

Using the Depression Anxiety Stress Scale 21 (DASS-21) across cultures

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The DASS-21 is a well-established instrument for measuring depression, anxiety, and stress with good reliability and validity reported from Hispanic American, British, and Australian adults. However, the lack of appropriate validation among Asian populations continues to pose concerns over the use of DASS-21 in Asian samples. Cultural variation may influence the individual's experience and emotional expression. Thus, when researchers and practitioners employ Western-based assessments with Asian populations by directly translating them without an appropriate validation, the process can be challenging. We conducted a series of rigorous statistical tests and minimized any potential confounds from the demographic information. Following factor analyses, we performed multigroup analysis across six nations to demonstrate consistency of our findings. The advantages of this revised DASS-18 stress scale are twofold. First, it possesses fewer items, which results in a cleaner factorial structure. Second, it has a smaller interfactor correlation. With these justifications, the revised DASS-18 stress scale is potentially more suitable for Asian populations. Nonetheless, given limitations, findings should be considered preliminary.

Keywords: Depression; Anxiety; Stress; Asian; Psychological strain; Psychometrics.

Le DASS-21 est un instrument reconnu pour mesurer la dépression, l'anxiété et le stress avec un bon taux de fiabilité et de validité chez la population adulte hispanophone américaine, britannique et australienne. Toutefois, le manque de validation appropriée auprès des populations asiatiques continue de poser problème lors de l'utilisation du DASS-21 dans les échantillons asiatiques. Les différences culturelles peuvent alors influencer l'expérience individuelle et l'expression des émotions. Ainsi, lorsque les chercheurs et les praticiens utilisent les formulations occidentales auprès des populations asiatiques en les traduisant directement sans aucune validation appropriée, le processus d'utilisation peut devenir risqué. Nous avons entrepris une série de tests statistiques rigoureux et avons réduit au minimum la confusion dans les énoncés sur les caractéristiques démographiques. Lors d'analyses factorielles, nous avons réalisé des analyses multi-groupes à travers six pays pour établir la consistance de nos résultats. Les avantages de ces analyses sur les échelles de stress du DASS-18 ainsi révisé sont de deux ordres. D'abord, l'échelle de stress révisée du DASS-18 contient moins d'items, ce qui permet d'obtenir une structure factorielle plus nette. Ensuite, nous observons moins de corrélations interfactorielles. Avec ces constats, l'échelle de stress du DASS-18 révisée apparaît mieux appropriée pour une utilisation auprès des populations asiatiques. Cependant, à titre limitatif, ces données doivent être considérées comme provisoires.

El DASS-21 es un instrumento bien establecido para medir la depresión, la ansiedad y el estrés con buena confiabilidad y validez informada por adultos hispanoamericanos, británicos y australianos. Sin embargo, la falta de una adecuada validación en las poblaciones asiáticas sigue suscitando preocupaciones acerca del uso del DASS-21 en muestras asiáticas. La variación cultural puede influir en la experiencia y expresión emocional del individuo. Por lo

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tanto, cuando los investigadores y los profesionales emplean evaluaciones basadas en Occidente en poblaciones asiáticas por medio de una traducción directa sin una validación adecuada, el proceso puede ser un desafío. Hemos llevado a cabo una serie de pruebas estadísticas rigurosas y redujimos cualquier potencial fuente de confusión a partir de la información demográfica. Luego de los análisis factoriales, se realizó un análisis multigrupo a través de seis naciones para demostrar la consistencia de nuestros resultados. Las ventajas de los análisis de la escala de estrés revisada DASS-18 son dobles. En primer lugar, la escala revisada DASS-18 posee menos ítems de estrés, lo que resultó en una estructura factorial más limpia. En segundo lugar, también se observó una correlación más baja entre factores. A partir de estas justificaciones, la escala de estrés revisada DASS-18 es potencialmente más adecuada para las poblaciones asiáticas. No obstante, dadas las limitaciones, los resultados deben considerarse como preliminares.

The Depression Anxiety Stress Scales (DASS) was developed to measure the constructs of depression and anxiety and to address the failure of earlier emotional measures in discriminating between anxiety and depression (SAQ; Lovibond & Lovibond, 1995). The original DASS has 42 items measuring three dimensions of negative emotional states, namely depression (DASS-D), anxiety (DASS-A), and stress/tension (DASS-S). Depression refers to low levels of positive affect, e.g., dysphoria, hopelessness, lack of energy, and anhedonia, while anxiety refers to a mixture of general distress such as irritability, agitation, difficulty relaxing, and impatience. A third factor emerged during the factor analysis. This factor was labeled "Stress." Later, a shorter version of the DASS, the DASS-21, was developed by Lovibond and Lovibond (1995) to reduce administration time and has been used widely in clinical samples to screen for symptoms at different levels of depression, anxiety, and stress¹ (Lovibond & Lovibond, 1995). DASS-21 is often administered by psychologists² or clinicians via pencil-and-paper questionnaires or structured clinical interviews (Antony, Bieling, Cox, Enns, & Swinson, 1998). Since its publication in 1995, the DASS-21 has been used in various types of research; e.g., early life stress and adult emotional experiences, lower back pain patients, problem gambling, work commitment, and spinal cord injury (e.g., Raylu & Oei, 2004).

DASS-21 has been validated in a number of populations such as Hispanic, American, and British adults (e.g. Crawford et al., 2009; Norton, 2007). The findings show that the DASS-21 is psychometrically sound, with good reliability and validity. It is clear from the literature that the DASS-21 is a well-established instrument for measuring depression, anxiety, and stress in the Western world. Nonetheless, the lack of appropriate validation among Asian

populations continues to pose concerns over the use of DASS-21 in Asian samples.

THE USE OF DASS-21 IN ASIAN POPULATIONS

Literature search via the PsycArticles and PsycInfo databases has produced many studies that used the DASS-21 on Asian populations in places such as Hong Kong, China, Taiwan, and Malaysia. However, these studies used the DASS-21 as a dependent variable and reported the construct reliability (as a composite scale) through the Cronbach alpha. This is not sufficient in validating the psychometric properties of the DASS-21 in an Asian sample, which can be compounded by social, cultural, and political variations between Asian countries. A case in point is the shared cultural values of ethnic Chinese from Singapore and China where at the same time there exist clear social, political, and dialectal differences between them. Hence without the use of confirmatory factor analysis to determine the factor structures of the DASS-21, it remains uncertain whether this scale is psychometrically sound and valid for use in Asian populations.

Crosscultural research has shown that Asians tend to have higher levels of collectivistic values which prioritize group goals over individual goals (Sawang, Oei, & Goh, 2006). These cultural values can also impact on how individuals express their emotions; for example, McCrae, Yik, Trapnell, Bond, and Paulhus (1998) described Chinese immigrants' personalities as scoring relatively higher on agreeableness and neuroticism when compared to Canadians. This suggests that the Chinese have a tendency to be more cooperative and concerned for others rather than for themselves. With higher levels of neuroticism, Chinese may lean more towards experiencing negative

¹Clinical cutoff for depression (moderate 28–40; severe 42–54; extremely severe 56 +), anxiety (moderate 20–28; severe 30–38; extremely severe 40 +) and stress (moderate 38–50; severe 25–66; extremely severe 68 +).

²In some studies, DASS was administered and scored by nonpsychologists.

emotions, which may be a result of the respondents' migrant status in the study. Kirmayer, Robbins, Dworkind, and Yaffe (1993) also found that Asians and Africans are more prone to somatization than North Americans. It is clear that culture can influence the experience and expression of depression and anxiety, including the forms of illness experienced, as symptomatology and symptom interpretation (Kirmayer et al., 1993). If this is the case, then the way an individual talks about distress and how it is perceived and defined will be a function of his or her culture. For example, although the term *Hwabyung* in Korean refers to gastric discomfort due to somatic distress, it also refers to anger due to personal conflict and a feeling of injustice (Pang, 1990). Given the multilevel interpretation and expression of an emotional state, it is possible that a scale that measures these emotional states may not produce an accurate value. This can be seen from Norton's (2007) study that produced DASS-21 scores across four races; i.e., African-American, Caucasian-American, Asian-American, and Hispanic-American. The findings indicated that Asian-Americans reported the highest DASS-21 scores across three scales (Norton, 2007). The higher DASS-21 score among Asians may be due to their collectivistic values or possibly to the way respondents interpret the questions, which were directly translated. Given the myriad possible interpretations of a word by a non-native speaker, a psychological assessment that is directly translated from Western measures can be limited in its validity and reliability. Hence the questions that one needs to ask are: "How well are the psychological assessments translated based on cultural meanings (not direct translation based on the dictionary)?" and "How reliable are the translated psychological assessments?"

Our literature search has found some studies that examined the criterion and construct validities of DASS-21 in Asian populations, and a few interesting findings were reported. For example, occupational stress was positively associated with all three scales from DASS-21; i.e., depression, anxiety, and stress symptoms among white-collar Korean employees (Park, Lee, Park, Min, & Lee, 2008) as well as Malaysian employees (Edimansyah et al., 2008). Su and colleagues (2008) found that Chinese individuals living with HIV/AIDS demonstrated high DASS-21 scores. Likewise, Malaysian university students who had eating disorders demonstrated high DASS-21 scores (Gan, Nasir, Zalilah, & Hazizi, 2008). Furthermore, Oei, Lin, and Raylu (2007) found that the overall DASS-21 score was higher among female Chinese than male Chinese. They also concluded that individuals who had high DASS-21 scores were associated with at-risk gambling

behavior. As noted above, of the numerous Asian-based studies that used a direct translation of DASS-21 and their computation of the constructs as composite three-scales (see Gu et al., 2010; Nüesch et al., 2009; Oei et al., 2007), none had carried out a prior examination of the factorial structure of DASS-21.

It is considered good practice to validate a scale that is being used outside its culture or country of origin (i.e., where it was developed). Therefore the widely used DASS-21 needs to be validated more thoroughly and methodically in non-Western contexts. Specifically, there is a need to delineate the underlying structure of this scale with, for example, different Asian populations. This study aimed to do so via the following steps: First, exploratory factor analysis (EFA) was used to determine whether the three-factor structure of DASS-21 could be replicated in the Asian samples. A major reason was that it could not be assumed that a similar structure would apply to Asian populations. Secondly, a confirmatory factor analysis (CFA) was used to confirm the specific psychometric structure identified by the EFA analysis. It is worth noting that as CFA is a more advanced technique designed to test the underlying theoretical structure about latent processes (Tabachnick & Fidell, 1996); this is an essential step in the validation of the DASS-21 within the Asian context. Finally, to calculate the reliability and to examine the concurrent validity, the DASS-21 was compared with the Beck Depression Inventory (BDI), the Beck Anxiety Inventory (BAI), the Positive and Negative Affect Scale (PANAS), and the Personal Strain Questionnaire (PSQ).

In summary, the DASS-21 is frequently used in Asian countries and yet its psychometric properties have not been properly examined. Thus this paper reports the psychometric properties of the DASS-21 in six Asian samples using EFA and CFA methods. We propose that the Asian samples (Malaysian, Indonesian, Singaporean, Sri Lankan, Taiwanese, and Thai) will display the same three-factor structure of DASS-21 as in the original Western samples.

METHODOLOGY

Participants

Two thousand six hundred and thirty employees from various companies were recruited from different research projects. The studies from Indonesia, Singapore, Sri Lanka, and Thailand aimed to assess work-related stress and coping strategies among employees in the education and health care sectors. The study from Taiwan examined gambling behavior among working adults and the study from Malaysia

TABLE 1
Demographic information of participants from each country

	<i>Malaysia</i>	<i>Indonesia</i>	<i>Singapore</i>	<i>Sri Lanka</i>	<i>Taiwan</i>	<i>Thailand</i>
Total sample	1013	433	131	210	501	325
Female (male)	78% (22%)	41% (59%)	25% (75%)	56% (44%)	35% (65%)	39% (61%)
Average age (years)	33	37	35	37	25	37
<i>Highest education</i>						
High school	58%	57%	75%	71%	67%	81%
Undergraduate	39%	13%	10%	24%	28%	14%
Graduate or higher	9%	30%	15%	5%	5%	5%

examined general health and wellbeing from a community sample.³ The collaborators in all countries were fully instructed in the procedure of administering the paper-based questionnaires and data entry. The inclusion criterion for participant recruitment for Indonesia, Malaysia, Singapore, Sri Lanka, and Thailand was individuals who were currently working. For the Taiwanese sample, the criteria were individuals who were currently working and experienced in gambling activities. The mean age from the combined data was 30.46 years. Of these, 53% were female and 47% were male. The lowest levels of education completed were 71% high-school level, 27% undergraduate level and 2% graduate level or higher. Table 1 shows the demographical information of participants from each country.

Measures

Demographic data

Demographic variables included age, gender, marital status, position, employment status, the number of years they had work in their firm and their highest level of education. However, the only demographic information common to all data sets was age, employment status, education, and gender.

DASS-21

This was designed to measure emotional distress in three subcategories (Lovibond and Lovibond, 1995) of depression (e.g., loss of self-esteem/incentives and depressed mood), anxiety (e.g., fear and anticipation of negative events), and stress (e.g., persistent state of overarousal and low frustration tolerance). It was a self-reporting questionnaire with 21 items (seven items for each category) based on a four-point rating scale. To calculate comparable scores with full DASS, each seven-item scale was multiplied by two. Items

included, “I found it hard to wind down,” “I was aware of dryness of my mouth,” and “I couldn’t seem to experience any positive feeling at all.” Participants were asked to rate how many of each of the items (in the form of statements) applied to them over the past week, with 0 = “did not apply to me at all” to 3 = “applied to me very much, or most of the time.” The higher the score, the more severe the emotional distress was.

Beck Anxiety Inventory (BAI)⁴

The BAI (Beck & Steer, 1990) is a 21-question self-report inventory that measures the severity of an individual’s anxiety. The scale ranges from 0 = “mildly” to 3 = “severely.” It is a viable tool for capturing mild levels of anxiety and for people with an anxiety diagnosis (Borden, Peterson, & Jackson, 1991). It has been validated in Asian samples and across specific ethnicities such as Chinese, Nepalese, and Korean (e.g., Kin-wing, 2002). Its internal consistency ranged from .75 to .92 (Fydrich, Dowdall, & Chambless, 1992). Previous studies indicated differential correlations between BAI and DASS-anxiety (e.g., Bados, Solanas, & Andres, 2005; Barrett, Farrell, Dadds, & Boulter, 2005). In our study, the internal consistency of BAI was .91.

Beck Depression Inventory (BDI)⁵

The BDI (Beck, Steer, Ball, & Ranieri, 1996) consists of 21 questions measuring the presence of depression. Respondents are asked to rate how they have been feeling in the past week. The ratings are: (0) I do not feel sad, (1) I feel sad, (2) I am sad all the time and I can’t snap out of it, (3) I am so sad or unhappy that I can’t stand it. The psychometric characteristics of BDI with an ethnically diverse population (e.g., African, Asian, Hispanic, and White American) showed high reliability (Carmody, 2005).

³These studies did not record a specific industry that each respondent was working in, screening only for full-time working adults.

⁴BAI was collected only in the Malaysian sample

⁵BDI was collected only in the Malaysian sample.

BDI's internal consistency ranged from .85 to .94 (Beck & Steer, 1990) and it was found to have adequate convergent and divergent validity with DASS-depression (Fydrich et al., 1992). BDI also displayed differential correlations with DASS-anxiety in many languages such as English, Chinese, and Spanish (e.g., Antony et al., 1998; Norton, 2007). This scale has been validated in Asian samples (Mukhtar & Oei, 2011); in our study the internal consistency of BDI was .91.

The Positive and Negative Affect Schedule (PANAS)⁶

PANAS is a 20-item questionnaire that assesses positive and negative moods (Watson, Clark, & Carey, 1988). Our study employed a 10-item negative affect (NA) construct to validate with DASS-21. High NA associated with subjective distress and unpleasant engagement, thus emotions such as lethargy and sadness characterized low positive affect (Watson & Clark, 1984). Each of the items was rated from 1 = "very slightly or not at all" to 5 = "extremely." PANAS was validated across Asian samples such as Korean and Chinese (e.g., Chan, 2007). The reliabilities of PANAS were .89 for PA and .85 for NA scales (Crawford et al., 2009). Previous studies indicated correlations between PANAS and DASS-21 (e.g., Norton, 2007). In our study, the reliabilities of PANAS were .69 for PA and .71 for NA scales.

Personal Strain Questionnaire (PSQ)⁷

PQS (Osipow, 1998) measured individuals' experiences in four areas: (1) vocational strain: individuals' attitudes to work, problems with work quantity/quality; (2) psychological strain: individuals' experiences of psychological problems; (3) interpersonal strain: degree of disruptions in interpersonal relationships; and (4) physical strain: individuals' symptoms of physical illness and health. Each area was composed of 10 items. Example items included "My eating habits are erratic" and "Lately, I have been anxious." A five-point rating scale was used with 1 reflecting "rarely or never" and 5 reflecting "most of the time." PSQ was validated and used across different countries, including China, Hong Kong, and Thailand (e.g., Sawang and Murray, 2005). Osipow (1998) reported an internal consistency of PSQ, based on 14 published studies, of .94. A previous study demonstrated a relationship between personal strain and DASS-21 (Goh & Oei, 1999). In

our study, the reliabilities of PSQ were .92 (Singapore), .91 (Sri Lanka), .88 (Indonesia), and .87 (Thailand).

Procedure

We gathered the data from research collaborators from six countries in Asia (i.e. Malaysia, Singapore, Sri Lanka, Indonesia, Taiwan and Thailand). Each of the researchers collected the data for different study purposes (as mentioned above); however, the DASS-21 was common to all the studies. While one set of DASS-21 data has been published as a dependent measure (Oei et al., 2007), the combined DASS-21 data set is new and has not been analyzed, in particular the psychometric properties of the DASS-21.

At the initial visit to an organization, the collaborators explained the research purposes to gain consent and then handed out a consent form to the individuals who were interested in the study. Participants were informed that their participation was purely voluntary, and that they were free to terminate their involvement in the study at any time. For those who were interested, the collaborators mailed a survey pack to them at their workplace, including a return prepaid envelope, and an information sheet explaining the purpose of the study. Participants were assured anonymity and given instructions as to what to do with the survey when completed. The participants could complete the survey at work or at home and return it to researchers via the pre-paid envelope for analysis.

The original DASS-21 translation procedures were conducted across five countries. Since Singapore's official language is English, this study used the English version for its samples. There was concern about whether it was appropriate to translate Western health-related measures and use them in Asian populations. However, it was argued that Western measures could be safely translated when an appropriate approach to translation was used. Instead of using existing DASS translations from the DASS website, our study adopted a two-stage translation: (1) by replicating the original as closely as possible to capture the content of the original for purposes of crossethnic comparisons, and (2) by a crosscultural adaptation of items that make little sense within the cultural context. We recruited volunteers who were bilingual, had experienced living overseas for at least one year, and had obtained local and/or Western degrees in psychology. The recruited volunteers translated the questionnaire from English

⁶PANAS-NA was collected only in the Malaysian sample.

⁷PSQ was collected only in Singapore, Sri Lanka, Indonesia, and Thailand.

into local languages. This translation⁸ captured the content of original DASS-21 with appropriate adaptations to a few items that made little sense within the cultural context in Stage 2. For example, idiomatic equivalence could not be reached in Mandarin Chinese, Taiwanese, Malay, Sinhala, Tamil, and Thai for expressions such as “downhearted and blue.” The closest possible meaning of the original words was “despair and sadness.” In Thai, the expressions of “panic” and “agitated” were translated into Thai expressions that captured the closest possible meaning of the original as “fear” and “upset.” Other bilingual volunteers (different volunteers who performed English–local languages translation) back-translated the measures into English. The back-translations did not differ too much from the original English version of DASS-21. We employed a similar translation procedure for BAI, BDI, and PSQ.

RESULTS

Testing the factor structure of DASS-21 in Asian samples

Given the fact that the psychometric properties of the Asian samples cannot be assumed to be similar to those of Western samples, it was decided to use EFA to explore the psychometric properties first, and then use CFA to confirm the structure. In order to achieve this, we performed three steps of analysis. First, the whole sample was randomly divided into three subsamples. Group A ($n = 1306$) was selected for the EFA. Second, we used Group B ($n = 1307$) to confirm the factor structure that was derived from the first step via CFA. Third, we used Group C (combined Group A and Group B) to confirm the factor structure that was derived from Step 2 via CFA. While it could be argued that CFA be used for both the model building and model testing stages of analysis, based on poor fit of the original factor structure it was decided to abandon a priori hypothesis about the factor structure in favor of a more exploratory technique.

Exploratory factor analysis

Our data were relatively normally distributed, thus maximum likelihood was the best choice because “it allows for the computation of a wide range of indexes of the goodness of fit of the model [and] permits statistical significance testing of factor loadings and correlations among factors and the computation of

confidence intervals” (Fabrigar, Wegener, MacCallum, & Strahan, 1999, p. 277). Exploratory factor analysis relies on various rules of thumb, with factor loading cutoff criteria ranging from .30 to .55, for establishing what is considered to be a strong factor loading coefficient. We used eigenvalues > 1 and examination of the screen plot to determine the number of factors (Hair, Anderson, Tatham, & Black, 1998).

Initial analyses of the Group A sample produced three eigenvalues over 1. When examining the loading matrices, we found three items from the stress scale loading on more than one factor; therefore, these items were subsequently deleted from the analyses (i.e., “I felt that I was using a lot of nervous energy,”⁹ “I found myself getting agitated,”¹⁰ and “I found it difficult to relax”¹¹). The final factor structures from the EFA using Sample Group A are presented in Table 2. As can be seen in the table, the three factors are similar to the original structures found by Lovibond and Lovibond (1995), but with reduced items in each factor. The three-factor solution accounted for 52.21% of total variance. The intercorrelations of factors were small, with good factor loadings and without crossloading items. Nonetheless, these correlations are somewhat higher than the original DASS-21. The results produced a more diffuse factor structure than the original DASS-21 without qualitative difference between this new DASS-18 and the original DASS-21.

After removing three items from the stress scale (resulting in a total of 18 items of DASS, hence DASS-18), Cronbach’s alpha coefficients were acceptable for all factors. The measure of internal consistency was present in DASS-depression, seven items ($\alpha = .86$); DASS-anxiety, seven items ($\alpha = .81$); DASS-stress, four items ($\alpha = .70$); and overall DASS with 18 items ($\alpha = .91$). These alpha values indicated acceptable to good internal reliability (Cicchetti, 1994). Our Cronbach alpha values were similar to those of Lovibond and Lovibond’s (1995) original study ($\alpha = .88$ for Depression, $\alpha = .82$ for Anxiety, $\alpha = .90$ for Stress, and $\alpha = .93$ for the total scale). While our Cronbach alpha for the stress scale fell below Lovibond and Lovibond’s (1995) original study, we have four items on this scale. It is worth noting that alpha is strongly affected by the number of items (i.e., the smaller the number of items, the lower alpha is). Therefore, a particular alpha value needs to be interpreted relative to the number of items, not as an absolute figure (Lovibond & Lovibond, 1995).

⁸Bahasa (Indonesia), Mandarin Chinese (Taiwan), Malay (Malaysia), Sinhala/Tamil (Sri Lanka), and Thai (Thailand).

⁹Factor loading on stress = .44 and crossloaded with anxiety factor = .44.

¹⁰Factor loading on stress = .37 and crossloaded with depression factor = .32.

¹¹Factor loading on stress = .34 and crossloaded with depression factor = .39.

TABLE 2
EFA results from the Group A sample

<i>Construct</i>	<i>Item</i>	<i>Communalities</i>	<i>Depression (Factor 1)</i>	<i>Anxiety (Factor 2)</i>	<i>Stress (Factor 3)</i>
Depression	I felt life was meaningless	0.58	0.75	0.27	0.01
	I felt I wasn't worth much as a person	0.40	0.72	0.15	0.25
	I was unable to become enthusiastic about anything	0.47	0.71	0.24	0.18
	I felt that I had nothing to look forward to	0.51	0.66	0.24	0.23
	I couldn't seem to experience any positive feeling at all	0.40	0.54	0.23	0.36
	I felt down-hearted and "blue" or sad	0.40	0.54	0.24	0.44
Anxiety	I found it difficult to work up the initiative to do things	0.57	0.54	0.24	0.47
	I was aware of the action of my heart in the absence of physical exertion	0.54	0.18	0.71	0.18
	I experienced breathing difficulty (e.g., excessive rapid breathing)	0.54	0.18	0.68	0.31
	I felt scared without any good reason	0.56	0.35	0.61	0.12
	I was aware of dryness of my mouth	0.35	0.33	0.57	-0.03
	I felt I was close to panic	0.54	0.45	0.49	0.31
	I was worried about situations in which I might panic and make a fool of myself	0.60	0.23	0.49	0.41
	I experienced trembling (e.g., in the hands)	0.58	0.39	0.49	0.35
	I found it hard to wind down	0.59	0.07	0.11	0.75
	I felt that I was rather touchy	0.53	0.33	0.12	0.64
Stress	I was intolerant of anything that kept me from getting on with what I was doing	0.43	0.28	0.13	0.50
	I tended to over-react to situations	0.64	0.34	0.31	0.43
	I found myself getting agitated	0.46	0.50	0.23	0.49
	I found it difficult to relax	0.55	0.45	0.20	0.48
	I felt that I was using a lot of nervous energy	0.64	0.04	0.44	0.45
	% variance		40.40	5.49	5.31
	Eigenvalues		8.48	1.15	1.12

Additional eigenvalues for Factor 4 = .88, Factor 5 = .79, Factor 6 = .76, Factor 7 = .74 and Factor 8 = .71.

Confirmatory factor analysis

In order to confirm the factor structure of the DASS with 18 items, LISREL 8.72 was used to perform a series of confirmatory factor analyses. In each analysis, the maximum likelihood estimation method was used, and covariance matrices were assessed. Assessment of model fit was computed and reported in several ways. Due to the relatively large sample size, traditional chi-square tests may provide inadequate assessments of model fit, and therefore other indices were reported. Given the varying definitions of model fit, researchers should use multiple measures that consider the issues of absolute fit, comparative fit, and parsimonious fit.

Tests of absolute fit are concerned with the ability to reproduce the correlation/covariance matrix. LISREL reports the root mean squared residual (RMR), the root mean squared error of approximation (RMSEA), the goodness-of-fit index (GFI), and the adjusted goodness-of-fit index (AGFI). For the RMR, values less than .05 are interpreted as indicating a good fit to the data, and RMSEA values below .05 indicate a very good fit to the data. However, values below .08 are also considered adequate (Byrne, 2001).

GFI and AGFI values exceeding .90 indicate a good fit to the data (Byrne, 2001; Kelloway, 1998). To test the comparative fit and parsimonious fit, the normed fit index (NFI) and the parsimonious normed fit index (PNFI) were used. NFI ranges from 0 to 1, with values exceeding .90 indicating a good fit. Similarly, higher values of PNFI indicate a more parsimonious fit.

We used the Group B sample to perform a series of confirmatory factor analyses. First, we tested the original DASS-21 (with three factors; i.e., DASS-depression, DASS-anxiety, and DASS-stress), as established originally by Lovibond and Lovibond (1995), and compared it with DASS-18 items (with three factors).

The original DASS-21 with three-factor model (Model 1) was not confirmed ($\chi^2 = 1877.51$, $df = 186$, $RMSEA = .10$, $GFI = .84$, $CFI = .43$, $NFI = .36$). Next, we attempted to confirm the three-factor model of DASS-18 (Model 2). This model yielded an acceptable fit ($\chi^2 = 789.89$, $df = 116$, $RMSEA = .07$, $GFI = .93$, $CFI = .92$, $NFI = .92$). Due to high factor correlations in the exploratory factor, a single factor might best represent the data. Consequently, a single-factor solution of DASS with 18 items was also examined (Model 3) but the result was not confirmed.

TABLE 3
Correlations, mean, standard deviation, and internal reliabilities from the Group C (total) samples

	1	2	3	4	5	Mean	SD
DASS-depression (7 items)	(0.86)	0.75**	0.75**	0.76**	0.92**	9.59	8.48
DASS-anxiety (7 items)		(0.81)	0.69**	0.74**	0.91**	9.78	7.94
DASS-stress (7 items)			(0.78)	0.91**	0.84**	11.54	7.12
DASS-stress (4 items)				(0.70)	0.88**	7.00	5.27
DASS (18 items)					(0.91)	26.37	19.83

** $p < .01$. Internal consistency; Cronbach's alpha is in diagonal.

TABLE 4
Summary of tests for invariance of DASS (three-factor 18-item model)

Competing models	χ^2	df	ECVI	RMSEA	GFI	CFI	NFI
Model 1 (free λ and φ)	1367.21	372	0.73	0.08	0.91	0.96	0.92
Model 2 (fixed φ)	1430.91	435	0.88	0.07	0.91	0.91	0.90
Model 3 (fixed λ)	1533.44	447	0.92	0.07	0.91	0.91	0.90

The root mean squared error of approximation (RMSEA); the goodness-of-fit index (GFI); normed fit index (NFI) the adjusted goodness-of-fit index (AGFI); the expected cross-validation index (ECVI).

This finding indicated that although there were strong correlations between the factors of the three-factor model of DASS-18 in Asian samples, the present data were best represented by more than one factor ($\chi^2 = 997.57$, $df = 119$, $RMSEA = .08$, $GFI = .90$, $CFI = .89$, $NFI = .87$). Chi-square difference tests confirmed that the three-factor model was a better fit to the data than the single-factor model. Therefore, Model 2 was the best model to explain the factorial structures of DASS in Asian samples. Although this model resulted in a significant χ^2 statistic, CFI, RMSEA, and other fit statistics indicated an acceptable fit to the data. We then confirmed this model using Group C (combined samples) and the results supported the three-factor model with 18 items ($\chi^2 = 552.01$, $df = 116$, $RMSEA = .06$, $GFI = .95$, $CFI = .94$, $NFI = .92$). Table 3 gives the correlation between factors, and reliability for the Group C sample.

Since three items were removed from the DASS-stress scale, we provided interfactor correlation comparison between the DASS-21 stress scale and the DASS-18 stress scale with DASS-depression and DASS-anxiety. The DASS-18 stress scale demonstrated a correlation coefficient of .76 and the DASS-21 stress scale demonstrated a correlation coefficient of .75 with DASS-depression. The DASS-18 stress scale demonstrated a correlation coefficient of .74 and the DASS-21 stress scale demonstrated a correlation coefficient of .69 with DASS-anxiety. Using the Fisher r -to- z transformation, we assessed the significant

difference between two correlation coefficients;¹² there was no significant difference between the DASS-18 stress scale and the DASS-21 stress scale with DASS-depression. There was however a significant difference between the DASS-18 stress scale and the DASS-21 stress scale with DASS-anxiety ($z = 2.62$, $p < .01$).

Testing for invariance across six nations: Malaysia, Singapore, Sri Lanka, Indonesia, Taiwan, and Thailand

Multiple group analysis was used to test simultaneously for group invariance across the six groups in order to obtain efficient estimates and the pattern of fixed and free parameters. We used this procedure to determine whether the invariant factorial structure would hold for six countries. All samples were used for this analysis. Table 4 gives the global goodness-of-fit statistics between the baseline model (Free λ and φ) and the two rival models (Fixed φ and Fixed λ).

The goodness-of-fit statistics for each group showed adequate to good model fit (Malaysia, $RMR = .03$, $GFI = .93$; Singapore, $RMR = .03$, $GFI = .90$; Sri Lanka, $RMR = .04$, $GFI = .90$; Indonesia, $RMR = .03$, $GFI = .90$; Taiwan, $RMR = .04$, $GFI = .91$; Thailand, $RMR = .07$, $GFI = .91$). As indicated by the above goodness-of-fit statistics, DASS was well described by a three-factor model comprising the 18

¹²The calculation table can be accessed at <http://faculty.vassar.edu/lowry/rdiff.html>

TABLE 5
Reliabilities of DASS (three-factor 18-item model) for each nation

<i>Scale</i>	<i>Country</i>	<i>Cronbach's alpha</i>
Depression	Malaysia	0.82
	Singapore	0.88
	Sri Lanka	0.81
	Indonesia	0.87
	Taiwan	0.88
	Thailand	0.82
Anxiety	Malaysia	0.76
	Singapore	0.83
	Sri Lanka	0.80
	Indonesia	0.85
	Taiwan	0.77
	Thailand	0.78
Stress	Malaysia	0.73
	Singapore	0.69
	Sri Lanka	0.68
	Indonesia	0.72
	Taiwan	0.69
	Thailand	0.69

items across the Asian samples. Table 5 gives the reliabilities of DASS with 18 items for each nation.

Construct validity

Firstly, convergent validity analysis of DASS with 18 items (DASS-18) was examined. According to the DASS-21 manual (Lovibond and Lovibond, 1995), for most research purposes (nonclinical) it was much better to use DASS-21 scores than to attempt to divide a sample into “normal” versus “clinical” or “high” versus “low.” Our study validated DASS-18 according to this recommendation as our samples were nonclinical. Firstly, we examined convergent validity by measuring the correlations between DASS-18 and other measures of depression and anxiety, including the BDI, the BAI, and the PANAS. It was expected that within the DASS-18, its depression scale and anxiety scale would strongly correlate with BDI and BAI respectively. Furthermore, DASS-18's depression, anxiety, and stress scales would significantly correlate with negative affectivity (PANAS-NA). Table 6 gives the DASS-18's satisfactory convergent validity; correlation between the DASS-18 depression scale and BDI was $r = .53$, correlation between the DASS-18 anxiety scale and BAI was $r = .51$. Similar to PANAS-NA, DASS-depression ($r = .58$), DASS-anxiety ($r = .58$) and DASS-stress (four items, $r = .60$; seven items, $r = .57$) were significantly correlated.

Secondly, construct validity analysis of DASS-18 was examined. This analysis aimed to study the discriminate power of DASS-18 on personal strain (PSQ: Personal Strain Questionnaire; Osipow, 1998).

The analysis showed that low psychologically strained individuals displayed lower DASS-18 scores than the highly psychologically strained individuals.

DISCUSSION

The purpose of this study was to examine the psychometric properties and generalizability of the original DASS-21 for use in Asian countries. Our study confirmed the three-factor structure of Depression, Anxiety, and Stress scales as in the original DASS-21. However, due to large residuals and crossloadings, three items (“I found it difficult to relax,” “I found myself getting agitated,” and “I felt that I was using a lot of nervous energy”) were removed from the factor named “Stress.” To examine crossvalidity, the model was compared across six different Asian samples (Indonesia, Malaysia, Singapore, Sri Lanka, Taiwan and Thailand). The results of DASS with 18 items (DASS-18) indicated that the model fit the data adequately. The internal reliabilities of DASS-18 were good within the Asian samples. The internal reliabilities in each country ranged between acceptable and good. Convergent validity indicated that DASS-18 correlated well with other depression, anxiety, and stress scales. While our Cronbach alpha for the stress scale fell below that of Lovibond and Lovibond's original study, we have four items on the stress scale. Alpha is strongly affected by the number of items (the smaller the number of items, the lower alpha is). Therefore, a particular alpha value needs to be interpreted relative to the number of items, not as an absolute figure.

Although we have conducted a comprehensive examination of the DASS-18, our study has only provided preliminary evidence. Specifically, the original DASS-21 stress scale (seven-item construct) might not apply directly in Asian samples, or might be expressed somewhat differently. Previous studies showed that translated versions of DASS often yield a poorer factor discrimination and it was not uncommon to see some deviation from the original structure of DASS-21 (e.g., Taouk, Lovibond, & Laube, 2001; Uncu, Bayram, & Bilgel, 2007). Evidently, many non-Asian translations also failed to mirror the English DASS factor structure perfectly. Therefore, item deviations from the expected structure of, for instance, the stress scale might not be due to unique translations issues relating to the Asian samples.

Although we found correlations between the DASS-18 scales and the BDI/BAI, these were much lower than those published for the English DASS-21 (as shown in Table 6). We do not know the degree to which respondents might make the subtle linguistic distinctions required to differentiate between closely

TABLE 6
Correlations of DASS-18 items with BAI, BDI, PANAS-NA, and PSQ

	BAI	BDI	PANAS-NA	Low PSQ	Average PSQ	High PSQ	ANOVA test
DASS-Depression, 7 items	.50**(.54) [†]	.53**(.74) [†]	.58**	Mean = 5.19; SD = 5.09	Mean = 10.92; SD = 8.16	Mean = 18.858; SD = 8.82	$F(2, 537) = 66.55$ ***
DASS-Anxiety, 7 items	.51**(.81) [†]	.35**(.58) [†]	.58**	Mean = 5.17; SD = 4.89	Mean = 10.78; SD = 7.89	Mean = 17.93; SD = 9.70	$F(2, 537) = 57.91$ ***
DASS-Stress, 7 items	.50**(.61) [†]	.43**(.60) [†]	.57**	Mean = 7.75; SD = 5.67	Mean = 12.13; SD = 6.52	Mean = 18.06; SD = 6.55	$F(2, 537) = 57.41$ ***
DASS-Stress, 4 items	.52**	.44**	.60**	Mean = 4.02; SD = 3.40	Mean = 8.01; SD = 4.80	Mean = 12.48; SD = 5.04	$F(2, 537) = 71.46$ ***
DASS, 18 items	.56**	.48**	.65**	Mean = 14.39; SD = 11.83	Mean = 29.71; SD = 18.95	Mean = 49.27; SD = 21.30	$F(2, 537) = 78.30$ ***

BAI, BDI, and PANAS-NA were collected only in the Malaysia sample. PSQ was collected only in Singapore, Sri Lanka, Indonesia, and Thailand. ** $p < .01$. BAI = Beck Anxiety Inventory, BDI = Beck Depression Inventory, PANAS-NA = Negative affectivity, PSQ = Psychological strain. [†]Comparing to published English DASS-21 (Lovibond & Lovibond, 1995).

related constructs between DASS and BDI/BAI. The DASS-18 depression scale correlated highly with BDI (0.53) and unexpectedly with BAI (0.50). This suggested that the DASS-18 depression scale was not mainly a measure of depression. It was possible in this Asian sample that the DASS-18 depression scale measured negative affect, which, due to the present study's limitation, could not be effectively examined. This was however not the case with the DASS-18 anxiety scale; the correlation with BAI was much lower than the correlation with BDI (refer to Table 6). Thus the DASS-18 depression scale should be used with caution.

We consider the differences between the original DASS-stress (seven items) and our DASS-stress (four items) scales to be relatively minor. These differences could be due to cultural perceptions of some items. For instance, relaxing can be seen as a sluggish behavior in many Asian countries (e.g., Singapore, Thailand). The item "I found it difficult to relax" could be interpreted as beyond the stress context in some cultures. It is possible that cultural factors can influence how individuals understand items in the DASS-stress scale, but do not influence on DASS-depression and DASS-anxiety as we found no significant cultural problems with those two scales. Furthermore, as can be seen from the statistical results, there was no problem in EFA findings. The factor structure of DASS clearly showed three factors as in the original DASS scale. We also found no invariances in our multigroup analysis across the six countries.

We provided a series of rigorous statistical tests minimizing any potential confounding from demographic information. After EFA and CFA analyses, we performed multigroup analysis across six nations to demonstrate consistency of our findings. Based on the construct validity examination, the four-item DASS-stress scale explained relationships with BAI, BDI, and PANAS-NA as well as the original DASS-stress scale (see Table 6). Nonetheless, the advantages of the revised DASS-stress scale are twofold. First, the revised DASS-stress scale obtained fewer items, which resulted in a cleaner factorial structure. Second, it had a smaller interfactor correlation. Based on these justifications, the revised DASS-stress scale could potentially be used in Asian population. However, as there can be some difficulty in comparing results with the seven-item DASS Stress scale and the 21-item DASS in the published literature, we recommend that the DASS-4 and DASS-18 be used with caution at present and that further replication is required before wider application of the shorter scales in Asian regions.

Our efforts to gather data from multiple countries have strengthened the credibility and importance of

our results. Our samples were obtained from six Asian countries with diverse cultural backgrounds, economies, religious beliefs, and languages. This research has a few limitations. Our data were derived from several different projects whose research aims were different (as described in the Methodology section). Furthermore, we did not have in-depth or detailed interview information on how the participants experienced or expressed their depression, anxiety, and stress as compared to Western samples. Future research may entail qualitative studies that observe experiences and interview individuals, and their unique expression of these emotions.

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