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Factor Structure of Hospital Anxiety and Depression Scale in Malaysian Patients With Coronary Artery Disease

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Abstract

The Hospital Anxiety and Depression Scale (HADS) is a common screening instrument used to determine the levels of anxiety and depression experienced by a patient and has been extensively used in patients with coronary artery disease (CAD). This study aimed to establish the factor structure of HADS in a Malaysian sample of 189 patients with CAD. Factor analysis of HADS using principal component analysis with varimax rotation yielded 3 factors. Confirmatory factor analysis supported the use of HADS in assessing 3 distinct dimensions of psychological distress—namely, anxiety, anhedonia, and psychomotor retardation. The HADS showed good internal consistency and was found to be a valid measure of psychological distress among Malaysian patients with CAD. However, low mean scores on the original 2 factors—that is, anxiety and depression—and also on the 2 depression subscales—anhedonia and psychomotor retardation—suggests that the recommended cutoff score to screen for psychological distress among CAD patients be reevaluated. Further research to determine the generalizability and consistency for the tridimensional structure of the HADS in Malaysia is recommended.

Keywords

coronary artery disease, dimensionality, factor structure, Hospital Anxiety and Depression Scale, validity

Introduction

Anxiety and depression are 2 common psychological disorders that coexist with each other and with other psychological and somatic disorders. It has been reported that depression is estimated to affect 350 million people.[1] In the Asia-Pacific region, rates of current or 1-month major depression range from 1.3% to 5.5%, and lifetime rates range from 1.1% to 19.9%.[2] Anxiety disorders also exert adverse effects similar to depression, but the epidemiological data are limited. A systematic review published in 2012 that included prevalence studies from 44 countries estimated the

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prevalence of anxiety to be between 0.9% and 28.3%.[3] The Hospital Anxiety and Depression Scale (HADS) was created specifically to help differentiate between symptoms and to assess the possible and probable causes of anxiety and depression in nonpsychiatric hospital outpatients. Originally developed by Zigmond and Snaith,[4] HADS is a commonly used instrument to measure depression and anxiety in clinical and nonclinical settings. The 14-item HADS is composed of two 7-item subscales, the HADS-A and HADS-D, which measure mutually exclusive levels of anxiety and depression, respectively.

Although HADS has been used prolifically, controversy exists regarding the construct validity of the original anxiety and depression bidimensional structure. Although latent variable analysis was not conducted during the creation of HADS, numerous studies have subsequently examined the validity of the originally proposed bidimensional anxiety-depression structure, and these have suggested that the dimensional structure of the HADS has only received limited empirical assessment, with equivocal results, and is in need of further clarification.[5,6] The HADS is an important psychometric tool in the assessment of individuals with somatic illnesses, notably for coronary heart disease patients, predicting cardiovascular morbidity and mortality.[7] A few studies were identified from the recent review on the latent structure of the HADS[8,9] that validated the factor structure of HADS among cardiac patients: a unidimensional structure,[10] a 2-dimensional structure,[11,12] and a 3-dimensional structure.[13,14]

The Malay HADS is a validated and highly reliable tool, with the ability to both diagnose and grade psychological states in many local clinical and nonclinical populations.[15-17] However, the valid factor structure of HADS in Malaysian clinical or nonclinical populations, including the CAD sample, has not been evaluated. The current scenario of contradictory results in the factor structure of HADS evident elsewhere around the globe and the absence of any study to confirm the factor structure of this instrument in Malaysia has prompted the authors to explore and confirm the factor structure of HADS specifically among CAD patients in the local context.

The purpose of this study was to (1) assess dimensional structure, internal consistency, and intercorrelation of HADS and (2) compare the fit of factor solution with the original 2 factors for the HADS.

Methods

Participants

The participants were recruited between October 2011 and January 2012 from the outpatient clinic at National Heart Institute, a semigovernment tertiary care cardiac center in Kuala Lumpur, Malaysia. The participants for the present study were selected for a larger study on psychosocial factors and coronary artery disease (CAD). The inclusion criteria for the participants for the present study were age 18 years and above and residing permanently in Malaysia with a confirmed diagnosis by a cardiologist of either myocardial infarction (MI) or unstable angina (UA) within the past 1 year. Patients who had been diagnosed and/or treated for any mental illness were excluded from the present study.

The sample size of 169 was calculated based on the previous study.[18] After including 15% (25) expected nonrespondents or missing data and rounding up, a sample size of 200 was selected. The study received ethics approval from the University of Malaya Medical Ethics Committee, and all participants gave written informed consent.

Procedure

This was a cross-sectional study in which participants with CAD attending the outpatients' clinic at the National Heart Institute, Kuala Lumpur, were enrolled. These patients were diagnosed by the cardiologists with a major cardiac event (MI and/or UA) within the past 12 months.

The 200 participants were then randomly selected from the randomly selected outpatient clinics by the researcher and a trained bilingual (Malay and English) ancillary staff. Among them, 5 patients refused to participate, for no specific reason, and 6 withdrew halfway through filling the questionnaires. The 189 (95%) participants who gave their approval for participation were interviewed on the demographic variables and were then requested to complete the Malay HADS (self-reported) in a private waiting area adjacent to the outpatients' clinics.

Statistical Analysis

Exploratory factor analysis was performed on the complete 14-item HADS. Using the Statistical Product and Service Solutions/Predictive Analytics Software package version 20 (SPSS/PASW-20), a principal component procedure was used to extract the initial factors from the HADS. The eigenvalue criterion was chosen for the number of factors to be extracted, with which factors were retained if they had an eigenvalue ≥1. Two methods of rotation of the factor solution were compared: an orthogonal rotation, using the Varimax procedure, and an oblique rotation, using Promax rotation, which allowed one to observe correlations among the factors. Reliabilities of the HADS and the subscales were tested for internal consistencies using Cronbach's α.

Confirmatory factor analysis was conducted on the original 2 factors and the 3-factors model using the Analysis of Moment Structures (AMOS) version 18 statistical software package. Maximum likelihood test was used for the estimation method, and the integrated 2-factor and 3-factor models were tested for comparison. The following criteria were used to indicate goodness of fit: goodness-of-fit index, normed fit index, and comparative fit index of 0.90 and higher and root mean square error of approximation of 0.08 or lower were used to evaluate the fit of the models.[19]

Measures

Clinical Variables. Information on recent (within 12 months) and previous (before 12 months) (1) cardiac event(s), including myocardial infarction and/or unstable angina, and (2) invasive treatment, including percutaneous coronary intervention and/or coronary artery bypass grafting, was obtained from the medical records of these patients. In addition, information on comorbid conditions such as hypertension, diabetes, and dyslipidemia was also obtained.

Anxiety and Depression. The Malay version of the HADS was used to measure symptoms of anxiety and depression. The scale consists of 14 items that are answered on a 4-point Likert scale (0-3). The score range for both the anxiety and depression subscales is 0 to 21. The HADS score is interpreted as follows: 0 to 7 (normal), 8 to 10 (mild), 11 to 14 (moderate), and 15 to 21 (severe). The HADS has been validated in general, somatic, psychiatric, and cardiac populations and has been shown to be a valid and reliable instrument, with Cronbach's α ranging from .67 to .93 for the 2 subscales.[20] A recent review reconfirms the performance of HADS in assessing symptom severity and caseness in somatic, psychiatric, and primary care patients and the general population, with a cutoff score ≥8.[21] The psychometric properties of the Malay HADS has been found to be satisfactory in local studies, where the Cronbach's α value was reported to be more than .75 among the husbands of breast cancer patients and above .80 for both anxiety and depression subscales in a rural community in peninsular Malaysia.[15,16]

Results

Patient Characteristics for the HADS Analysis

Out of 200 participants, 189 (94.5%) completed the HADS. The patient characteristics, including information on sociodemographic, clinical, and psychosocial variables, are presented in Table 1.

Table 1. Characteristics of Patients with CAD (n = 189).

Variables	Mean (SD)	n (%)
Age (years)	54.57 (11.55)	
Gender		
Male		130 (68.8)
Females		59 (31.2)
Ethnicity		
Malay		126 (66.7)
Chinese		27 (14.3)
Indians		34 (18)
Marital status		
Married/Living together		170 (89.9)
Divorced/Separated/Widow(er)		7 (3.7)
Never married		12 (6.3)
Occupation		
Managers/Professionals		57 (30.2)
Self-employed		17 (9)
Employees		43 (22.8)
Retired/Never employed		72 (38.1)
Smoking status		
Current smokers		24 (12.7)
Former smokers (before last 30 days)		56 (29.6)
Recent cardiac events (within 12 months)		
Myocardial infarction		64 (33.9)
Unstable angina		133 (70.4)
Percutaneous coronary intervention		93 (49.2)
Coronary artery bypass grafting		5(2.6)
Previous cardiac events (before 12 months)		
Myocardial infarction		4 (2.1)
Unstable angina		14 (7.4)
Percutaneous coronary intervention		47 (24.9)
Coronary artery bypass grafting		6 (3.2)
Total duration of illness (years)	7 months (2 years, 4 months)	
Comorbidity		
Hypertension		137 (72.5)
Diabetes mellitus		82 (43.4)
Dyslipidemia		122 (64.6)
Psychosocial variables		
Anxiety	6.13 (4.24)	60 (31.7)
Depression	4.87 (3.13)	41 (21.7)
Anhedonia	2.70 (2.17)	
Psychomotor retardation	2.17 (1.62)	

Abbreviations: CAD, coronary artery disease; SD, standard deviation.

Exploratory Factor Analysis of the HADS

Three eigenvalues were ≥1, which determined the number of factors computed. The 3 factors accounted for 57.5% of the unrotated and rotated variances. Following an orthogonal rotation (varimax), the 3 factors were clinically interpretable by using a loading criterion of 0.40 as a cutoff point. All the anxiety items were compiled into a single anxiety factor (items 1, 3, 5, 7, 9, 11, and 13), with 30.3% of the variance and eigenvalue 4.2. The depression items loaded onto 2

Table 2. Exploratory Factor Analysis of HADS.

	Factor 1 (Anxiety)	Factor 2 (Anhedonia)	Factor 3 (Psychomotor Retardation)
Anxiety (HADS-A)			
1. I feel tense or "wound up"	0.73	0.19	0.12
3. I get a sort of frightened feeling as if something awful is about to happen	0.73	0.24	0.05
5. Worrying thoughts go through my mind	0.78	0.03	0.21
7. I can sit at ease and feel relaxed	0.72	0.26	0.03
9. I get a sort of frightened feeling like "butterflies" in the stomach	0.80	0.20	0.11
11. I feel restless as if I have to be on the move	0.69	0.08	0.10
13. I get sudden feelings of panic	0.75	0.17	0.19
Anhedonia (HADS-D/A)			
2. I still enjoy the things I used to enjoy	0.04	0.83	0.04
4. I can laugh and see the funny side of things	0.30	0.63	0.01
6. I feel cheerful	0.30	0.68	0.10
14. I can enjoy a good book or TV program	0.13	0.56	0.37
Psychomotor retardation (HADS-D/PR)			
8. I feel as if I am slowed down	0.10	0.10	0.74
10. I have lost interest in my appearance	0.06	0.21	0.66
12. I look forward with enjoyment to things	0.39	0.26	0.59
Variance explained (%)	30.3	15.8	11.5
Eigenvalue	4.2	2.2	1.6

Abbreviations: HADS-A, Hospital Anxiety and Depression Scale–Anxiety; HADS-D/A, HADS-Depression/Anhedonia; HADS-D/PR, HADS-Depression/Psychomotor Retardation.

separate factors: anhedonia (items 2, 4, 6, and 14) with 15.8% of the variance, eigenvalue 2.2, and psychomotor retardation (items 8, 10 and 12) with 11.5% of the variance, eigenvalue 1.6 (Table 2).

Because of the low unrotated eigenvalue of 1.2 of the psychomotor retardation factor, an orthogonal rotation was performed with 2 predetermined factors in order to test if the 2-factor model (depression and anxiety subscales) best fit the data. The 2 factors derived from the HADS factor analysis captured 49.0% of the variance (anxiety explaining 30.4% of the variance, eigenvalue 4.3; depression capturing 18.6% of the variance, eigenvalue 2.6; Table 3). However, strikingly, this 2-factor model was less clinically relevant because of the low loading value of the fourth depression item (I feel as if I am slowed down) of 0.23 and unexpected cross-loading of the sixth depression item (I have lost interest in my appearance) on the anxiety factor, with a factor loading of 0.43.

Pearson correlation was used to measure the discriminant validity. According to Farrell,[22] a correlation of .50 is taken as signature of a distinct concept, whereas a correlation of .80 and above may indicate a lack of conceptual distinction. The scores on depression and each depression factor—anhedonia and psychomotor retardation—and anxiety showed a correlation of .35 between the 2 depression factors, a correlation of .47 between anhedonia and anxiety, and a correlation of .39 between psychomotor retardation and anxiety. These results showed that the correlation was below .80, suggesting discriminant validity among the constructs.

Oblique rotation (promax), which takes into account the link between symptoms of anxiety and depression was then performed. The same 3 factors emerged, explaining 57.5% of the variance with the following factor correlations: .30 between the 2 depression subscales, .37 between

Table 3. Exploratory Factor Analysis of HADS With 2 Predetermined Factors.

	Factor 1 (Anxiety)	Factor 2 (Depression)
Anxiety (HADS-A)		
1. I feel tense or "wound up"	0.73	0.22
3. I get a sort of frightened feeling as if something awful is about to happen	0.72	0.25
5. Worrying thoughts go through my mind	0.80	0.12
7. I can sit at ease and feel relaxed	0.71	0.25
9. I get a sort of frightened feeling like "butterflies" in the stomach	0.80	0.23
11. I feel restless as if I have to be on the move	0.69	0.12
13. I get sudden feelings of panic	0.76	0.24
Depression (HADS-D)		
2. I still enjoy the things I used to enjoy	0.01	0.77
4. I can laugh and see the funny side of things	0.27	0.58
6. I feel cheerful	0.28	0.66
8. I feel as if I am slowed down	0.17	0.22[a]
10. I have lost interest in my appearance	0.11	0.47
12. I look forward with enjoyment to things	0.43[b]	0.49
14. I can enjoy a good book or TV program	0.14	0.66
Variance explained (%)	30.4	18.6
Eigenvalue	4.3	2.6

Abbreviations: HADS-A, Hospital Anxiety and Depression Scale–Anxiety; HADS-D, HADS–Depression,
[a]The fourth depression item with low factor loading.
[b]The sixth depression item with cross-loading on factor 1 (anxiety).

Table 4. Confirmatory Factor Analysis of the HADS Showing 2- and 3-Factor Fit Scores.

	Two-Factor Model		Three-Factor Model	
Model Fit Parameters	Original Model	Standardized Model	Original Model	Standardized Model
χ^2 (*df*)	171.02 (76)[a]	134.60 (74)[a]	146.80 (74)[a]	101.30 (71)[b]
RMSEA	0.08	0.07	0.07	0.05
CFI	0.90	0.94	0.92	0.97
NFI	0.83	0.87	0.86	0.90
GFI	0.89	0.92	0.91	0.94

Abbreviations: RMSEA, root mean square error of approximation; CFI, comparative fit index; NFI, normed fit index; GFI, goodness-of-fit index.
[a]χ^2 analysis was statistically significant at $P \leq .001$.
[b]χ^2 analysis was statistically significant at $P \leq .01$.

anxiety and psychomotor retardation, and .46 between the anxiety and anhedonia subscale. A main-component analysis was carried out on the 3 HADS subscales separately. The analysis of each HADS depression subscale resulted in a single factor, which accounted for 52.6% of the variance for anhedonia and 51.5% of the variance for psychomotor retardation. A single factor was also derived from the HADS anxiety subscale analysis, which showed 59.8% variance.

Confirmatory factor analysis of HADS. including the factor models tested and the accompanying fit indices. are shown in Table 4. The model fitness summary indicates that the original 2-factor model, before and after standardization and the 3-factor model before standardization showed χ^2 goodness-of-fit analyses to be statistically significant at $P < .001$. On standardization, both models showed improved results, but the standardized 3-factor model showed a χ^2 goodness-of-fit

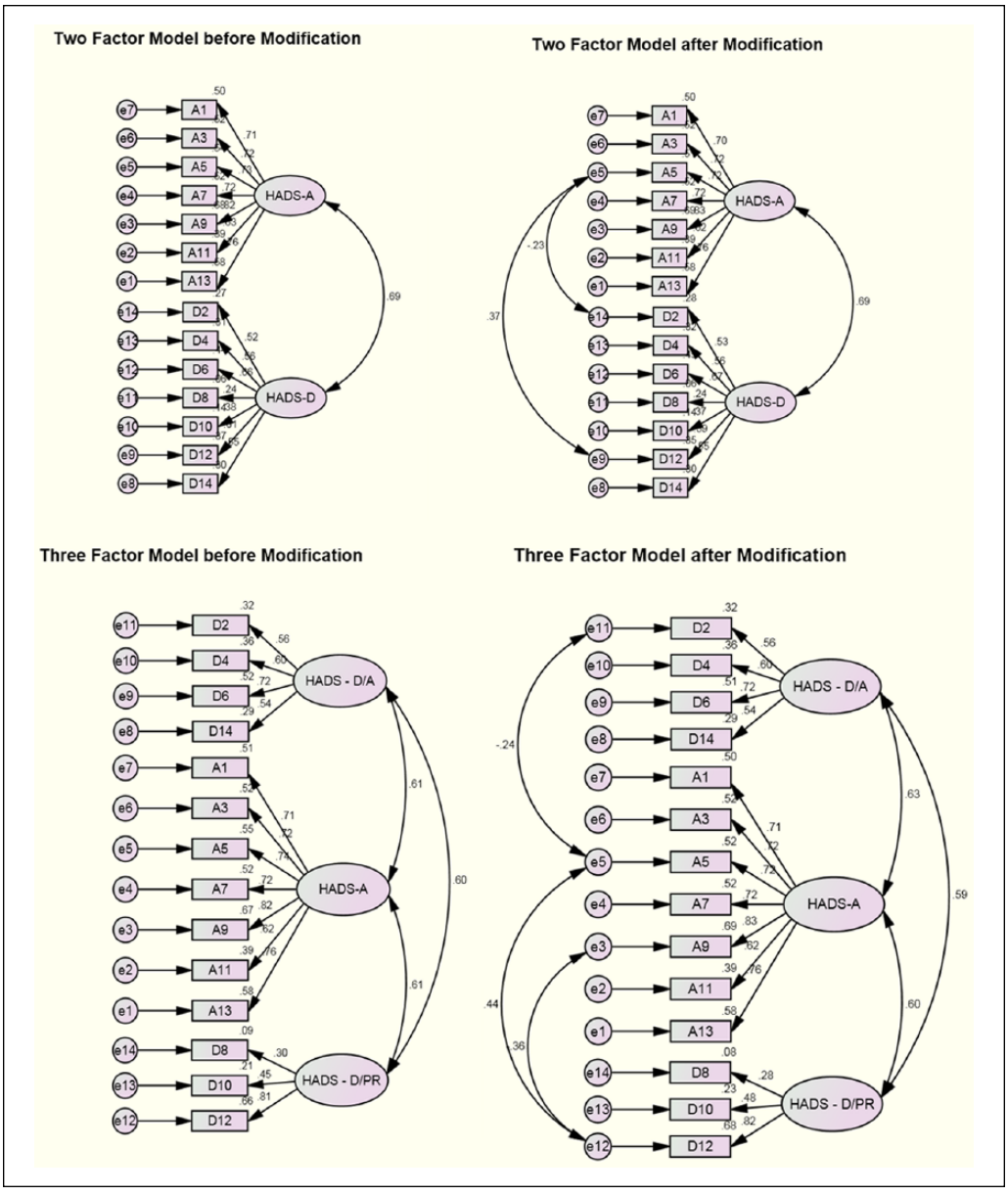

Figure 1. Factor loading patterns for 2- and 3-factor models of HADS.
Abbreviations: HADS-A, Hospital Anxiety and Depression Scale–Anxiety; HADS-D/A, HADS-Depression/Anhedonia; HADS-D/PR, HADS-Depression/Psychomotor Retardation.

analyses to be statistically significant at $P < .01$. The root mean square error of approximation for the original 2-factor model was 8% before standardization but reduced to 7% error after standardization. The 3-factor model showed 7% error before and 5% after standardization. The comparative fit index, normed fit index, and goodness-of-fit index were favorable in the standardized 3-factor model when compared to others. The standardized 3-factor model, thus, offered a significantly better fit to the data than the original 2-factor model of HADS. Figure 1 provides a pictorial representation of the 2- and 3-factor models of HADS and the change observed in the regression scores after standardization. The modification indices were used to find the sets of correlated

errors; the linking of these correlated errors would reduce the error value in the latent variables and provide an improved overall model fit. The linking of error terms for A5 and D2, A5 and D12, and A9 and D12 improved the overall model fit and reduced the error value significantly.

Following the establishment of the 3-factor model of HADS, the mean was computed for the Malay HADS (Table 1): anxiety ($M = 6.13$; standard deviation [SD] = 4.24), depression ($M = 4.87$; SD = 3.13), anhedonia (M = 2.70; SD = 2.17), and psychomotor retardation ($M = 2.17$; SD = 1.62). The reliability (Cronbach's α) estimate for the 14 items of HADS was .86. The Cronbach's α values for the subscales were .89 for anxiety, .69 for the original (7 items) depression subscale, .70 for anhedonia, and .51 for psychomotor retardation.

Discussion

In the present study, the HADS was tested on a Malaysian sample of CAD patients at National Heart Institute (outpatients). This was the one of the first few studies of its kind administered in Malaysia to examine the dimensional structure of HADS and to evaluate the fitness of the model against the 2- and 3-factor models for the HADS. The HADS appears to have high internal consistency: Cronbach's α value for the total HADS was .86.

The Cronbach's α value for the third factor of HADS—that is, the psychomotor retardation subscale—was low (.51). For the third factor of HADS, the present study found 3 statements to be closely linked to psychomotor retardation. In comparison to other established scales that measure several domains within this broad construct, the 3 items from the original HADS-D scale were clearly insufficient.[23,24] The small number of items explained the lower internal consistency estimates for the subscale.

Exploratory factor analysis and confirmatory factor analysis of the internal factor structure of HADS provided evidence for a 3-dimensional structure consisting of anxiety, anhedonia, and psychomotor retardation. This structure was also supported by other studies that assessed the factor structure of HADS with data from a cardiac sample population.[13,14] However, our results are in contrast with previous studies that have been reported—that is, single dimensionality in a clinical population, including patients with MI and stroke[25] and a study including 894 patients with cardiovascular disease[10]; and 2-dimensional structure with the Norwegian version of the HADS in 484 elderly patients,[26] in 512 Italian cancer patients, and in a large nonclinical population (n = 5857) in Hong Kong.[27,28]

These differences can be explained as follows: (1) the type of population: persons with CAD with a mean age of 54.57 years, the ethnic diversity evident in the Malaysian population, and the cross-cultural context, which could explain their different experiences resulting in a wider diversity of anxiety and depressive symptoms; (2) the cardiac status of the patients: the duration of illness, recent and previous major cardiac events (MI and UA), recent and previous invasive interventions (percutaneous coronary intervention and coronary artery bypass grafting), and the comorbidity of other somatic disorders may all determine the psychosocial status of the patients and presentation; (3) the factor loadings of items: the fourth, fifth, and sixth depression items (item 8, 10, and 12) clearly identified with factor 3—namely, psychomotor retardation—in the 3-factor model. Among these 3 items, the fourth depression item (item 8) loaded very low on factor 2 (depression) in the predetermined 2-factor model, and the sixth depression item (item 12) showed cross-loading on factor 1 (anxiety) in the same. The low factor loading of the fourth depression item (I feel as if I am slowed down) and the unexpected cross-loading of the sixth depression item (I look forward with enjoyment to things) in the case of the predetermined 2-factor model indicated that a 2-factor solution was inadequate to explain the diversity in the experience of anxiety and depressive symptoms. A 3-factor model was found to be best suited for HADS with reference to these data.

The results were closely linked to a 3-factor solution of HADS demonstrated by Dunbar et al,[29] who found that the tripartite theory of anxiety and depression was the best fit for their data. The most recent systematic review and a meta–confirmatory factor analysis have provided evidence that among the validation studies in the cardiac population, 50% have supported a 3-factor model irrespective of the item distribution.[8,9] The Malaysian version of HADS seems to be 3 dimensional; thus, it could be considered that the 3 subscales of the HADS measure anxiety, anhedonia, and psychomotor retardation independently. The correlations among the 3 subscales of HADS were low, from .35 to .47, which suggests that these subscales measure 3 distinct concepts. The mean scores of the original 2 subscales were generally low in accordance to other local studies that used HADS to measure anxiety and depression in a different clinical population[15,30] but are in contrast to the study by Yusoff et al,[16] where the mean scores were equal to or greater than 10 for both anxiety and depression among husbands of breast cancer patients.

Conclusion

This study has provided the dimensional structure for a very popularly used instrument to measure anxiety and depression in the Malaysian context. Furthermore, the contradictory evidence demonstrated here directed the researchers to reevaluate the internal structure of the instrument for the respective populations before drawing any conclusions based on the predetermined 2-factor model. But the authors acknowledge that this study has some limitations—in particular, the modest sample size and the absence of a comparison to a gold standard, such as a structured clinical interview to assess for anxiety and depressive disorders. The low mean scores on the subscales indicate the importance of establishing optimal cutoff scores for the subscales in determining caseness before applying it in the Malaysian context. Further research to determine the generalizability and consistency for the tridimensional structure of the HADS in other clinical groups in Malaysia is recommended. The authors would recommend methodological research designs encompassing (1) a larger sample size that would include diverse clinical and nonclinical groups, (2) test-retest reliability analysis to confirm the stability of the scale over time, and (3) the use of other robust scales on anxiety, depression, anhedonia, and psychomotor retardation that cover broader domains under each construct to help establish the construct validity of the HADS scales and subscales.

Authors' Note

The research material can be accessed on request from the corresponding author.

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