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The Hospital Anxiety and Depression Scale: A meta confirmatory factor analysis

Sam Norton [a,*], Theodore Cosco [b], Frank Doyle [c], John Done [d], Amanda Sacker [e]

[a] *Psychology Department, Institute of Psychiatry, King's College London, UK*
[b] *Department of Public Health & Primary Care, Institute of Public Health, University of Cambridge, UK*
[c] *Division of Population Health Sciences, Royal College of Surgeons in Ireland, Ireland*
[d] *School of Psychology, University of Hertfordshire, UK*
[e] *Institute for Social & Economic Research, University of Essex, UK*

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ABSTRACT

Objective: To systematically evaluate the latent structure of the Hospital Anxiety and Depression Scale (HADS) through reanalysis of previous studies and meta confirmatory factor analysis (CFA).
Method: Data from 28 samples were obtained from published studies concerning the latent structure of the HADS. Ten models were considered, including eight previously identified models and two bifactor models. The fit of each model was assessed separately in each sample and by meta CFA. Meta CFA was conducted using all samples and using subgroups consisting of community samples, cardiovascular disease samples and samples from studies administering the English language version of the HADS.
Results: A bifactor model including all items loading onto a general distress factor and two orthogonal anxiety and depression group factors provided the best fit for the majority of samples. Meta CFA provided further support for the bifactor model with two group factors. This was the case using all samples, as well as all subgroup analyses. The general distress factor explained 73% of the covariance between items, with the (autonomic) anxiety and (anhedonic) depression factors explaining 11% and 16%, respectively.
Conclusion: A bifactor structure provides the most acceptable empirical explanation for the HADS correlation structure. Due to the presence of a strong general factor, the HADS does not provide good separation between symptoms of anxiety and depression. We recommend it is best used as a measure of general distress.

Introduction

The Hospital Anxiety and Depression Scale (HADS) is a widely used measure of psychological distress designed for use in non-psychiatric patient populations [1]. Numerous studies examining its construct validity using exploratory (EFA) and confirmatory (CFA) factor analysis and item response theory (IRT) methods in clinical and non-clinical populations have been published. The findings of these studies have been summarized in several reviews [2–5]. However, disagreement about the underlying dimensionality of the HADS remains and concerns regarding the apparent lack of consistency between studies have led to calls for the abandonment of the HADS [6]. Inconsistency is likely to be partially due to the application of different methodologies between studies.

As we have previously suggested, the reason for the apparent inconsistency between methods may also be due to the presence of a general distress factor [7]. Two alternative hierarchical models — higher-order and bifactor — have been proposed to represent the structure of scales with a general factor. The most widely supported three factor structure in the Cosco et al. [5] review of the HADS is a higher-order model, proposed by Dunbar and colleagues [8], based on the Tripartite theory of anxiety and depression [9]. The Tripartite theory posits that a higher-order general somatopsychic distress trait, negative affectivity (NA), accounts for the observed association between anxiety and depression. The Tripartite theory stipulates that the specific component of anxiety is autonomic arousal marked by somatic symptoms, and that the main component of depression is anhedonia characterized by low positive affect — a loss of pleasure and interest in life and inability to feel please even when engaging in pleasurable activities [10]. As was noted by Dunbar and colleagues [8], several of the HADS items fit these constructs well.

The crucial difference between higher-order and bifactor models lies in the ability to separate the variance accounted for by the general factor from the other factors. Higher-order models are composed of first-order factors (e.g. autonomic arousal, anhedonia) onto which the observed items load and higher-order factors (e.g. distress/NA) onto which the first-order factors load. This superordinate higher-order factor is assumed to cause the correlation between the observed items loading on different scales. Where the higher-order factor explains a large proportion of the variance in the lower-order factors (i.e. the first-order factors are highly correlated) the use of the total score, calculated by

* Corresponding author at: Psychology Department, Institute of Psychiatry, King's College London, 5th Floor Bermondsey Wing, Guy's Hospital Campus, London Bridge, London, SE1 9RT, UK. Tel.: +44 20 7188 0198.
E-mail address: sam.norton@kcl.ac.uk (S. Norton).

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summing across the subscales, is a valid measure of the higher-order factor. In this situation it is difficult to disentangle the separate effects of the first-order factors from any higher-order factor. For example, it is unclear whether the association between depression, anxiety and anger with cardiovascular disease is due to specific components of these overlapping affective constructs or by some general negative affective disposition [11].

Bifactor models consist of a broad general factor, such as distress or depression, onto which all observed items load and conceptually narrower group factors onto which observed items with related content load [12]. The essential difference is that the general factor is at the same level conceptually as the group factors, thus allowing for the parsing of the variance explained by the general and group factors. This enables the evaluation of the specific components independent contribution to prediction, of say incident cardiovascular disease, controlling for the general factor. As with the higher-order model, where there is a strong general factor a combined overall score is a valid measure of the general factor. A bifactor version of the tripartite model would consist of a general factor and group factors relating to autonomic arousal and anhedonia, and would allow for the separation of item variance into the variance explained by the general factor and each of the group factors. Also known as *group-factor* models, bifactor models were initially developed in intelligence research [13] but have since been applied to the study of psychological distress [14–18]. A bifactor structure has not yet been considered in relation to the HADS.

The present study involves a re-analysis and meta-analysis of previously published studies considering the latent structure of the HADS. The goal is to examine whether uncertainty regarding the latent structure of the HADS is due to differences between the methods and samples of earlier studies. Some of the ambiguity in previous studies may have arisen from the methods used, both in terms of the overarching method (EFA, CFA and IRT) and also differences in the structures compared within CFA studies. A re-analysis will enable the comparison of all previously identified 'best fitting' latent structures using CFA, thus minimizing any ambiguity that might have arisen from the application of different methods. As well as the 'best fitting' structures, the bifactor structure will also be considered since this has shown optimal fit for similar instruments. The meta-analysis involves pooling inter-item correlation matrices from samples used in previous studies, which are then subjected to CFA. Subgroup analysis considering samples drawn from specific populations (community samples, cardiovascular disease samples) and also only studies using English translations of the HADS will further allow for the consideration of whether ambiguity may be due to different latent structures across populations.

Methods

Sample

Data were drawn from studies selected for inclusion in a recent systematic review of the HADS [5], which included studies published between 2002 and 2010. Where the inter-item correlation matrices were not included in the original publication, the corresponding author was contacted by email. Where no response was received from the corresponding author within 4 weeks, a follow-up email was sent. If the corresponding author's email address was no longer active, attempts were made to identify a current email address via their affiliated institution or by contacting other authors.

In addition, seven studies meeting the recruitment criteria for the Cosco et al. review but published since the literature search was conducted were also included [19–26]. Again, the corresponding author was contacted if the inter-item correlation matrices were not included in the publication.

In total, we attempted to obtain summary data relating to 54 published studies concerning the latent structure of the HADS (Fig. 1). We failed to obtain any response in relation to 26 studies and the corresponding author was not able to provide the required information for a further 8 studies. Data concerning 21,820 individuals across 21 studies with 28 unique samples were obtained. Information regarding the 21 studies that provided data is given in Table 1.

Hospital Anxiety and Depression Scale

The HADS is a self-administered scale consisting of 14 items split across anxiety and depression subscales, each with a four-point ordinal response format. To reduce the risk of a false positive bias, the scale does not assess symptoms of anxiety and depression related to physical disorder, such as fatigue and insomnia. The HADS has been shown to have adequate diagnostic accuracy. A recent meta-analysis of diagnostic test accuracy studies reported that, using a score of 8 or more as the cut-off, the HADS depression scale gave 82% sensitivity and 74% specificity for detecting major depressive disorder; and the anxiety scale gave 78% sensitivity and 74% specificity for detecting generalised anxiety disorder [27].

Statistical analysis

A total of eight different factor structures have been suggested in the literature as providing the '*best fit*' to the HADS item structure (1 unidimensional distress, 2 bidimensional consisting anxiety and depression, and 5 tridimensional consisting of anxiety depression and restlessness/agitation/negative-affectivity) [1,8,28–32]. Furthermore, two bifactor structures were considered since this model has been shown to provide the best fit in other studies jointly assessing symptoms of anxiety and depression [17,18]. The first bifactor model included two group-factors consisting of the anxiety and depression items, respectively. The second bifactor model consisted of three group-factors — depression, anxiety and restlessness. The restlessness factor involved the items common to the restlessness/agitation/negative-affectivity factors of the previously identified three factor models with related meaning — A7 "*I can sit at ease and feel relaxed*", A11 "*I feel restless as if I have to be on the move*", and D14 "*I can enjoy a good book or radio or TV programme*". In total, ten different structures were considered. The pattern of item loadings on each factor is provided in Fig. 2.

Higher-order models with two or three lower-order factors may only be estimated using equality constraints on the loadings of the first-order factors onto the second-order factor [33,34]. The resulting model is mathematically equivalent to a model without the higher-order and allowing the lower-order factors to correlate [34]. Therefore, we can consider the comparison of the models nine and ten, the two bifactor models, to models two through seven as a direct comparison of a bifactor versus a higher-order structure. It is also important to note that the higher-order model can be considered nested within the bifactor model [34], with the direct effects of the general factor on the observed items constrained to zero. Standard likelihood ratio tests can be applied to assess whether this restriction is appropriate only when four or more lower-order factors are present, hence its omission from the current analysis.

Recently, it has been suggested that the inclusion of an item wording method factor may further increase model fit in CFA of the HADS [25,26]. Therefore, each model was also estimated with the inclusion of a method factor to account for the positive wording of items A7, D2, D4, D6, D12, D14.

Initially each of the structures was considered in relation to the item correlation matrices for each of the 28 separate samples. The fit statistics for each model in each of the samples, along with the sample correlation matrices, is provided in Appendix A.1. Goodness-of-fit was assessed using the χ^2 test of exact fit, the root mean squared error of approximation (RMSEA), standardized root mean squared residual (SRMR), Comparative Fit Index (CFI), and the Tucker–Lewis Index (TLI). Values of