Factorial Validity and Internal Consistency of Malaysian Adapted Depression Anxiety Stress Scale - 21 in an Adolescent Sample

Hairul Anuar Hashim, Freddy Golok, Rosmatunisah Ali

International Journal of Collaborative Research on Internal Medicine & Public Health
Vol. 3 No. 1 (January 2011)

Special Issue on "Chronic Disease Epidemiology"
Lead Guest Editor: Professor Dr. Raymond A. Smego
Coordinating Editor: Dr. Monica Gaidhane

International Journal of Collaborative Research on Internal Medicine & Public Health (IJCRIMPH)

ISSN 1840-4529 | Journal Type: Open Access | Volume 3 Number 1

Journal details including published articles and guidelines for authors can be found at:
http://www.iomcworld.com/ijcrimph/

To cite this Article: Hashim HA, Golok F, Ali R. Factorial Validity and Internal Consistency of Malaysian Adapted Depression Anxiety Stress Scale - 21 in an Adolescent Sample. *International Journal of Collaborative Research on Internal Medicine & Public Health*. 2011; 3:29-39.

Article URL: http://iomcworld.com/ijcrimph/ijcrimph-v03-n01-04.htm

Correspondence concerning this article should be addressed to Dr. Hairul A Hashim, Sports Science Unit, School of Medical Sciences, Universiti Sains Malaysia Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia; Email: hairul@kb.usm.my / Tel: +60 9 7676973 / Fax: +60 9 7641945

Paper publication: 20 February 2011

Factorial Validity and Internal Consistency of Malaysian Adapted Depression Anxiety Stress Scale - 21 in an Adolescent Sample

Hairul Anuar Hashim [*], Freddy Golok, Rosmatunisah Ali

School of Medical Sciences, Universiti Sains Malaysia (USM), Malaysia

** Corresponding author; Email: hairul@kb.usm.my*

ABSTRACT

Background: Psychometrically sound measurement instrument is a fundamental requirement across broad range of research areas. In negative affect research, Depression Anxiety Stress Scale (DASS) has been identified as a psychometrically sound instrument to measure depression, anxiety and stress, especially the 21-item version. However, its psychometric properties in adolescents have been less consistent.

Objectives: Thus, the present study sought to examine the factorial validity and internal consistency of the adapted 21-item version of DASS in Malaysian adolescents.

Method: Using cross-sectional study design, DASS-21 was administered to 750 Malaysian adolescents (Mean age = 13.40 ± 0.49). The data were then analyzed using Confirmatory factor analysis (CFA), in which the original DASS-21 factor structure (depression-stress-anxiety) was compared to 8 other alternative models.

Results: CFA results revealed a weak support for DASS-21 as a differentiated measure of depression, anxiety and stress in Malaysian adolescents. Extremely high latent factors intercorrelations were observed in the model reflecting original DASS factor structure. On the other hand, despite the best overall fit of a 4-factor model consisting of depression, anxiety, and stress, as well as a general negative affect factor, individual factor loadings for the specific factors were uninterpretable. Although model fit of 1-factor model was inferior when compared the other competing models, this model (1-factor) exhibit reasonable model fit.

Conclusion: We concluded that the use of Malaysian adapted DASS-21 as a differentiated measure stress, anxiety, and depression in Malaysian adolescent should proceed with caution and further refinement of the scale is necessary before a concrete conclusion can be made.

Keywords: Psychometric assessment, depression, anxiety, stress

Running title: *Negative affect measure*

Introduction

Stress has the potential to adversely affect individual states of health either through direct impact or through the mediation of health risk behaviors. In adolescents, early identification of stress is important for at least two reasons. Firstly, it has been implicated that stress precedes the elevation, recurrence, and exacerbation of depression. Adolescents who reported higher level of stress are four times more likely to exhibit depressive symptoms[1]. Indeed, elevation of the rates of depressed mood associated with stress represents substantial risk of developing clinically significant depressive disorders and impaired functioning. Even more worrying, depression is often co morbid with other psychological disorders such as anxiety related disorders among adolescents[2] Furthermore, it has been widely acknowledged that depression is also comorbid with other chronic physical diseases such as arthritis and diabetes.[3,4] While physical chronic diseases led to reduced health related quality of life, the presence of depression further worsen the health related outcomes. Despite its chronic course, recurrent and associated with increasing disability, depression remains secondary in term of treatment priority.[3,4]

Early identification of emotional distress such as stress and anxiety may be an important step in preventing the risk of the development of clinically significant psychological disorders. Importantly, accurate identification of these negative affects relies on sound psychometrically sound measurement instrument. In fact, psychometrically sound instrument is a fundamental requirement across broad range of research areas. Negative affect research has benefited from a number of psychometrically sound instruments such as Depression Anxiety Stress Scale (DASS),[3-5] both its 42 – item version, and more recently, a 21 - item version.[5]

Developed as a measure of anxiety and depression, DASS covers a wide range of core symptoms of both anxiety and depression. In addition, DASS also measures stress component through the summation of items such as difficulty of relaxing, tension, impatience and agitation. In adult's populations, the psychometric properties of this scale have been extensively studied and a growing body of literature supports its validity and reliability in both clinical [6, 7] and nonclinical populations, [8,9] as well as across different cultural groups. [e.g., 7,9,10] Between the two versions, the shorter version appears to exhibit a more stable and distinct factors structure. [11]

In Malaysian population, DASS-21 has been translated into the local language and evidence exists suggesting the psychometric properties of the adapted version reflect that of the original DASS-21. [7, 10] Despite evidence of the validity and reliability of the Malaysian adapted DASS-21 in adult population, its psychometric properties in younger populations have not been studied. In fact, very limited studies have been conducted to examine the validity and reliability of the original version among younger respondents. [11] Within these limited studies, it appears that the factor structure of DASS-21, when used in the younger population, is unstable. [11, 12, 13, 14]

For instance, in a study conducted by Szabó and Lovibond [12] involving 7 to 14 years old children and adolescents, a 2-factor structure incorporating anxiety and a combined depression-stress items best fitted the data. Similarly, in another study involving 11 to 15 years old adolescent conducted by Duffy et al., [13] the findings did not support the original 3-factor structure (depression-anxiety-stress) of DASS-21. Instead, the researchers only observed reasonable model fit when the items of DASS-21 were grouped into 2 factors, Physiological hyperarousal and General negative affect, while allowing some error terms to covary. On the basis of the results,

Duffy et al. [13] speculated that young people might not yet develop the ability to differentiate between depression, anxiety, and stress. Instead, adolescents are likely to report their experience in a more general negative experience and physiological arousal.

Inconsistent factor structure of DASS-21 in younger population is also evident in two studies that are more recent. In one of those studies, Szabó [11] revealed that DASS-21 was best used as a measure of anxiety and depression instead of the 3-factor structure in 11 to 15 years old children and adolescents. Contrary to Szabó, [11] Tully et al.'s [14] observed that DASS-21 was best seen as a measure of depression, physiological arousal, and general negative affect.

Consistent across these studies, the researchers view that emotion differentiation is still developing in younger respondents and they may not be able to fully appreciate the differentiation in depression, anxiety, and stress as reflected in the DASS-21 items. [11, 13] Furthermore, Szabó [11] contended that DASS contained several expressions and words that might not be familiar to adolescents. Thus, the failure to obtain a clear factor structure when using DASS-21 in younger respondents.

In summary, assessment of psychometric properties of this measure among young respondents is critical given the fact that youth populations may not be able to report their experience using the items designed for adult populations. Given the inconsistencies in relation to the factorial structure of DASS-21 among younger populations and potential benefits that developmental research can obtain from DASS-21, it is critically important to evaluate the psychometric properties of DASS-21 in younger respondents.

The present study is important for at least two reasons. First, although the psychometric properties of the Malaysian adapted DASS-21 have been established in adult populations, no studies have been conducted in younger respondents. Second, psychometrically sound instrument contribute to accurate identification of elevated rates of stress and depressed mood, which may curb the risk of developing clinically significant depressive and anxiety disorders in adolescents. Therefore, the primary objective of the present study was to examine the factorial validity and internal consistency of the culturally adapted DASS-21 in Malaysian youth. It was hypothesized that DASS-21 would exhibit similar factor structure as in the original version and exhibit acceptable reliability indices.

Methods

Participants

Participants were 750 secondary school students (boys = 492 and girls = 258). They were randomly sampled from three schools in one of the district in the eastern state of Malaysia. Participants aged 13 and 14 years old (13.40 ± 0.49) and the breakdown of participants aged 13 and 14 were 59.9% and 40.1%, respectively. The sample size was determined on the basis of the recommended 10 participants per questionnaire item as suggested by Tabachnick and Fidell[15] for factor analysis. Thus, the total sample exceeded the minimal required sample size to analyze DASS-21 factor structure (i.e. 210 participants).

Depression Anxiety Stress Scale - 21[5]

DASS-21 is a measure of three distinct negative affects: depression, stress, and anxiety. Respondents were to indicate the extent to which they experience each of the symptoms 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*). The Malay translated version of DASS-21 was used in the present study. In adult population, initial assessment of the translated

version revealed adequate validity and reliability indices.[7,10] Detailed description of the translation process and the psychometric properties of the translated version can be found elsewhere.[7,10]

Procedures

Permissions to conduct the study were obtained from the relevant authorities. Specifically, ethical approval was obtained from the relevant human ethics committees. Additionally, permission was also obtained from the relevant ministry and the principles of the participating schools. Following the approval from the respective authorities, an explanatory letter and information packets were sent to the schools to be distributed to the students. Students who were interested to take part in the study were then given the Consent Forms, both for themselves and their parents or guardians.

Students who consented to participate and permitted by their parents were given the questionnaire to be completed. Questionnaire administration took place in a classroom setting and was supervised by the second and third authors. Participants spent on an average of 10 minutes to complete the questionnaire.

Analysis

Maximum likelihood estimation procedure was used along with a range of fit indices to compare the models. Specifically, chi-square and five other descriptive indices were used. They were goodness fit index (GFI),[16] the standardized root mean residual (SRMR), the root mean square of approximation (RMSEA),[17] the expected cross validation index (ECVI), and the Parsimony-Adjusted CFI (PCFI).[18] A non-significant chi-square value indicates the data describe the model. Values of 0.90 or greater for GFI indicate a close fitting model. The SRMR provides an average difference between the variance of the sample and estimated populations, and values of 0.05 or lower indicate a good fitting model. Similarly, values of lower than 0.05 for RMSEA indicates a close fitting model. An index recommended for comparing models in smaller samples is the ECVI. Models with smaller values indicate the best potential of replication in samples of equivalent size and precision of the ECVE is presented in confidence interval. Lastly, PCFI takes into account the complexity of the model and values above 0.70 indicates good fit, with higher values indicating better fit.

Model Testing

Formulation of alternative models was based on previous validation studies of DASS-21 involving adolescents.[11-14] Specifically, we first tested a 1-factor model to explore the proposition that DASS-21 is best conceptualized as a measure of an undifferentiated, general negative affective state in this age group. This was then followed by a 2-factor model-A consisting of General negative affect and Physiological arousal, which was based on Duffy et al.'s [13] study. Next, another two-factor model incorporating Physiological hyperarousal and a General negative affect factors was tested. Formulation of this model was based on Szabó and Lovibond's [12] study.

We subsequently tested five 3-factor models. The first tested model (3- model factor model-A), reflected a factorial structure identical to the adult version of DASS.[5] Subsequently tested models (3-factor model-B and C) were similar to model-A, except that 3 and 4 pairs of errors terms were allowed to covary, respectively. The correlated error terms for 3-factor model B were between items 2 and 7, items 4 and 19, and item 11 and 12. For the 3-factor model-C, an additional pair of item (items 17 and 21) was also set to covary. These two models were formulated following Henry and Crawford's [8] and Szabó's [11] studies, respectively. The remaining 3-factor models (models D and E), consisted of factors reflecting Low positive affect, General

negative affect, and Physiological hyperarousal. Following Duffy et al.'s [13] procedures, the latent factors were allowed to covary for the 3-factor model-D, while analysis of the 3-factor model-E followed Szabó [11] procedures, in which the factors were set to orthogonal. Lastly, we evaluated a 4-factor model whereby all item were set to load on an additional factor (General negative affect). This model was specified in order to test the notion of shared variance of the items between the specific factors (depression-anxiety-stress) and a common negative affect factor. Item-factor specifications for all of the models are presented in Table 1.

Results

Racial composition of the sample include Malay (98.8%) followed by Indian (0.5%), Chinese (0.4%) and other ethnic groups (0.3%). Male represented 65.6% of the total sample and the percentage of participants aged 13 and 14 were 59.9% and 40.1%, respectively. For male respondents, the mean scores of depression, anxiety, and stress were 6.06 (4.27), 6.19 (4.52), and 10.29 (5.17), respectively. For female respondents, the mean scores for depression, anxiety, and stress were, 7.39 (5.25), 8.08 (4.62), and 12.07 (5.59), respectively. Age wise, the mean scores for depression, anxiety, and stress for the 13 years old were 6.75 (4.78), 7.12 (4.81), and 11.13 (5.66), respectively. For 14 years old, the mean scores were 6.21 (4.5), 6.45 (4.38) and 10.59 (4.97), for depression, anxiety and stress.

CFA results for the 1-factor model revealed adequate fit (Table 2). However, we observed significant model improvement between the 2-factor model (model A) incorporating Physiological hyperarousal and General negative affect factors when compared to the 1-factor model ($\Delta\chi^2 = 55.36$, $\Delta df = 1$, $p < 0.05$). Similarly, comparison between a 2-factor model consisting of depression and stress-anxiety items (2-factor model-B) and the 1-factor model also revealed significantly better 2-factor models ($\Delta\chi^2 = 24.62$, $\Delta df = 1$, $p < 0.05$). Between these 2-factor models, model A exhibited a better overall model fit.

A subsequent test of 3-factor model-A, reflecting DASS-21 original factor structure, also yielded adequate model fit. However, relatively high latent factor intercorrelations were present (depression-anxiety = 0.83; depression-stress = 0.87; and anxiety–stress = 0.84). Following Szabó [11] and Henry and Crawford [8] procedures, two 3-factor models (B and C) with correlated error terms were subsequently tested. Indeed, allowing error terms to covary for Anxiety (items 2 and 7; items 4 and 19) and Stress (items 11 and 12) subscales further improved the fit of the model ($\Delta\chi^2 = 38.56$, $\Delta df = 3$, $p = <0.05$). In fact, allowing another pair of overlapping depression items (item 17 and 21) significantly improved the model fit ($\Delta\chi^2 = 37.39$, $\Delta df = 1$, $p = <0.05$). This finding lends support for proposition regarding the covariance of error terms between these two depression items. However, this procedure appeared to compromise the discriminant validity of the subscales. Specifically, an increase in the latent factor intercorrelation was observed (depression-anxiety: 0.89, depression-stress: 0.91, and anxiety-stress: 0.89).

We also tested two other alternative 3-factor models (models D and E), incorporating Low positive affect, Physiological hyperarousal, and General negative affect factors. Specification of these two models was based on Duffy et al.[13] and Szabó [11] studies. Model-D, with orthogonal factor structure, did not fit the data well. The second model (model-E) with correlated latent factors exhibited significant improvement, although its overall model fit was inferior to that of original factor structure.

Our last analysis involved the 4-factor model incorporating depression-anxiety, and stress and a common negative affect factors. This analysis was performed to examine the notion of shared variance of the items between the specific factors (depression-anxiety-stress) and a common negative affect factors. The results showed this model best described the data when compared to other competing models. Despite a significantly better overall fit of the 4-factor model, closer inspections of individual items revealed nonsignificant unstandardized factor loadings on the specific factors (i.e., depression, anxiety, and stress) for 19 out of 21 items, implying lack of convergent validity. Furthermore, standardized item loadings revealed only five items with positive loadings and only three of these five items have values in accordance to the expectations. In contrast, significant loadings were obtained for all items specified to load on the General Negative Affect factor. Although the findings implied that the items measure only one common, results of the 1-factor model revealed poorer model fit compared to the 2-factor and 3-factor models.

Given the fact that the results of individual item loadings of the 4-factor model did not support the notion of the items shared variance between specific and a common factor, and the lack of discriminant validity of the subscale, we are in the view that the Malay translated DASS-21 is best used as an undifferentiated measure of negative affects among adolescents.

In light of these findings, the 1-factor model was then further tested for invariance between male and female samples. The results indicated model invariance between the two samples in term of the measurement model ($\chi^2 = 28.96$, $df = 20$, $p > .05$). Detailed descriptions of individual path loadings for both male and female samples are presented in Table 3.

In terms of the scale reliability, alpha reliability of the scale was computed and alpha coefficients for stress, anxiety, and depression were 0.68, 0.67, and 0.70 for, respectively. Furthermore, Spearman-Brown split half reliability for stress, anxiety, and depression subscales were 0.70, 0.65, and 0.70, respectively.

Discussion

A series of confirmatory factor analysis was performed to investigate the factorial validity of the adapted version DASS-21 among Malaysian adolescents. DASS-21 original factor structure was compared to eight other alternative models derived from previous studies.

Contrary to previous studies, our findings revealed adequate model fit for the 1-factor model. Indeed, in exception of the significant chi-square and chi-square-df ratio, all other indices were above the recommended levels of model fit. Although this finding implied that the measure could be seen as an undifferentiated negative affect measure, it should be acknowledged that subsequent analyses revealed significantly better overall model fit of other models when compared to the 1-factor model.

In Duffy et al.'s [13] study, the 2-factor model comprising of Physiological hyperarousal and General negative affect best described their data. On the other hand, in Szabó's[11] analysis, 2-factor model incorporating factors reflecting depression and combined anxiety-stress items, best reflected their data. In the present study, both of these models exhibited significant improvement in model fit, when compared to the 1-factor model. Again, it should be noted that subsequent analysis of 3-factor and the 4-factor models revealed significantly better fit of the latter models.

Indeed, our analysis indicated that the 4-factor model exhibit the closest model fit. This model was evaluated to examine the notion of

shared variance between the three specific factors (Anxiety-Depression-Stress) and a common negative affect factor. Despite close model fit, results of the individual item loadings failed to support the notion of shared variance of the items. Specifically, only 3 items appears to account for shared variance as speculated.

Further evaluation of 3-factor models revealed that original DASS-21 factor structure (3-factor model A) fit the data reasonably well. In fact, inspection of individual items revealed significant unstandardized regression weight for all items, lending support for the convergent validity of the subscales. However, very high latent factors intercorrelations were observed, indicating lack of discriminant validity. Modification of this model was then undertaken by allowing 3 pairs of correlated error terms. Correlated error terms in measurement models indicated overlapping between, and unique variances of the associated indicators. In other words, the indicators may measure something in common in addition to their specified latent constructs[19]. Consistent with Szabó, [11] allowing error terms to correlate significantly improved the model fit. In fact, another model with correlated error terms for a pair of depression items further improved the model. This finding supports Szabó's [11] contentions regarding the error terms for depression items. Despite improvement observed in the overall fit indices, this procedure inflated the latent factor intercorrelations, thus, compromised the discriminant validity of the subscale. In light of this finding, we examined two 3-factor models incorporating Physiological hyperarousal, Low positive affect, and General negative affect. Following Duffy et al.'s [13] procedures, the latent factors were allowed to covary, while analysis of the second model followed Szabó [11] procedures, in which the factors were set to orthogonal. Our findings did not support either of these models, although the model fit was satisfactory for model with the correlated latent factors.

Contrary to the adult version of Malay translated DASS-21, [7,10] which has shown strong psychometric properties, no concrete conclusion could be gathered from the results of the present study. Although the data implied differentiation of depression, anxiety, and stress, high latent factors intercorrelations suggested lack of fine differentiation between these three negative affects. Furthermore, despite inferior fit indices of the unidimensional model (1-factor model), it is generally acceptable. Thus, it appears at this stage that the adapted DASS-21 is best used as a unidimensional measure of negative affect among adolescents. Its usage as a measure of differentiated negative affective states among adolescent, should proceed with caution.

There are at least two feasible explanations for the present findings. Firstly, consistent with previous studies such as Szabó, [11] we view that adolescents may not yet developed adult-like emotional states as assessed in DASS-21. Szabó [11] for instance viewed that the adult version of DASS-21 may contain expression and wordings that may not be familiar to adolescents. In this regard, further refinements of items are indeed needed for young populations.

Another probable explanation for the lack of discriminant validity in the present sample might be the result of response bias. One of the major types of response bias, response tendency, has received considerable attention from survey researchers. It is generally acknowledged that that response tendency varies across cultures and may influence the respondents' tendency to give socially desirable answers. [20] Therefore, even if the translated questions work well, inadequate divergence in symptom reports could still occur when response tendency differs culturally. Indeed, in a study comparing response patterns on the Center for Epidemiologic Studies Depression Scale

(CES-D) items, it was observed that Japanese adolescents tended to respond to positively worded items markedly different than those of American adolescents. [21] It was reasoned that this response pattern was due to cultural influence. Specifically, it was suggested that Japanese respondents might suppress positive affect expression and, thus, affect the way positively worded questionings were responded to. Although this issue was not assessed in the present sample, this issue certainly warrants future comprehensive analysis of DASS-21 responses among adolescents sample. [21]

References

1. Frojd AA, Nissinen ES, Pelkonen M U I, Marttunen M J, Koivisto AM, & Kaltiala-Heino R. Depression and school performance in middle adolescent boys and girls. *J Adolesc*. 2008; 31: 485-498.
2. Hankin B J. Adolescent depression: Description, causes, and interventions. *Epilepsy Behav*. 2006; 8: 102-114.
3. Cassano P, Fava M. Depression and public health: An overview. *J Psychosom Res*. 2002; 53: 849-857.
4. Chapman DP, Perry GS, Strine TW. The vital link between chronic diseases and chronic disorders. *Prev Chronic Dis*. 2005; 2; A14.
5. Lovibond SH, Lovibond PF. *Manual for the Depression Anxiety, stress scales*. Sydney: Psychology Foundation; 1995.
6. Antony MM, Bieling PJ, Cox BJ, Enns MW, Swinson RP. Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychol Assess.* 1998;10(2):176-181.
7. Ramli M, Salmiah MA, Nurul Ain M. Validation and psychometric properties of Bahasa Malaysia version of the Depression Anxiety And Stress Scales (DASS) among diabetics patients. *Malays J Psychiatry.* 2009;18(2):40-45.
8. Henry JD, Crawford JR. The short version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *Br J Clin Psychol.* 2005;44(2):227-239.
9. Imam SS. Depression Anxiety Stress Scales (DASS): Revisited. The 4th International Postgraduate Research Colloquium. Bangkok, Thailand: IPRC Proceedings; 2007: 184-96.
10. Ramli M, Ariff MF, Zaini Z. Translation, validation and psychometric properties of Bahasa Malaysia version of Depression Anxiety and Stress Scales (DASS). *Asian J Psychiatry.* 2007;8(2):82-89.
11. Szabó M. The short version of the Depression Anxiety Stress Scales (DASS-21): Factor structure in a young adolescent sample. *J Adolesc.* 2010;33(1):1-8.
12. Szabó M, Lovibond PF. Anxiety, depression and tension/stress in children. *J Psychopatol Behav.* 2000;28(3):195-205.
13. Duffy CJ, Cunningham EG, Moore SM. The factor structure of mood states in an early adolescent sample. *J Adolesc.* 2005;28:677-680.
14. Tully PJ, Zajac IT, Venning AJ. The structure of anxiety and depression in a normative sample of younger and older Australian adolescents. *J Abnorm Child Psych.* 2009;37:717-726.
15. Tabachnick BG, Fidell LS. *Using Multivariate Statistics*. 4 ed. Boston, Massachusetts: Allyn and Bacon; 2001.
16. Joreskog KG, Sorbom D. *LISREL-VI user's guide*. 3 ed. Mooresville, IN: Scientific Software; 1984.
17. Browne MW, Cudeck R. Alternate ways of assessing model fit. In: Bollen K, Long JS, eds. *Testing structural equation models*. Newbury Park, CA: Sage; 1993:132-162.
18.Bentler PM. Comparative fit indexes in structural models. *Psychol Bull.* 1990;107:238-246.
19. Kline, R. B. (1998). *Principles and practice of structural equation modeling*. New York: The Guilford Press.
20. Kirmayer L. Cultural variations in the response to psychiatric disorders and emotional distress. *Soc Sci Med.* 1989; 29: 327–339.
21. Iwata N, Saito K, Roberts RE. Responses to a self-administered depression scale among younger adolescents in Japan. *Psychiatry Res;* 1993 53, 1275-287.

Table 1: Items–factors specification for the tested models

	Items/Subscales	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Model 1	General negative affect	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Model 2	Physiological hyperarousal		x		x			x												x		
	General negative affect	x		x		x	x		x	x	x	x	x	x	x	x	x	x	x		x	x
Model 3	Depression			x		x					x			x			x	x				x
	Combined stress-anxiety	x	x		x		x	x	x	x		x	x		x	x			x	x	x	
Model 4	Depression			x		x					x			x			x	x				x
	Anxiety		x		x			x		x						x				x	x	
	Stress	x					x		x			x	x		x				x			
Model 7	Physiological hyperarousal		x		x			x												x		
	Low positive affect			x							x						x	x				
	General negative affect	x				x	x		x	x		x	x	x	x	x			x		x	x
Model 9	Depression			x		x					x			x			x	x				x
	Anxiety		x		x			x		x						x				x	x	
	Stress	x					x		x			x	x		x				x			
	General negative affect	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Notes:

1. Model 5 similar to Model 4 but with 3 pairs of correlated error terms (items 2-7; 4-19 and 11-12).

2. Model 6 is similar to model 4 but with 4 pair correlated errors (items 2-7; 4-19; 11-12, and 17-21)

3. Model 8 is similar to model 7 but with correlated latent factors

Table 2: Goodness of fit indices of the tested models

	χ^2	df	$\Delta\chi^2$	Δdf	χ^2/df	GFI	PCFI	RMR	ECVI	RMSEA	AIC
1-factor[1]	613.36	189	-	-	3.24	0.93	0.77	0.03	0.93	0.06	697.36
2-factor model A[2]	558.00	188	55.36	1	2.96	0.93	0.78	0.03	0.86	0.05	644.00
2-factor model B[3]	587.15	188	24.62	1	3.12	0.93	0.77	0.03	0.90	0.05	673.15
3-factor model A[4]	553.26	186	33.89	1	2.97	0.93	0.77	0.03	0.86	0.05	643.20
3-factor model B[5]	514.70	183	38.56	3	2.81	0.94	0.77	0.03	0.82	0.05	610.70
3-factor model C[6]	477.31	182	75.95	4	2.63	0.94	0.78	0.03	0.77	0.05	575.31
3-factor model D[7]	1212.96	189	735.65	7	6.42	0.87	0.58	0.09	1.73	0.09	1296.96
3-factor model E[8]	555.28	186	625.07	7	2.985	0.93	0.77	0.27	0.86	0.05	645.28
4-factor model[9]	359.90	169	117.41	13	2.13	0.96	0.75	0.02	0.65	0.04	483.89

Notes:

[1] *All items are permitted to load on one common factor (General Negative Affect)*

[2] *Model consisting of Physiological hyperarousal and General Negative Affect*

[3] *Model consisting of Depression items and Stress-Anxiety items combined*

[4] *Model reflecting original DASS-21 factor structure for adult*

[5] *Model similar 3-factor model A, but with 3 pairs of correlated error terms (items 2-7; 4-19 and 11-12).*

[6] *Model similar 3-factor model A, but with 4 pair correlated errors (items 2-7; 4-19; 11-12, and 17-21)*

[7] *Orthogonal model incorporating Low positive affect, General negative affect, and Physiological hyperarousal*

[8] *Model consisting of factor of Low positive affect, General negative affect, and Physiological hyperarousal with correlated latent factors*

[9] *Orthogonal model with all items are permitted to load on one common factor (General Negative Affect), in addition to loading on its specific factors (depression, anxiety, and stress)*

Table 3: Detailed descriptions of path loadings

	Male Sample		Female Sample	
	URW	SRW	URW	SRW
Item 1	1.00	0.35	1.00	0.54
Item 2	0.96	0.30	0.24	0.11
Item 3	0.89	0.30	1.11	0.53
Item 4	0.72	0.30	0.45	0.25
Item 5	0.71	0.25	0.87	0.43
Item 6	0.86	0.28	0.72	0.39
Item 7	0.58	0.25	0.40	0.24
Item 8	0.99	0.32	0.65	0.35
Item 9	1.16	0.39	0.81	0.38
Item 10	1.03	0.35	0.91	0.52
Item 11	1.34	0.47	1.08	0.56
Item 12	1.56	0.54	0.97	0.50
Item 13	1.42	0.49	1.31	0.65
Item 14	1.37	0.40	0.92	0.42
Item 15	1.05	0.43	0.99	0.52
Item 16	1.11	0.39	0.82	0.45
Item 17	0.79	0.37	0.63	0.40
Item 18	1.32	0.43	1.02	0.50
Item 19	1.11	0.42	0.68	0.37
Item 20	1.37	0.42	0.71	0.39
Item 21	0.58	0.36	0.44	0.36

Note: *All unstandardized regression weights (URW) are significant at 0.05. SRW = Standardized regression weight*