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Recommended citation:

Zanon, C., Zhao, N., Topkaya, N., Şahin, E., Vogel, D. L., Ertl, M. M., … Nasvytienė, D. (2025). Psychometric properties of the Depression, Anxiety, and Stress Scale–21 (DASS-21) across nine countries/regions. *International Journal of Testing, 25*(2), 178–193. https://doi.org/10.1080/15305058.2025.2489359

Psychometric Properties of the Depression, Anxiety, and Stress Scale–21 (DASS-21) Across Nine Countries/Regions

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Abstract

Examinations of the internal structure of the Depression, Anxiety, and Stress Scale-21 (DASS-21) have yielded inconsistent conclusions within and across cultural contexts. This study examined the dimensionality and reliability of the DASS-21 across three theoretically plausible factor structures (i.e., unidimensional, oblique three-factor, and bifactor) as well as measurement equivalence/invariance of the DASS-21 using two different approaches (i.e., multigroup confirmatory factor analysis and the alignment approach) with a large, diverse sample of 2,920 young adult college student participants from nine countries/regions (i.e., Australia, Brazil, Germany, Hong Kong, Lithuania, Taiwan, Türkiye, United Arab Emirates, and the United States). Results showed an excellent fit of the bifactor model in all countries/regions except the UAE and the US in which the model did not converge. Regarding parameter equivalence, we found configural, threshold, and loading invariance for the oblique three-factor model (across the nine studied countries/regions) and for the bifactor model (across seven countries/regions). Results indicate that DASS-21 scores measure a general psychological distress factor with more validity and reliability than depression, anxiety, or stress constructs independently. Findings supported the bifactor structure of DASS-21 and demonstrated that cross-cultural comparisons using this scale should be conducted using proper procedures, such as the alignment approach.

Keywords: DASS-21, bifactor, general distress, measurement invariance, cross-cultural validation

Psychometric Properties of the Depression, Anxiety, and Stress Scale–21 (DASS-21) Across Nine Countries/Regions

Mental health concerns affect one in four people worldwide (World Health Organization, 2001) and constitute a major reason for early death (Arias et al., 2022) as well as approximately 13% of the total global economic burden of disease—exceeding both cardiovascular disease and cancer (Collins et al., 2011). Further, in recent years we have increasing rates of mental health problems (Richter et al., 2019) that may be exacerbated as a result of the COVID-19 pandemic (Czeisler, 2020; Santomauro et al., 2021). One of the groups most impacted by recent global stressors is young adults, with an estimated 60% of US college students meeting the criteria for a diagnosable mental health problem (Lipson et al., 2022). Depression and anxiety are among the most common concerns experienced by young adults around the world, indicating a clear obligation for researchers to have culturally-valid tools to understand these phenomena in order to understand and develop targeted culturally-sensitive interventions.

One widely used tool is the Depression, Anxiety, and Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995a, 1995b). Drawing from the tripartite model of psychopathology (Clark & Watson, 1991), the DASS-21 postulates that depression, anxiety, and stress collectively form an overarching construct of general distress, while concurrently exhibiting discernible individual attributes (Lovibond & Lovibond, 1995a). Previous findings indicate that DASS-21 has demonstrated evidence of validity and reliability in both clinical samples (Antony et al.,1998; Clara et al., 2001) and nonclinical samples (Sinclair et al., 2012). In support of the tripartite model an oblique three-factor model, which includes three correlated factors—depression, anxiety, and stress—has received support in college students samples around the world, such as the United States (US; Sinclair et al, 2012), South Korea (Lee, 2019), Portugal (Xavier et al., 2017), Indonesia, Malaysia, Singapore, Sri Lanka, Taiwan, and Thailand (Oei et al., 2013), Poland, Russia, the United Kingdom (Scholten et al., 2017), Pakistan and Germany (Bibi et al., 2020).

However, other work directly testing competing models of the internal structure of the DASS-21 across a variety of cultures challenged the original three-factor solution. For

example, Zanon and colleagues (2021) investigated the psychometric properties of the DASS-21 across eight countries (N = 2,580): Brazil, Canada, Hong Kong, Romania, Taiwan, Türkiye, United Arab Emirates (UAE), and the US. Confirmatory factor analyses were conducted to compare four structural models of the DASS-21: a unidimensional model, the traditional three-correlated-factors model, a higher-order model, and a bifactor model. Among these, the bifactor model, which includes three specific factors (depression, anxiety, and stress) alongside a general factor (general distress), provided the best fit within each country. Ancillary bifactor indices were calculated to further assess the dimensionality and reliability of the model. These indices offered insight into the degree of unidimensionality present in the scale and supported the potential use of the DASS-21 as a unidimensional scale (Rodriguez et al., 2016a). The authors concluded that the DASS-21 is most effectively used as a general measure of distress, rather than as separate scales for depression, anxiety, and stress, across the countries studied.

Support for a general factor of the DASS-21, while not originally proposed by the scale developers, does actually align with the transdiagnostic framework of psychopathology, which emphasizes the shared attributes of anxiety and mood disorders rather than their delineations (Barlow et al., 2010; Forbush & Watson, 2013). Depression and anxiety disorders exhibit commonality in terms of cognitive, emotional, and physical symptoms (Tiller, 2013). Studies show that symptoms of mood and anxiety disorders are strongly correlated in adults and that individuals who are diagnosed with mood or anxiety disorders in their lifetime have an increased risk of subsequently developing the other disorder (McGrath et al., 2020; Saha et al., 2021). Given the inconclusive empirical and theoretical conclusions that have been drawn by researchers, the widespread use of the DASS-21 across the globe, as well as the clinical implications of its use by researchers and practitioners, it is necessary to further replicate the findings of Zanon et al. (2021) to evaluate the robustness of a bifactor model of the DASS-21 worldwide. This conceptual replication addresses the problem of the replication crisis in psychology (Open Science Collaboration, 2015) and extends the previous work by evaluating the measurement invariance of the DASS-21 across nine countries.

In addition, few studies have examined the measurement equivalence/invariance (ME/I) of the DASS-21 across populations of young adults from diverse countries. Those that have tested ME/I only used the traditional framework (e.g., Bibi et al., 2020; Zanon et al., 2021), which assesses configural invariance, metric invariance (equality of factor loadings), and scalar invariance (equality of loadings and thresholds). The conventional method of constraining factor loadings to equality in the initial step affects the estimation of subsequent parameters, such as thresholds and intercepts, which are crucial for assessing invariance. This approach risks obscuring meaningful group differences and undermining the validity of findings. As such, the relevance of the proposed replication lies in the need to reassess previous findings and align them with new methods for evaluating ME/I, such as the optimized method (Wu & Estabrook, 2017) and the alignment method (Asparouhov & Muthén, 2014). Wu and Estabrook (2017) proposed an improved strategy that enhances the precision of parameter estimation in ME/I testing. Their approach begins by constraining thresholds across groups, as thresholds reflect the underlying distribution of item responses and form the foundation for evaluating invariance. If threshold equality is supported, factor loadings are then constrained to assess metric invariance. Finally, if both thresholds and loadings are equivalent, intercepts can be constrained to test for scalar invariance, allowing valid latent mean comparisons between groups. This optimized method reduces the likelihood of misidentifying invariance due to methodological artifacts, leading to more robust and reliable conclusions.

On the other hand, the alignment method (Asparouhov & Muthén, 2014) offers a flexible and innovative approach to testing measurement invariance, particularly when dealing with a large number of groups. Unlike traditional methods, which impose strict equality constraints on factor loadings and intercepts, the alignment method identifies approximate invariance by allowing some degree of parameter variability across groups. It works by estimating group-specific factor means and variances and then aligning these parameters to minimize non-invariance. This approach not only identifies items or parameters with significant deviations but also ensures sufficient comparability for meaningful cross-group analyses. As a result, it is particularly useful in cross-cultural research and other

contexts where strict invariance may not be held, providing a computationally efficient solution for studies involving multiple groups.

The present study aimed to replicate the findings of Zanon et al. (2021) with a different sample of participants in nine countries/regions (i.e., Australia, Brazil, Germany, Hong Kong, Lithuania, Taiwan, Türkiye, the UAE, and the US). First, we examined the dimensionality and reliability of the DASS-21 across three theoretically plausible factor structures (i.e., unidimensional, oblique three-factor, and bifactor). The second aim of the study is to examine the ME/I of the DASS-21 using two different approaches—multigroup confirmatory factor analysis (MGCFA; Svetina et al., 2020; Wu & Estabrook, 2016) and the alignment approach (Asparouhov & Muthén, 2014). By accommodating partial invariance, the alignment approach allows for valid comparisons of latent means and variances across groups, even in the presence of some non-invariant parameters. This makes it an ideal tool for ensuring robust and interpretable results when studying psychological constructs across diverse populations (Luong & Flake, 2023).

Method

Participants and Procedures

Participants were 2,920 college students from universities/colleges located in nine different countries and regions: Australia (n = 312; 80.4% women; M_{age} = 23.13, SD_{age} = 6.84), Brazil (n = 275; 80.2% women; M_{age} = 25.24, SD_{age} = 8.44), Germany (n = 356; 81.5% women, M_{age} = 24.15, SD_{age} = 5.11), Hong Kong (n = 336; 61.0% women; M_{age} = 19.92, SD_{age} = 3.10), Lithuania (n = 285; 66.7% women; M_{age} = 21.87, SD_{age} = 2.35), Taiwan (n = 311; 77.5% women; M_{age} = 20.14, SD_{age} = 1.29), Türkiye (n = 353; 61.4% women; M_{age} = 21.00, SD_{age} = 2.98), the UAE (n = 354; 80.2% women; M_{age} = 20.48, SD_{age} = 2.31), and the US (n = 338; 63.8% women; M_{age} = 19.56, SD_{age} = 1.76). Each university/college obtained the approval of its Institutional Review Board before collecting data. All participants consented before participation and were presented with a debriefing statement post-survey. The current sample was part of a larger unrelated cross-national study examining mental health stigma (see Vogel et al., 2024). Researchers with expertise in stigma, and representing populations from across the globe (i.e., Asia, Australia, Europe, the Middle East, North

America, and South America) that vary in cultural values, collected college student samples in their country. The current study utilized the data available from countries that administered the DASS-21 as part of their data collection efforts. The DASS-21 was not used in previous work and the results have not been published.

Measures

The short form of the Depression, Anxiety, and Stress Scale (DASS-21; Lovibond & Lovibond, 1995a, 1995b) was used to measure depression, anxiety, and stress symptoms in the past week. Each subscale consists of 7 items (e.g., depression – "I couldn't seem to experience any positive feelings"; anxiety – "I experienced breathing difficulty"; stress – "I found it hard to wind down") rated on a 4-point Likert scale ranging from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much, or most of the time*). Higher scores on each subscale indicate more severe symptoms of depression, anxiety, and stress, respectively. The DASS-21 has been translated and validated for many languages such as Chinese (Wang et al., 2016), Portuguese (Vignola & Tucci, 2014), Turkish (Şahin et al., 2022), German (Bibi et al., 2020). Participants responded to the DASS-21 in their native language. The descriptive statistics and internal consistency reliability for each country/region sample in our study can be referred to Supplemental Table 1.

Data Analytic Plan

Model Comparison

The current study used R package "lavaan" and "semtools" for model comparison. First, we estimated three hypothesized competing measurement models of the DASS-21 in each country: (1) *Unidimensional model* in which all 21 items were set to load onto a single latent factor; (2) *Oblique three-factor model*, in which items from each 7-item subscale (i.e., depression, anxiety, and stress) were set to load onto their respective factor with no cross-loadings (the three factors were intercorrelated); and (3) *Bifactor model*, in which each item was set to load on both a specific factor (i.e., depression, anxiety, or stress) and a general factor (i.e., general distress). All four factors, including the general factor and the three specific factors, were uncorrelated and cross-loadings were set to zero. For each model, we used the Chi-square, Root Mean Square Error of Approximation (RMSEA), Comparative Fit

Index (CFI), Standardized Root Mean Square Residual (SRMR), and Tucker-Lewis Index (TLI) to evaluate the model fit. Cutoff values of RMSEA and SRMR ≤ .08 and CFI and TLI ≥ .90 indicate an acceptable fit to the data, while RMSEA and SRMR ≤ .06 and CFI and TLI ≥ .95 indicate a good model fit (Hu & Bentler, 1999).

Model-Based Reliability and Dimensionality

If the bifactor model demonstrates the best fit, we will assess the model-based reliability (i.e., the reliability of using a total score and subscale scores to measure the intended construct) and dimensionality (i.e., whether the general factor can be specified as a unidimensional latent variable in structural equation modeling) according to a group of ancillary bifactor indices (Reise et al., 2013, 2023; Rodriguez et al., 2016a, 2016b). For the reliability indices, we used the Coefficient Omega Hierarchical (ωH), Coefficient Omega Hierarchical Subscale (ωHS), and Proportion of Reliable Variance (PRV). ωH reflects the proportion of systematic variance accounted for by the general factor (i.e., general distress) after treating the specific factors (i.e., depression, anxiety, stress) as measurement error. A higher ωH would demonstrate that the general factor is the main source of systematic variance and thus supports the use of a raw total score. In parallel, each subscale's ωHS reflects the proportion of systematic variance accounted for by the specific subscale score after partitioning out variability attributed to the general factor. Similarly, a high ωHS score would demonstrate the specific factor is the main source of systematic variance and thus supports the use of a raw subscale score. PRV reflects the percentage of the total reliability that can be attributed to the reliability of the general factor (or specific factors) without including error variance in its calculations. A benchmark of ωH > .80 and PRV (for general factor) > .75 indicates that researchers can interpret the raw total score as an appropriate measure of the general factor. On the other hand, a benchmark of ωHS > .80 and PRV (for specific factors) > .75 implies that researchers can use the composite subscale score to measure that specific subscale.

For the dimensionality indices, we used the Explained Common Variance (ECV) and Average Relative Parameter Bias (ARPB). ECV indicates the proportion to which a general factor accounts for the explained variance among all factors in the model. ARPB is a measure

for examining the difference between the factor loading of a unidimensional model and the general factor loading of the bifactor model. Appropriate benchmarks for unidimensional model would be ECV ≥ .70 and ARPB < 10-15% (Rodriguez et al., 2016b).

Measurement Equivalence/Invariance (ME/I)

Multigroup Confirmatory Factor Analysis (MGCFA).

We used MGCFA to test the measurement invariance of DASS-21. MGCFA tests the equality of measurement properties (e.g., factor structure, loadings, intercepts, and residuals) across groups in increasingly strict stages. Given the categorical nature of the DASS-21, we used the weighted least squares means and variance adjusted (WLSMV) estimation with DELTA parameterization to test the ME/I of ordered categorical data (Svetina et al., 2020; Wu & Estabrook, 2016). We serially examined (1) configural invariance (i.e., all item loadings are freely estimated across groups); (2) threshold invariance (i.e., all item thresholds are constrained to be equal across groups); (3) loading invariance (i.e., all item thresholds and loadings are constrained to be equal across groups); and (4) intercept invariance (i.e., all item thresholds, loadings, and intercepts are constrained to be equal across groups). When examining model equivalence, we used the suggested cutoff of $\Delta CFI \geq -.01$ and $\Delta RMSEA \leq 0.01$ as indicative of invariance in specific model fit indices (Cheung & Rensvold, 2002; Svetina et al., 2020). If the DASS-21 demonstrates configural, threshold, loading, and intercept invariance, latent mean difference tests can be conducted to compare group latent means. R package “lavaan” and “semTools” were used to test ME/I with a traditional factor analytic approach. We tested the ME/I of the DASS-21 across nine countries/regions for both an oblique three-factor model and a bifactor model.

Alignment Method

One limitation of a traditional factor analytic approach is that ME/I (especially the intercept invariance) is often difficult to achieve with a large number of groups, as in our study of nine countries/regions. To address this challenge, we used a newer approach, alignment method in M*plus* 7.2 (Asparouhov & Muthén, 2014). Alignment method provides *approximate* (rather than exact) ME/I across groups and allows for factor mean comparisons

and *ad-hoc* item invariance analysis accounting for small amounts of measurement non-invariance.

Results

Evaluation of Measurement Models

Table 1 presents the fit indices for the unidimensional, oblique three-factor model and the bifactor model for the DASS-21 in each country/region. The unidimensional model presented a poor fit for all countries/regions. The oblique three-factor model in all countries/regions presented a good (i.e., Brazil and the US) or acceptable fit (i.e., Australia, Germany, Hong Kong, Lithuania, Taiwan, Türkiye, and the UAE). The bifactor model presented a good fit in Australia, Brazil, Germany, Lithuania, and Taiwan and an acceptable fit in Hong Kong and Türkiye. Overall, the bifactor model with a general distress factor and three specific factors consistently presented the highest CFIs and lowest RMSEAs in most countries except the UAE and the US, for which the bifactor model failed to converge.

Table 2 presents the ancillary bifactor indices for the bifactor model of DASS-21. The bifactor indices supported that using a raw DASS-21 total score instead of the raw subscale scores in all seven countries/regions that have achieved the bifactor model. Indices met the benchmarks for the general factor for all countries ($.89 \leq \omega H \leq .95$, $.91 \leq PRV \leq .96$, $.70 \leq ECV \leq .84$, $ARPB < 12\%$). On the other hand, indices did not reach the benchmarks for the specific factors for all countries, including depression ($.05 \leq \omega HS \leq .45$, $.05 \leq PRV \leq .46$, $.05 \leq ECV \leq .46$), anxiety ($.11 \leq \omega HS \leq .29$, $.11 \leq PRV \leq .29$, $.16 \leq ECV \leq .29$), or stress ($.03 \leq \omega HS \leq .16$, $.005 \leq PRV \leq .26$, $.08 \leq ECV \leq .23$). Overall, these results best support the use of the DASS-21 items in a raw, composite total score of general distress in Australia, Brazil, Germany, Hong Kong, Lithuania, Taiwan, and Türkiye.

Measurement Equivalence/Invariance and Latent Mean Comparisons

Multigroup Confirmatory Factor Analysis

First, we examined the ME/I of the oblique three-factor solution as it has been the most widely used in existing literature. As shown in Table 3, the oblique three-factor model achieved full configural (M0), threshold (M1), and loading invariance (M2) across nine countries. However, fit indices for intercept invariance (M3) demonstrated a worse fit than

M2 (ΔCFI = - 0.018, ΔRMSEA = 0.014). Therefore, the intercept invariance of the DASS-21 for the oblique three-factor model was not supported, which precluded the possibility of comparing latent mean across countries. Second, we tested the ME/I of the best-fitting model – the bifactor model. Since the bifactor model did not converge in the UAE and the US, MGCFA was conducted in seven other countries/regions. As shown in Table 3, the bifactor model achieved full configural (M0), threshold (M1), and loading invariance (M2), but not intercept invariance (M3) (ΔCFI = - 0.022, ΔRMSEA = 0.017) across seven countries. Similarly, the lack of intercept invariance precluded the possibility of comparing latent mean scores (e.g., latent general factor score, latent specific factor scores) across countries/regions.

Alignment Method

Given MGCFA often makes it difficult to achieve intercept invariance, particularly with a large number of groups, we used the alignment method to examine approximate (rather than exact) ME/I across groups. We tested the oblique three-factor model of DASS-21 using alignment method (see Table 4). For depression, the number of groups with approximate measurement invariance ranged from 7 to 9 for loadings and 6 to 9 for thresholds/intercepts, with 4.76% and 7.41% of the factor loadings and intercepts being non-invariant, resulting in 6.75% of total non-invariance in depression. For anxiety, the number of groups with approximate measurement invariance ranged from 8 to 9 for loadings and 5 to 9 for thresholds/intercepts, with 3.17% and 7.41% of the factor loadings and intercepts being non-invariant, resulting in 6.35% of total non-invariance in anxiety. For stress, the number of groups with approximate measurement invariance ranged from 7 to 9 for loadings and 6 to 9 for thresholds/intercepts, with 7.94% and 13.77% of the factor loadings and intercepts being non-invariant, resulting in 12.30% of total non-invariance in stress. The non-invariance rates of depression, anxiety, and stress were all below the 25% threshold proposed by Asparouhov and Muthén (2014), indicating that the estimated latent mean of subconstructs could be compared. Overall, Türkiye had the highest levels of depression, anxiety, and stress; Germany and the US had the lowest levels (see Supplemental Table S2). Unfortunately, because the current alignment method does not allow estimation for models with cross-loadings (e.g., bifactor model), we couldn't examine the ME/I of the bifactor DASS-21

model across groups with the alignment method, which means it is still unknown if we could compare latent general factor score of DASS-21 (e.g., the general distress) across the seven countries/regions.

Discussion

This study examined the internal structure, measurement invariance, and reliability of DASS-21 scores across nine countries/regions: Australia, Brazil, Germany, Hong Kong, Lithuania, Taiwan, Türkiye, the UAE, and the US. Our comprehensive results demonstrated validity evidence for the original oblique three-factor model across nine countries, yet also showed that the bifactor model constitutes the most accurate representation of the DASS-21 underlying factor structure. Regarding parameter equivalence, we found configural, threshold, and loading invariance for the oblique three-factor model (across all nine countries/regions) and for the bifactor model (across seven countries/regions). Results replicated previous findings that favored the utility of bifactor models of DASS-21 (e.g., Osman et al., 2012; Yeung et al., 2020; Zanon et al., 2021) and demonstrated that cross-cultural comparisons should be conducted using proper procedures (e.g., alignment approach; Asparouhov & Muthén, 2014).

Model examination demonstrated an excellent fit of the bifactor model in Australia, Brazil, Germany, Hong Kong, Lithuania, Taiwan, and Türkiye. However, the bifactor model failed to converge with the data from the UAE and the US suggesting the model may not accurately represent the true structure of the data in these countries or sample idiosyncrasies. Though fit indexes also supported the theoretical oblique three-factor model (Lee et al., 2019; Shaw et al., 2017; Sinclair et al., 2012) the inter-factor latent correlations for depression, anxiety, and stress were high (e.g., *rs* = .73 to .89 for depression and anxiety, *rs* = .71 to .92 for depression and stress, *rs* = .78 to .92 for anxiety and stress across nine countries/regions), indicating the possibility of a shared underlying factor structure (Kline, 2023).

Ancillary bifactor indices of dimensionality and reliability also advocate for the unidimensionality and use of a single raw score for the DASS-21 across seven countries/regions. The proportion of reliable variance was consistently high for the general latent factor, ranging from .91 (Taiwan) to .96 (Türkiye), and was consistently low in

subscales that ranged from .01 (Germany) to .46 (Taiwan) in the depression subscale, .11 (Australia) to .29 (Germany) in the anxiety subscale, and .01 (Taiwan) to .26 (Hong Kong) in the stress subscale. These results indicated that the general factor is more reliable than the specific depression, anxiety, and stress latent factors. In other words, the percentage of systematic variance in the DASS-21 total scores can be attributed to individual differences in the general psychological distress factor (Reise et al., 2013, 2023; Rodriguez et al., 2016a). Therefore, DASS-21 total scores can be considered essentially a unidimensional measure of psychological distress in many parts of the world, which is in accordance with the transdiagnostic framework for understanding and treating mental health symptoms (e.g., Barlow et al., 2010).

Our replication study addressed the need to use an optimized approach to test ME/I of DASS-21 across countries. The significance of this approach lies in its ability to uncover subtle biases in cross-group comparisons, which is particularly important when analyzing diverse populations (Wu & Estabrook, 2016). Our study is the first to apply this method to evaluate the measurement invariance of the DASS-21 across different countries, ensuring a rigorous and methodologically sound analysis. Results indicated the configural, threshold, and loading invariance for the bifactor model, but not intercept invariance. This warrants the comparison of factor variances but not factor means (Kline, 2023; Wu & Estabrook, 2016). These results are not consistent with Scholten et al. (2017), which supported the scalar invariance of the three-factor DASS-21in Poland, Russia, the United Kingdom, and the US. This is possible because of the large number of groups in our study, and the optimized model identification procedure we used (Wu & Estabrook, 2016). Further analysis with alignment procedure addressed this limitation and indicated that items of depression, anxiety, and stress reached approximate invariance across nine countries/regions as the percentage of non-invariant parameters were in line with the cut-off score (i.e., 25%; Asparouhov & Muthén, 2014). Latent mean difference analyses also revealed substantial differences in depression, anxiety, and stress scores across groups. Specifically, findings indicated that Turkish university students exhibited the highest levels of psychological distress as characterized by symptoms of depression, anxiety, or stress, whereas students from Germany and the US

reported the lowest distress levels. Although researchers did not collect potential confounding factors such as academic performance and socioeconomic status, these findings may be interpreted within the cultural context of these countries. Türkiye is a collectivistic upper-middle-income country (Hoftede et al., 2010) in which individuals tend to prioritize the needs of the group over their own needs. In contrast, Germany and the US are individualistic, high-income countries with small power distance between higher and lower ranked group members (Hoftede et al., 2010). Turkish university students, therefore, may feel more pressure to conform to societal expectations and meet the needs of their families and communities as compared to their counterparts in other countries (Kağıtçıbaşı, 2017). Furthermore, Türkiye has undergone a period of political and economic instability in recent years, such as terrorist attacks, a failed coup attempt, restrictions on civil liberties, high inflation, and high unemployment (Altınörs & Akçay, 2022). These contextual factors may also contribute to higher levels of stress and anxiety among Turkish university students.

Limitations

Some limitations should be considered when interpreting findings. First, participants were university students from nine countries/regions across the globe, with a notable female predominance. Consequently, the generalizability of study outcomes to populations, cultures, languages, and countries not included in the research is constrained. The external validity of this study is limited since the countries and university students examined represent a minority of the global population, and depression, anxiety, and stress manifestations may vary significantly in regions not studied (e.g., South Asia and Africa). Second, while our study identified the bifactor model of DASS-21 as the optimal fit, we didn't compare the latent means of the general factor and three specific factors because of the limitation of alignment method, which hasn't yet supported models with cross-loadings. Future studies could explore the latent mean differences across countries using more advanced methods to address this limitation. Third, our study did not account for potential confounding factors like previous diagnosis of mental health disorders (e.g., major depressive disorders, anxiety disorders), socioeconomic status, academic performance, and psychotropic medication use, which might impact symptom presentation and lead to systematic variation in responses unrelated to the

latent constructs of the DASS-21 (Brown, 2015; Kline, 2023). Future research could collect this information to reach a thorough explanation of latent mean differences across countries. Nevertheless, given the substantial sample sizes across the nine countries/regions, it is less likely that these factors significantly biased results (Brown, 2015; Wang & Wang, 2020). Finally, since our study focused exclusively on the psychometric properties of the DASS-21 related to internal structure, invariance, and reliability, future research could explore convergent, discriminant, and predictive validity of DASS-21 scores, as well as their short-term and long-term stability.

Conclusions

Our study replicated the findings of Zanon et al. (2021) and best supported the bifactor structure of DASS-21 for college students in many parts of the world (i.e., Australia, Brazil, Germany, Hong Kong, Lithuania, Taiwan, and Türkiye). Reliability analyses supported the use of the DASS-21 items in a raw, composite total score of general distress instead of the raw score of three subscales. As such, we recommend mental health professionals and researchers consider using a DASS-21 total score as a general measure of psychological distress instead of as a separate screening measure of depression, anxiety, or stress symptoms, at least for these seven countries/regions.

Combined with the traditional ME/I approach and the newer alignment method, our study suggested that full measurement invariance is not supported for the oblique three-factor and bifactor model without taking into account non-invariant item intercepts. In other words, we suggest that latent mean comparisons of DASS-21 (e.g., general factor or subscales) should be made by using proper procedures that allow non-invariant parameters to be freely estimated, like alignment (Asparouhov & Muthén, 2014) or partial invariance (Byrne & van de Vijver, 2010). Mean comparisons that do not consider non-invariant item intercepts may lead to biased results and should be avoided.

References

Altınörs, G., & Akçay, Ü. (2022). Authoritarian neoliberalism, crisis, and consolidation: The political economy of regime change in Turkey. *Globalizations, 19*(7), 1029–1053. https://doi.org/10.1080/14747731.2021.2025290

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. https://doi.org/10.1037/1040-3590.10.2.176

Arias, D., Saxena, S., & Verguet, S. (2022). Quantifying the global burden of mental disorders and their economic value. *EClinicalMedicine, 54,* Article 101675. https://doi.org/10.1016/j.eclinm.2022.101675

Asparouhov, T., & Muthén, B. (2014). Multiple-group factor analysis alignment. *Structural Equation Modeling: A Multidisciplinary Journal, 21*(4), 495–508. https://doi.org/10.1080/10705511.2014.919210

Barlow, D. H., Farchione, T. J., Sauer-Zavala, S., Latin, H. M., Ellard, K. K., Bullis, J. R., Bentley, K. H., Boettcher, H. T., & Cassiello-Robbins, C. (2010). *Unified protocol for transdiagnostic treatment of emotional disorders: Therapist guide.* Oxford University Press.

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

Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). Guilford Press.

Byrne, B. M., & van de Vijver, F. R. (2010). Testing for measurement and structural equivalence in large-scale cross-cultural studies. *International Journal of Testing, 10*(2), 107–132. https://doi.org/10.1080/15305051003637306

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*(2), 233–255. https://doi.org/10.1207/S15328007SEM0902_5

Clara, I. P., Cox, B. J., & Enns, M. W. (2001). Confirmatory factor analysis of the Depression–Anxiety–Stress Scales in depressed and anxious patients. *Journal of Psychopathology and Behavioral Assessment, 23,* 61–67.

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

Collins, P. Y., Patel, V., Joestl, S. S., March, D., Insel, T. R., Daar, A. S., Anderson, W., Dhansay, M. A., Phillips, A., Shurin, S., Walport, M., Ewart, W., Savill, J., Bordin, I. A., Costello, E. J., Durkin, M., Fairburn, C., Glass, R. I., Hall, W., … Stein, D. J. (2011). Grand challenges in global mental health. *Nature, 475*(7354), 27–30. https://doi.org/10.1038/475027a

Czeisler, M. É., Lane, R. I., Petrosky, E., Wiley, J. F., Christensen, A., Njai, R., Weaver, M. D., Robbins, R., Facer-Childs, E. R., Barger, L. K., Czeisler, C. A., Howard, M. E., & Rajaratnam, S. M. W. (2020). Mental health, substance use, and suicidal ideation during the COVID-19 pandemic—United States, June 24–30, 2020. *MMWR. Morbidity and Mortality Weekly Report, 69*(32), 1049–1057. https://doi.org/10.15585/mmwr.mm6932a1

Forbush, K. T., & Watson, D. (2013). The structure of common and uncommon mental disorders. *Psychological Medicine, 43*(1), 97-108. https://doi.org/10.1017/S0033291712001092

Hoftede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and organizations: Software of the mind* (3rd ed.). McGraw-Hill.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Kağıtçıbaşı, Ç. (2017). *Family, self, and human development across cultures: Theory and applications.* Routledge.

Kline, R. B. (2023). *Principles and practice of structural equation modeling* (5th ed.). Guilford Press.

Lee, D. (2019). The convergent, discriminant, and nomological validity of the Depression Anxiety Stress Scales-21 (DASS-21). *Journal of Affective Disorders, 259*, 136–142. https://doi.org/10.1016/j.jad.2019.06.036

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: An International Journal of Quality of Life Aspects of Treatment, Care & Rehabilitation, 28*(9), 232–2339. https://doi.org/10.1007/s11136-019-02177-x

Lipson, S. K., Zhou, S., Abelson, S., Heinze, J., Jirsa, M., Morigney, J., Patterson, A., Singh, M., & Eisenberg, D. (2022). Trends in college student mental health and help-seeking by race/ethnicity: Findings from the national healthy minds study, 2013–2021. *Journal of Affective Disorders, 306*, 138–147. https://doi.org/10.1016/j.jad.2022.03.038

Lovibond, P. F., & Lovibond, S. H. (1995a). 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

Lovibond, P. F., & Lovibond, S. H. (1995b). *Manual for the Depression Anxiety Stress Scales* (2nd ed.). Psychology Foundation of Australia.

Luong, R., & Flake, J. K. (2023). Measurement invariance testing using confirmatory factor analysis and alignment optimization: A tutorial for transparent analysis planning and reporting. *Psychological Methods, 28*(4), 905–924. https://doi.org/10.1037/met0000441

McGrath, J. J., Lim, C. C. W., Plana-Ripoll, O., Holtz, Y., Agerbo, E., Momen, N. C., Mortensen, P. B., Pedersen, C. B., Abdulmalik, J., Aguilar-Gaxiola, S., Al-Hamzawi, A., Alonso, J., Bromet, E. J., Bruffaerts, R., Bunting, B., Almeida, J. M. C. de, Girolamo, G. de, Vries, Y. A. D., Florescu, S., … Jonge, P. de. (2020). Comorbidity within mental disorders: A comprehensive analysis based on 145 990 survey respondents from 27 countries. *Epidemiology and Psychiatric Sciences, 29*, Article e153. https://doi.org/10.1017/S2045796020000633

Oei, T. P. S., Sawang, S., Goh, Y. W., & Mukhtar, F. (2013). Using the Depression Anxiety Stress Scale 21 (DASS-21) across cultures. *International Journal of Psychology, 48*(6), 1018–1029. https://doi.org/10.1080/00207594.2012.755535

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science, 349*(6251), aac4716. https://doi.org/10.1126/science.aac4716

Osman, A., Wong, J. L., Bagge, C. L., Freedenthal, S., Gutierrez, P. M., & Lozano, G. (2012). The Depression Anxiety Stress Scales—21 (DASS-21): Further examination of dimensions, scale reliability, and correlates. *Journal of Clinical Psychology, 68*(12), 1322–1338. https://doi.org/10.1002/jclp.21908

Reise, S. P., Mansolf, M., & Haviland, M. G. (2023). Bifactor measurement models. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (pp. 329–348). Guilford Press.

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

Richter, D., Wall, A., Bruen, A., & Whittington, R. (2019). Is the global prevalence rate of adult mental illness increasing? Systematic review and meta-analysis. *Acta Psychiatrica Scandinavica, 140*(5), 393–407. https://doi.org/10.1111/acps.13083

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016a). 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

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016b). Evaluating bifactor models: Calculating and interpreting statistical indices. *Psychological Methods, 21*(2), 137–150. https://doi.org/10.1037/met0000045

Saha, S., Lim, C. C., Cannon, D. L., Burton, L., Bremner, M., Cosgrove, P., Huo, Y., & J McGrath, J. (2021). Co-morbidity between mood and anxiety disorders: A systematic review and meta-analysis. *Depression and Anxiety*, *38*(3), 286-306. https://doi.org/10.1002/da.23113

Şahin, E., Topkaya, N., & Gençoğlu, C. (2022). Severity and correlates of the symptoms of depression, anxiety, and stress in a nationally representative sample of Turkish secondary boarding school counselors. *SAGE Open*, *12*(2), 1-16. https://doi.org/10.1177/21582440221096123

Santomauro, D. F., Mantilla Herrera, A. M., Shadid, J., Zheng, P., Ashbaugh, C., Pigott, D. M., Abbafati, C., Adolph, C., Amlag, J. O., Aravkin, A. Y., Bang-Jensen, B. L., Bertolacci, G. J., Bloom, S. S., Castellano, R., Castro, E., Chakrabarti, S., Chattopadhyay, J., Cogen, R. M., Collins, J. K., … Ferrari, A. J. (2021). Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *The Lancet, 398*(10312), 1700–1712. https://doi.org/10.1016/S0140-6736(21)02143-7

Scholten, S., Velten, J., Bieda, A., Zhang, X. C., & Margraf, J. (2017). Testing measurement invariance of the Depression, Anxiety, and Stress Scales (DASS-21) across four countries. *Psychological Assessment*, *29*(11), 1376-1390. https://doi.org/10.1037/pas0000440

Shaw, T., Campbell, M. A., Runions, K. C., & Zubrick, S. (2017). Properties of the DASS-21 in an Australian community adolescent population. *Journal of Clinical Psychology*,

73(7), 879-892. https://doi.org/10.1002/jclp.22376

Sinclair, S. J., Siefert, C. J., Slavin-Mulford, J. M., Stein, M. B., Renna, M., & Blais, M. A. (2012). Psychometric evaluation and normative data for the Depression, Anxiety, and Stress Scales-21 (DASS-21) in a nonclinical sample of U.S. adults. *Evaluation & the Health Professions*, *35*(3), 259-279. https://doi.org/10.1177/0163278711424282

Svetina, D., Rutkowski, L., & Rutkowski, D. (2020). Multiple-group invariance with categorical outcomes using updated guidelines: An illustration using Mplus and the lavaan/semTools Packages. *Structural Equation Modeling: A Multidisciplinary Journal, 27*(1), 111-130. https://doi.org/10.1080/10705511.2019.1602776

Tiller, J. W. G. (2013). Depression and anxiety. *The Medical Journal of Australia, 199*(6 Suppl), S28–S31. https://doi.org/10.5694/mja12.10628

Vignola, R. C. B., & Tucci, A. M. (2014). Adaptation and validation of the depression, anxiety and stress scale (DASS) to Brazilian Portuguese. *Journal of Affective Disorders*, *155*, 104-109.

Vogel, D. L., Zhao, N., Vidales, C. A., Al-Darmaki, F. R., Baptista, M. N., Brenner, R. E., Ertl, M. M., Liao, H.-Y., Mak, W. W. S., Rubin, M., Schomerus, G., Şahin, E., Topkaya, N., & Wang, Y.-F. (2024). Interdependent stigma of seeking mental health services: Examining a new scale across eight countries/regions. *Journal of Counseling Psychology, 71*(5), 356–368. https://doi.org/10.1037/cou0000757

Wang, J., & Wang, X. (2020). *Structural equation modeling: Applications using Mplus* (2nd ed.). Wiley.

Wang, K., Shi, H.-S., Geng, F.-L., Zou, L.-Q., Tan, S.-P., Wang, Y., Neumann, D. L., Shum, D. H. K., & Chan, R. C. K. (2016). Cross-cultural validation of the Depression Anxiety Stress Scale–21 in China. *Psychological Assessment, 28*(5), e88-e100. https://doi.org/10.1037/pas0000207

World Health Organization. (2001). *The world health report 2001: Mental disorders affect one in four people.* World Health Organization. https://www.who.int/news/item/28-09-2001-the-world-health-report-2001-mental-disorders-affect-one-in-four-people

Wu, H., & Estabrook, R. (2016). Identification of confirmatory factor analysis models of different levels of invariance for ordered categorical outcomes. *Psychometrika, 81*(4), 1014-1045. https://doi.org/10.1007/s11336-016-9506-0

Xavier, S., Martins, M. J., Pereira, A. T., Amaral, A. P., Soares, M. J., Roque, C., & Macedo, A. (2017). Contribution for the Portuguese validation of the Depression, Anxiety and Stress Scales (DASS-21): Comparison between dimensional models in a sample of

students. *European Psychiatry, 41*(S1), S416. https://doi.org/10.1016/j.eurpsy.2017.01.365

Yeung, A. Y., Yuliawati, L., & Cheung, S. (2020). A systematic review and meta-analytic factor analysis of the Depression Anxiety Stress Scales. *Clinical Psychology: Science and Practice*, *27*(4), Article e12362. https://doi.org/10.1037/h0101782

Zanon, C., Brenner, R. E., Baptista, M. N., Vogel, D. L., Rubin, M., Al-Darmaki, F. R., Gonçalves, M., Heath, P. J., Liao, H.-Y., Mackenzie, C. S., Topkaya, N., Wade, N. G., & Zlati, A. (2021). Examining the dimensionality, reliability, and invariance of the Depression, Anxiety, and Stress Scale–21 (DASS-21) across eight countries. *Assessment*, *28*(6), 1531-1544. https://doi.org/10.1177/1073191119887449

Tables

Table 1
Fit Indexes for Unidimensional, Oblique Three-Factor, and Bifactor Models for the DASS-21 Across Nine Countries/Regions.

	Australia					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	791.732	189	0.101	0.961	0.059	0.956
Oblique three-factor model	441.651	186	0.066	0.983	0.04	0.981
Bifactor model	258.736	168	0.042	0.994	0.03	0.993
	Brazil					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	649.361	189	0.094	0.961	0.061	0.957
Oblique three-factor model	340.415	186	0.055	0.987	0.038	0.985
Bifactor model	290.774	168	0.052	0.99	0.034	0.987
	Germany					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	887.34	189	0.102	0.935	0.075	0.928
Oblique three-factor model	523.998	186	0.071	0.969	0.051	0.965
Bifactor model	324.782	168	0.051	0.985	0.037	0.982
	Hong Kong					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	829.754	189	0.1	0.923	0.071	0.915
Oblique three-factor model	554.169	186	0.077	0.956	0.055	0.95
Bifactor model	377.129	168	0.061	0.975	0.044	0.969
	Lithuania					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	533.081	189	0.08	0.923	0.074	0.914
Oblique three-factor model	389.16	186	0.062	0.954	0.061	0.948
Bifactor model	336.989	168	0.059	0.962	0.056	0.952
	Taiwan					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	927.033	189	0.112	0.897	0.098	0.885
Oblique three-factor model	605.004	186	0.085	0.941	0.072	0.934
Bifactor model	310.979	168	0.052	0.98	0.048	0.975
	Türkiye					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	647.413	189	0.083	0.943	0.06	0.936
Oblique three-factor model	575.633	186	0.077	0.951	0.054	0.945
Bifactor model	455.726	168	0.070	0.964	0.047	0.955
	UAE					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	669.866	189	0.085	0.918	0.065	0.909
Oblique three-factor model	475.631	186	0.066	0.951	0.053	0.944
Bifactor model	-	-	-	-	-	-
	US					
Models tested	χ^2	*df*	*RMSEA*	*CFI*	*SRMR*	*TLI*
Unidimensional model	701.145	189	0.09	0.959	0.063	0.954
Oblique three-factor model	384.859	186	0.056	0.984	0.042	0.982
Bifactor model	-	-	-	-	-	-

Note. DASS-21 = Depression Anxiety Stress Scale–21. χ^2 = robust chi-square. *df* = degrees of freedom. *CFI* = comparative fit index. *RMSEA* = root mean square error of approximation. *SRMR* = standardized root mean squared residual. *TLI* = Turker-Lewis index. All countries presented significant chi-square ($\chi 2$) values for all tested models ($p < .001$). All countries were evaluated through the bifactor model, except UAE and the US whose bifactor baseline model failed to converge.

Table 2
Ancillary Bifactor Indices for the DASS-21 in All Countries/Regions Sampled (Except UAE and USA)

Country	Factor	*ECV*	*ωH/ ωHS*	*PRV*	Model *ARPB*
Australia	General Factor	**.834**	**.949**	**.951**	
	Depression	.236	.224	.225	**.054**
	Anxiety	.153	.106	.107	
	Stress	.101	.055	.056	
Brazil	General Factor	**.840**	**.945**	**.948**	
	Depression	.225	.219	.221	**.052**
	Anxiety	.175	.162	.163	
	Stress	.077	.034	.034	
Germany	General Factor	**.825**	**.944**	**.948**	
	Depression	.005	.005	.005	**.071**
	Anxiety	.225	.286	.289	
	Stress	.228	.134	.135	
Hong Kong	General Factor	**.769**	**.892**	**.927**	
	Depression	.296	.239	.137	**.063**
	Anxiety	.205	.123	.169	
	Stress	.189	.155	.262	
Lithuania	General Factor	**.761**	**.919**	**.924**	
	Depression	.326	.300	.303	**.065**
	Anxiety	.191	.169	.172	
	Stress	.189	.090	.091	
Taiwan	General Factor	**.700**	**.906**	**.910**	
	Depression	.463	.452	.457	**.123**
	Anxiety	.286	.176	.178	
	Stress	.154	.005	.005	
Türkiye	General Factor	**.838**	**.955**	**.958**	
	Depression	.141	.090	.090	**.035**
	Anxiety	.215	.174	.176	
	Stress	.135	.088	.089	

Note. The UAE and US were not included because the bifactor model did not converge. *ECV* = Explained Common Variance; *ωH* = Coefficient Omega Hierarchical; *ωHS* = Coefficient Omega Hierarchical Subscale; *PRV* = Proportion of Reliable Variance; *ARPB* = Average Relative Parameter Bias; Depression, Anxiety and Stress refer to the three DASS-21 specific factors. All bolded coefficients meet the appropriate benchmarks (*ECV* ≥ .70, *ωH* and *ωHS* ≥ .80, *PRV* ≥ .75, Model *ARPB* < 10-15%).

Table 3

Measurement Invariance of the Oblique Three-Factor Model Across Nine Countries/Regions

Nested models tested	χ^2	*df*	$\Delta\chi^2$	*RMSEA*	Δ*RMSEA*	*CFI*	Δ*CFI*	*TLI*	Δ*TLI*
M0: configural	4284.054*	1674	-	.069	-	.970	-	.966	-
M1: threshold	4486.426*	1842	178.930	.067	-.002	.969	-.001	.969	.003
M2: loading	4725.972*	1986	378.590*	.065	-.002	.968	-.001	.970	.001
M3: intercept	6451.814*	2130	1668.880*	.079	.014	.950	-.018	.956	-.014
Measurement Invariance of the Bifactor Model across Seven Countries (US and UAE Excluded)									
Nested models tested	χ^2	*df*	$\Delta\chi^2$	RMSEA	Δ*RMSEA*	*CFI*	Δ*CFI*	*TLI*	Δ*TLI*
M0: configural	2350.925*	1176	-	.056	-	.983	-	.978	-
M1: threshold	2486.654*	1302	140.580	.054	.002	.983	.000	.980	.002
M2: loading	3382.923*	1530	860.740*	.062	-.008	.973	-.010	.974	-.006
M3: intercept	4972.561*	1656	1102.820*	.079	.017	.951	-.022	.957	-.017

Note. χ^2 = robust chi-square. *df* = degrees of freedom. $\Delta\chi^2$ = scaled chi-squared difference test (method = "satorra.2000"). * $p < 0.001$. *CFI* = comparative fit index. Δ*CFI* = difference in *CFI* between the compared models. *RMSEA* = root mean square error of approximation. Δ*RMSEA* = difference in *RMSEA* between the compared models. *TLI* = Tucker Lewis index. Δ*TLI* = difference in *TLI* between the compared models. M0 = parameters freely estimated across the countries. M1 = item thresholds constrained to be the same across the countries. M2 = item thresholds and factor loadings constrained to be the same across the countries. M3 = item thresholds, loadings, and intercepts constrained to be the same across the countries.

Table 4

Measurement Invariance of Parameter Estimates for the Free Alignment Analysis of DASS-21 (Oblique Three-Factor Model).

Factor/Item	Factor Loadings			Thresholds/Intercepts								
				Threshold$1			Threshold$2			Threshold$3		
	Average value	# of invariant groups	R^2	Average value	# of invariant groups	R^2	Average value	# of invariant groups	R^2	Average value	# of invariant groups	R^2
Depression												
DASS3	3.268	9	0.731	-2.858	7	0.317	0.157	9	0.761	2.730	8	0.603
DASS5	1.757	7	0.000	-3.012	8	0.000	-0.797	9	0.000	1.076	9	0.000
DASS10	3.962	9	0.795	-3.568	6	0.384	-0.501	9	0.816	1.852	8	0.580
DASS13	3.758	9	0.562	-4.599	8	0.000	-1.224	9	0.190	1.425	8	0.678
DASS16	3.774	9	0.895	-3.013	9	0.400	-0.234	9	0.743	2.185	8	0.669
DASS17	4.222	8	0.328	-2.426	9	0.000	-0.060	9	0.134	2.049	9	0.242
DASS21	3.760	9	0.442	-1.992	9	0.658	0.202	9	0.725	2.354	6	0.569
Anxiety												
DASS2	1.105	9	0.118	0.061	6	0.264	1.530	9	0.604	3.432	9	0.537
DASS4	2.021	9	0.962	0.857	9	0.835	2.923	9	0.590	5.127	9	0.507
DASS7	1.821	9	0.347	0.884	9	0.769	2.746	9	0.715	4.549	9	0.497
DASS9	2.064	8	0.697	-0.630	5	0.131	1.308	5	0.215	3.672	7	0.328
DASS15	2.722	9	0.247	0.542	8	0.033	3.122	9	0.722	5.604	9	0.427
DASS19	2.089	9	0.523	0.503	9	0.000	2.608	9	0.826	4.399	9	0.456
DASS20	2.641	8	0.329	0.778	9	0.308	3.059	9	0.433	5.030	9	0.379
Stress												
DASS1	2.709	7	0.000	-3.311	6	0.219	0.400	9	0.762	3.267	6	0.493
DASS6	2.038	9	0.612	-1.872	8	0.000	0.512	8	0.411	2.596	9	0.510
DASS8	2.342	8	0.403	-2.163	7	0.000	0.483	7	0.085	2.897	7	0.062
DASS11	2.868	8	0.284	-2.377	9	0.688	0.551	9	0.670	3.051	6	0.221
DASS12	3.042	9	0.588	-2.810	9	0.288	0.172	9	0.433	2.975	8	0.185
DASS14	1.945	9	0.643	-1.373	8	0.691	0.991	9	0.719	3.206	8	0.590
DASS18	2.129	8	0.347	-1.086	7	0.013	1.141	6	0.296	2.782	8	0.498

Note. Since alignment method does not allow cross-loadings, only oblique three-factor CFA model was examined with alignment method. Average value = weighted average value of the estimated parameter across invariant groups. # of invariant groups = the number of groups with approximate measurement invariance. Min/Max = the minimum/maximum value of the estimated parameter across all groups. R^2 = the degree of parameter variability that can be explained by the groups' factor means and variances. Higher R^2 indicates higher degrees of invariance.

Supplemental Materials

Table S1

Descriptive Statistics and Internal Consistency Reliability of the DASS-21 Across Nine Countries/Regions.

		Depression			Anxiety			Stress		
Country	*N*	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*	*α*
Australia	312	6.50	5.58	.91	5.30	5.25	.89	8.43	5.69	.91
Brazil	275	6.36	5.84	.90	4.94	5.67	.91	8.51	5.99	.91
Germany	356	5.19	4.67	.89	3.33	3.78	.83	6.08	4.55	.87
Hong Kong	336	6.35	4.26	.83	5.53	3.87	.82	8.31	4.77	.88
Lithuania	285	5.62	4.13	.82	3.67	3.93	.83	7.65	4.24	.79
Taiwan	311	5.06	3.90	.80	4.68	3.74	.78	8.62	4.94	.87
Türkiye	353	6.58	5.22	.84	6.18	4.97	.82	8.91	5.44	.84
The UAE	354	6.25	4.65	.82	4.93	4.57	.83	7.36	5.17	.86
US	338	5.22	4.88	.89	4.38	4.21	.84	5.92	4.81	.88

Note. DASS-21 = Depression., Anxiety, and Stress Scale-21. *α* = alpha internal consistency coefficient, also known as Cronbach's alpha.

Table S2

Factor Mean Comparisons of DASS-21 Among Nine Countries/Regions Based on the Free Alignment Analysis.

	Ranking	Country	Factor mean	Groups with significantly smaller factor mean
Depression	1	Türkiye	-0.566	Hong Kong, Lithuania, Australia, Taiwan, US, Germany
	2	The UAE	-0.606	Hong Kong, Lithuania, Australia, Taiwan, US, Germany
	3	Brazil	-0.708	Taiwan, US, Germany
	4	Hong Kong	-0.750	Taiwan, US, Germany
	5	Lithuania	-0.813	Taiwan, US, Germany
	6	Australia	-0.916	/
	7	Taiwan	-1.020	/
	8	US	-1.108	/
	9	Germany	-1.159	/
Anxiety	1	Türkiye	0.400	Hong Kong, UAE, Australia, Brazil, Taiwan, US, Lithuania, Germany
	2	Hong Kong	0.112	US, Lithuania, Germany
	3	The UAE	0.097	US, Lithuania, Germany
	4	Australia	0.071	Lithuania, Germany
	5	Brazil	-0.048	Germany
	6	Taiwan	-0.070	Germany
	7	US	-0.112	Germany
	8	Lithuania	-0.318	/
	9	Germany	-0.408	/
Stress	1	Türkiye	-0.073	UAE, Germany, US
	2	Taiwan	-0.126	Germany, US
	3	Australia	-0.181	Germany, US
	4	Brazil	-0.190	Germany, US
	5	Lithuania	-0.210	Germany, US
	6	Hong Kong	-0.247	Germany, US
	7	The UAE	-0.332	Germany, US
	8	Germany	-0.677	/
	9	US	-0.725	/

Note. Groups are ordered from high to low according to factor means and the groups that have factor means that differ on the 0.05 significance level are determined.