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The factor structure of the Hospital Anxiety and Depression Scale in older individuals with acquired amputations: a comparison of four models using confirmatory factor analysis

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SUMMARY

Background There has been little attention to the underlying dimensional structure of the Hospital Anxiety and Depression Scale (HADS) in analyses involving individuals older than 65 years of age despite its routine application in this age group.

Methods The factor structure of the HADS was investigated using a sample of 680 veterans with limb amputations who were aged at least 66 years (mean 79.0, SD 5.02; range 66–92). Four models were specified and estimated using Lisrel 8.54. Model 1 specified a uni-dimensional structure. Model 2 specified a correlated two-factor model. Model 3 specified a correlated two-factor model but with cross factor loadings for item 7. Model 4 specified a three-factor model after Clark and Watson's (1991) tripartite theory of anxiety and depression.

Results Models 2, 3 and 4 were found to adequately fit the data. However, on balance, model 4 was found to be a better explanation of the data than the alternative specifications.

Conclusions The results indicate that factor models for the HADS developed in younger samples are replicable with older adults, thus supporting the suggestion that the HADS structure is invariant for age. However, considering the composition of the current sample, i.e. veterans with limb amputations, further research is necessary to determine whether these findings are generalisable to the wider population of older adults. Copyright © 2005 John Wiley & Sons, Ltd.

KEY WORDS — Hospital Anxiety and Depression Scale; confirmatory factor analysis; older adults

INTRODUCTION

The Hospital Anxiety and Depression Scale (HADS: Zigmond and Snaith, 1983) is extensively used as both a clinical and a research tool (see Herrmann, 1997; Bjelland *et al.*, 2002, for reviews). An appealing attribute of the HADS relates to the exclusion of somatic symptoms of anxiety and depression (such as dizziness, headaches, and insomnia) from the instrument because of their potential endorsement due to physical rather than psychological states. The HADS was originally developed as a brief assessment of anxiety and depression for use with hospital outpatients aged between 16- and 65-years-old (Zigmond and Snaith, 1983). However, its application routinely extends beyond the intended target age group (e.g. Wands *et al.*, 1990; Biggam and Power, 1999; Holtom and Barraclough, 2000; Roberts *et al.*, 2001; Thompson, 2001; Watts *et al.*, 2002; Hawley, 2003; Lintz *et al.*, 2003).

The widespread use of the scale underscores the theoretical and practical importance of investigating its psychometric properties. Nonetheless, there has been little attention to the underlying dimensional structure of the HADS in analyses involving indivi-

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duals younger than 16 years of age or older than 65 years. Indeed, despite the suggestion that depression and anxiety may be phenomenologically different in later life (e.g. Georgotas, 1983; Shapiro *et al.*, 1999) thus limiting the generalisability of models developed in younger samples to cases involving older individuals (Meeks *et al.*, 2002), to our knowledge, just one study (Spinhoven *et al*., 1997) has reported investigation of the dimensionality of the HADS in a sample exclusively comprised of respondents aged 66 years or older. This study conducted by Spinhoven *et al.* (1997) implemented exploratory principal components analysis to examine the HADS factor structure among 3293 general population Dutch participants aged 66 years or older. Their analysis revealed a bi-dimensional factor structure corresponding to Zigmond and Snaith's (1983) original two-factor formulation, suggesting that the psychometric properties of the HADS are invariant for age.

In order to further understanding of the psychometric properties of the HADS, the current study compares four alternative models of the HADS structure suggested in the literature, using data from individuals with acquired limb amputations aged at least 66 years of age. Through implementation of *confirmatory* rather than *exploratory* analysis it overcomes a limitation of much of the previous research on the HADS factor structure which has, with few notable exceptions (Lewis, 1991; Dunbar *et al.*, 2000; Johnston *et al.*, 2000; Roberts *et al.*, 2001; Caci *et al.*, 2003; McCue *et al.*, 2003), relied on exploratory factor analytic techniques.

The first model specified hypothesised a single psychological distress factor underlying the HADS items. This model is consistent with the findings of Razavi *et al.* (1990) who used the HADS in a study of an oncology in-patient population and concluded that the HADS was a uni-dimensional measure of emotional distress. This model is inconsistent with the theoretical development of the scale (Snaith, 1991).

The second model hypothesised an oblique two-factor model underlying the HADS items. This model specified two correlated factors with the Depression items (items 2, 4, 6, 8, 10, 12, and 14) loading on one factor and the Anxiety items (items 1, 3, 5, 7, 9, 11, and 13) loading on the other. This represents the original theoretical basis of the scale (Zigmond and Snaith, 1983). A recent review (Bjelland *et al.*, 2002) of the literature examining the dimensional structure of the HADS revealed that most of the studies identified (11/19) demonstrated that the HADS performs as a bidimensional instrument, albeit with factors not entirely consistent with the Anxiety and Depression subscales. The most consistent finding was that item 7 ('I can sit at ease and feel relaxed', an item on the Anxiety subscale) did not load uniquely on the Anxiety factor (Bjelland *et al.*, 2002). Therefore, model 3 allowed item 7 ('I can sit at ease and feel relaxed') to load onto both the Anxiety and Depression factors. This structure was suggested by Moorey *et al.* (1991) following analyses based on data from 575 consecutive cancer patients. Similar findings have also been reported elsewhere (Bedford *et al.*, 1997; Dagnan *et al.*, 2000; Herrmann, 1997; Savard *et al.*, 1998).

The fourth model tested hypothesised a three-factor model (Dunbar *et al.*, 2000) derived from the tripartite theory of anxiety and depression (Clark and Watson, 1991). The tripartite theory broadly distinguishes between aspects of positive affect, negative affect and physiological hyperarousal, with different constellations of these variables constituting depressive and anxious experiences, and has found support among adult and child samples, as well as across different cultural groups (e.g. Dunbar *et al.*, 2000; Kiernan *et al.*, 2001; McCue *et al.*, 2003). A question that remains, however, is whether this structure is invariant for age (Meeks *et al.*, 2002). The tripartite model tested here specified three correlated factors with the seven Depression items (items 2, 4, 6, 8, 10, 12, and 14) loading onto one factor representing Anhedonic Depression, while four of the HADS-Anxiety items (items 1, 5, 7 and 11) load onto the second factor representing general distress or 'Negative Affectivity' and the remaining three HADS-Anxiety items (items 3, 9, and 13) load onto the third factor representing Autonomic Anxiety. This model of the HADS structure has also been supported by McCue *et al.* (2003).

Although the HADS is a widely used assessment of affective disorder in general medical settings (Herrmann, 1997), its psychometric properties have not been adequately delineated within an elderly sample, a context in which the need for such an assessment will surely increase. Furthermore, the present sample, i.e. individuals with acquired amputations, is one where there is considerable controversy regarding the incidence of affective reactions (Desmond and MacLachlan, 2004), and where there have been few explorations of the psychometric qualities of such screening instruments.

METHOD

Participants

The HADS was completed by 680 members of the British Limbless Ex-Service Men's Association

(BLESMA), who were aged at least 66 years old, as part of a larger postal survey of psychosocial adaptation to amputation. The average age of respondents was 79 years (SD 5.02) ranging from 66 to 92 years. The majority of respondents were male (96.9%) and most had sustained amputation(s) of a lower extremity (82.9%, $n = 563$).

Materials and procedure

The Hospital Anxiety and Depression Scale (HADS: Zigmond and Snaith, 1983) is a 14-item scale designed as a brief assessment of both anxiety and depression in non-psychiatric populations (Herrmann, 1997). Items are answered on a four-point Likert scale (range 0 to 3). The anxiety and depression subscales each comprise seven items that are summed to give subscale scores ranging from 0 to 21, with higher scores indicating greater levels of anxiety and depression.

A series of confirmatory factor models were specified and estimated using Lisrel 8.54 (Joreskog and Sorbom, 2003a). A covariance matrix and an asymptotic weight matrix were computed using PRELIS 2.54 (Joreskog and Sorbom, 2003b) and the parameters were estimated using maximum likelihood. In keeping with common practice, alternative models were evaluated using a variety of fit indices: the Satorra-Bentler scaled chi-square (Satorra and Bentler, 1988), the root-mean-square error of approximation (RMSEA) with 90% confidence intervals (CI), the standardized root-mean residual (SRMR) and the Comparative Fit Index (CFI: Bentler, 1988). The RMSEA is a measure of the discrepancy of fit, essentially a measure of lack of fit per degree of freedom (MacCallum, 1995). Hu and Bentler (1999) propose that RMSEA values of close to 0.06 are optimal while values up to 0.08 are acceptable. The SRMR is a standardised summary of the average covariance residuals. When the model fit is perfect SRMR is zero. Hu and Bentler (1999) suggest that an SRMR value of close to 0.08 is indicative of relatively good fit. The CFI is an incremental fit index. Models with CFI values close to 0.95 are viewed as fitting the data well (Hu and Bentler, 1999).

The Expected Cross Validation Index (ECVI; Browne and Cudeck, 1989) and the Akaike Information Criterion (AIC; Akaike, 1987) were used to assess the comparative fit of alternative models, with the smallest values being indicative of the best fitting model.

RESULTS

The fit indices for the factor models tested are presented in Table 1. The Satorra-Bentler chi square statistic was significant for each of the models ($p < 0.01$) indicating that a significant proportion of the variance was unexplained by each model. However, this should not necessarily lead to model rejection, as 'trivial' variations in fit, particularly with large sample sizes can easily produce a significant and sizeable χ^2 statistic (Bollen and Long, 1993). The reported values of RMSEA and SRMR for models 2, 3 and 4 are indicative of acceptable fit. Furthermore, for each of these models the CFI value exceeds the cut-off value of 0.95 also indicating acceptable fit for each of the models. Comparison of the ECVI values for the Zigmond and Snaith (1983) and Moorey *et al.* (1991) models (ECVI values 0.40 and 0.38) reveals similar values for each and a slightly lower value for the three oblique factors model (ECVI = 0.033). Model 4 also had the lowest AIC value and inspection of the 90% CI for the RMSEA reveals that the upper bound of the interval is less than the RMSEA estimates for each of the other models. Therefore, model 4, based on Clark and Watson's (1991) tripartite theory is considered to be the best explanation of the data. The factor loadings are presented in Table 2. All loadings were statistically significant ($p < 0.05$). The

Table 1. Goodness of fit indicators for the three models tested

Model	S-B χ^2 (d.f.)	RMSEA (90% CI)	SRMR	CFI	AIC	ECVI
(1) Razavi *et al.* (1990)	630.93 (77)	0.102 (0.095; 0.11)	0.066	0.93	686.93	0.99
(2) Zigmond and Snaith (1983)	213.82 (76)	0.052 (0.044; 0.060)	0.044	0.98	271.82	0.40
(3) Moorey *et al.* (1991)	204.99 (75)	0.051 (0.042; 0.058)	0.041	0.98	264.99	0.38
(4) Dunbar *et al.* (2000)*	166.50 (74)	0.043 (0.034; 0.050)	0.039	0.98	228.50	0.033

Note: RMSEA = root mean square error of approximation; SRMR = standardised root mean square residual; CFI = comparative fit index; ACI = Akaike information criteria; ECVI = expected cross validation index.
*This model is premised on Clark and Watson's (1991) tripartite theory of anxiety and depression.

Table 2. Factor loadings for the Confirmatory Factor Analysis of the Hospital Anxiety and Depression Scale (Model 4)

Item	Negative Affectivity	Autonomic Anxiety	Anhedonic Depression
1. I feel tense or 'wound up'	0.62	*	*
2. I still enjoy the things I used to enjoy	*	*	0.57
3. I get a sort of frightened feeling as if something awful about to happen	*	0.72	*
4. I can laugh and see the funny side of things	*	*	0.56
5. Worrying thoughts go through my mind	0.72	*	*
6. I feel cheerful	*	*	0.50
7. I can sit at ease and feel relaxed	0.39	*	*
8. I feel as if I am slowed down	*	*	0.38
9. I get a sort of frightened feeling like 'butterflies' in the stomach	*	0.58	*
10. I have lost interest in my appearance	*	*	0.33
11. I feel restless as if I have to be on the move	0.43	*	*
12. I look forward with enjoyment to things	*	*	0.64
13. I get sudden feelings of panic	*	0.67	*
14. I can enjoy a good book or TV programme	*	*	0.34

*Parameters constrained to zero in the model.

Table 3. Factor correlation matrix

	1	2
1. Negative Affectivity		
2. Autonomic Anxiety	0.88	
3. Anhedonic Depression	0.72	0.65

correlations between the factors are illustrated in Table 3.

DISCUSSION

The aim of the present study was to examine the factor structure of the HADS in a sample of older veterans with limb amputations and thus to investigate the generalisability of HADS factor structures developed in younger samples to older adults. This is the first study to report a confirmatory factor analytic approach to investigation of the dimensional structure of the HADS with data from participants aged at least 66 years old.

Of the four models evaluated, a three factor model (Dunbar *et al.*, 2000) based on Clark and Watson's (1991) tripartite theory of anxiety and depression provided the best description of the data. The factor loadings for the items (Table 2) show that they are adequate indicators of their respective factors: loadings on the Anhedonic Depression factor range from 0.33 to 0.64, loadings on the Autonomic Anxiety factor range from 0.58 to 0.72 and loadings on the Negative Affectivity factor range from 0.39 to 0.72. The intercorrelations between the factors indicate that they share a considerable degree of variation. This is not surprising given the known overlap between the constructs of anxiety and depression. Assuming the psychometric integrity of the three factors as separate indices of Anhedonic Depression, Autonomic Anxiety and Negative Affectivity future investigation of the possible clinical applications of these factors is necessitated. Replication is recommended to further verify the consistency, stability and validity of the factors and to explore their relative predictive contributions to a variety of clinical outcomes such as health-related quality of life, psychiatric morbidity and mortality.

Nonetheless, while the tripartite model was the best fitting of a series of alternative specifications it must be noted that both of the two-factor models specified also met the criteria for good fit. Indeed on the basis of parsimony Model 2, which has fewest parameters and which is consistent with the scales theoretical development, may be considered preferable to the three-factor model. The separation of anxiety and depression confirmed here supports the use of the two-factor model in samples comprised of individuals aged 66 years or older, thus permitting comparative conclusions regarding similarities and differences between older and younger samples.

A notable limitation of the current study relates to the high preponderance of male respondents in the sample. Research is necessary to determine whether this structure is invariant for older females. Furthermore, additional research is necessary to determine whether the findings reported here are generalisable to the wider population of older adults who have not sustained limb amputations.

In conclusion, the replicability of the dimensional structures of the HADS, originally derived in younger samples, in the current sample comprised of individuals over 65 years of age supports Spinhoven *et al.*'s (1997) assertion that the factor structure of the HADS is invariant for age. The potential clinical utility of the three-factor solution of the HADS in an elderly population requires further investigation.

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