validity.

3.3. Concurrent validity with emotional exhaustion

To evaluate concurrent validity regarding emotional exhaustion, ESEM was utilized across different versions of the DASS. This approach was identified as the optimal factor structure for analyzing data from schoolteachers in both countries. The primary focus was to examine the coefficient that describes the concurrent relationship between emotional exhaustion and the three emotional disorder factors. The SEM results indicated an acceptable fit for the model across all DASS versions for participants from both countries (see Table 6). Further analysis showed that the standardized coefficients associating depression with emotional exhaustion ranged from 0.40 to 0.46 among Spanish schoolteachers and from 0.18 to 0.30 among Chinese schoolteachers, all reaching statistical significance. For anxiety, the significant coefficients ranged from 0.21 to 0.26 for Spanish schoolteachers, but they were not statistically significant for Chinese schoolteachers. In the case of stress, the significant coefficients varied from 0.60 to 0.63 for Spanish schoolteachers, and from 0.44 to 0.59 for Chinese schoolteachers. In summary, the three dimensions of psychological distress accounted for most of the unique variance in emotional exhaustion. However, the relationship between anxiety and emotional exhaustion was consistently non-significant among Chinese schoolteachers across the different DASS versions. Notably, stress was identified as the most significant factor influencing emotional exhaustion in both countries across all versions of the DASS.

3.4. Utilizing latent profile analysis and receiver operating characteristic curves to determine cutoff points for the different versions of the DASS

LPA was used to identify distinct subgroups within Spanish and

Table 5

Assessing composite reliability and average variance extracted for constructs across different versions of the DASS based on ESEM.

	Depression		Anxiety		Stress	
	Spanish teachers	Chinese teachers	Spanish teachers	Chinese teachers	Spanish teachers	Chinese teachers
DASS-21						
CR	0.78	0.43	0.75	0.44	0.76	0.63
AVE	0.35	0.14	0.31	0.15	0.33	0.23
DASS-12						
CR	0.72	0.23	0.66	0.39	0.76	0.56
AVE	0.39	0.12	0.34	0.19	0.46	0.29
DASS-8						
CR	0.68	0.16	0.67	0.43	0.68	0.46
AVE	0.43	0.06	0.41	0.24	0.53	0.33

Note. CR = Composite Reliability; AVE = Average Variance Extracted.

Table 6
ESEM model fit for emotional exhaustion and different DASS version structures among Spanish and Chinese schoolteachers.

Sample	χ^2 (df)	CFI	NNFI	RMSEA	SRMR
DASS-21					
Spanish	1017.65 (351)	0.957	0.946	0.044	0.027
Chinese	2242.63 (335)	0.951	0.940	0.047	0.035
DASS-12					
Spanish	4168.85 (111)	0.973	0.962	0.045	0.025
Chinese	1307.52 (146)	0.957	0.944	0.056	0.036
DASS-8					
Spanish	329.17 (61)	0.968	0.953	0.062	0.026
Chinese	962.44 (88)	0.960	0.945	0.062	0.032

Note. The variation in the scale of emotional exhaustion utilized across the two groups resulted in differences in the degrees of freedom. CFI = comparative fit index; NNFI = non-normed fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Chinese schoolteacher cohorts based on responses to the different DASS versions and their subscales. Model fit details are provided in Supplementary Tables S2 and S3 and elbow plots (Figs. S1 to S12). Subgroups with significant psychological distress were used as reference categories for ROC analysis.

For psychological distress assessed by the DASS-21, recommended cutoffs were 23 (out of 63) for Spanish schoolteachers and 30 (out of 63) for Chinese schoolteachers. For the DASS-12, recommended cutoffs were 14 (out of 36) for Spanish schoolteachers and 17 (out of 36) for Chinese schoolteachers. For the DASS-8, recommended cutoffs were 11 (out of 24) for Spanish schoolteachers and 12 (out of 24) for Chinese schoolteachers. Sensitivity and specificity estimates ranged from 0.98 to 0.99.

For depression, recommended cutoffs for Spanish schoolteachers were 8 (out of 21), 5 (out of 12), and 4 (out of 9) for the DASS-21, DASS-12, and DASS-8, respectively. For Chinese schoolteachers, recommended cutoffs were 10 (out of 21), 5 (out of 12), and 4 (out of 9) across the DASS versions. Sensitivity and specificity values ranged from 0.87 to 0.99.

For anxiety, recommended cutoffs for Spanish schoolteachers were 11 (out of 21), 5 (out of 12), and 4 (out of 9) for the DASS-21, DASS-12, and DASS-8. For Chinese schoolteachers, recommended cutoffs were 11 (out of 21), 5 (out of 12), and 4 (out of 9). Sensitivity and specificity values ranged from 0.86 to 0.98.

For stress, recommended cutoffs for Spanish schoolteachers were 10 (out of 21), 6 (out of 12), and 3 (out of 6) for the DASS-21, DASS-12, and DASS-8. For Chinese schoolteachers, recommended cutoffs were 10 (out of 21), 5 (out of 12), and 3 (out of 6). Sensitivity and specificity values ranged between 0.86 and 0.98.

4. Discussion

The present study examined the psychometric properties, with particular focus on factorial structure, and optimal cutoff scores of three DASS versions (DASS-21, DASS-12, and DASS-8) among samples of primary schoolteachers from Spain and China. CFA/ESEM were employed to examine factorial, convergent, and discriminant validity, while SEM with emotional exhaustion as the criterion variable was used to assess concurrent validity (Aluja et al., 2005; Wu et al., 2016). Results showed that all DASS versions demonstrated satisfactory internal reliability, with the ESEM structure showing superior model fit compared to alternative models among both Spanish and Chinese primary schoolteacher samples. While all DASS versions demonstrated robust convergent, discriminant, and concurrent validity within the ESEM framework for the Spanish sample, the Chinese sample exhibited comparatively weak validity indices.

The DASS versions exhibited high internal consistency among primary schoolteachers in both countries, consistent with previous research on other populations (Ali et al., 2023; Evans et al., 2021, 2022). ESEM

models best represented the factor structures of the three DASS versions among both cohorts, aligning with findings from Iannatone et al. (2023). High cross-loadings among the Chinese cohort suggested a tendency to generalize depression, anxiety, and stress as general distress, reflecting cultural differences in emotional expression (Chen, Gamble, & Lin, 2023; Morin & Wang, 2016). This may be due to higher levels of alexithymia among Chinese individuals compared to their Western counterparts (Chan et al., 2023; Dion, 1996; Konrath et al., 2011; Le et al., 2002; Lo, 2014), leading to difficulties in distinguishing feelings from bodily sensations (Goerlich, 2018; Wang et al., 2013). Therefore, researchers examining the DASS among Chinese primary schoolteachers should utilize the DASS as a composite construct rather than separate components (Cao, Liao, Gamble, et al., 2023).

ROC curves with LPA were used to explore optimal cutoffs in both country contexts. The ideal cutoff points for DASS-21 subscales were more stringent than the original scale developers' thresholds (Lovibond & Lovibond, 1995b). These higher cutoffs may suggest that a higher level of symptoms is needed to indicate significant distress among teacher populations, possibly due to their occupational characteristics of maintaining professional performance under stress (Doyle et al., 2024; Gu & Day, 2007; Liu et al., 2022; Liu & Chu, 2024). Overall optimal cutoffs were higher among the Chinese cohort compared to the Spanish cohort, while corresponding subscale cutoffs were nearly consistent.

5. Limitations and conclusion

Despite the findings, the present study had some limitations. Firstly, due to practical constraints, the sampling was restricted to the Catalonia region of Spain and specific areas in China, which limited the generalizability of the research findings. Secondly, the study utilized non-probability sampling methods (convenience sampling), making it challenging to control for variables. The results indicated that the age of the Spanish primary schoolteachers participating in the study was notably older than that of the Chinese schoolteachers, which could have potentially biased the findings. In addition, two different scales were used to assess participants' emotional exhaustion. This may have influenced the examination of concurrent validity. Lastly, while the present study identified the optimal cutoffs for the three DASS instruments among Chinese and Spanish primary schoolteachers, it did not extensively explore the reasons underlying these results. Future research investigating the mechanisms underlying these findings is therefore needed.

The present study addressed the previously reported issues of inconsistent factor structures and excessively high inter-dimensional correlations in the DASS by employing ESEM across Spanish and Chinese primary schoolteacher samples. Model comparisons supported ESEM as the optimal representation of factor structure in both countries, effectively reducing the inflated correlations between dimensions. The study further showed differential validity patterns between the two cultural contexts, with stronger psychometric properties observed among the Spanish sample. By integrating LPA with ROC curve analysis, the present study introduced an innovative approach to establishing culturally appropriate cutoff scores. These findings not only advance the understanding of DASS measurement properties but also provide practical guidelines for assessing psychological distress among teachers in different cultural settings.

CRedit authorship contribution statement

Xue-heng Zhou: Project administration, Conceptualization. **Zi-Zheng Shen:** Formal analysis, Data curation. **Cui-Hong Cao:** Writing – review & editing. **Xiao-Ling Liao:** Resources, Data curation. **Xing-Yong Jiang:** Methodology, Investigation. **Mark D. Griffiths:** Writing – review & editing, Writing – original draft. **I-Hua Chen:** Writing – original draft, Supervision, Formal analysis. **Chung-Ying Lin:** Writing – review & editing, Project administration. **Olga Malas:** Visualization, Validation.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (IRB) of the Jiangxi Psychological Consultant Association (IRB ref: JXSL-2020-J013). Electronic informed consent was obtained from all participants, where the purpose of the study, researcher's affiliation, and privacy guarantee were explained.

Consent for publication

Not applicable.

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Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.actpsy.2024.104626>.

Data availability

Data will be made available on request.

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