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Revisiting the dimensionality of the Hospital Anxiety and Depression Scale in an international sample of patients with ischaemic heart disease

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ABSTRACT

Objective: Recently controversy has surrounded the dimensionality of the Hospital Anxiety and Depression Scale (HADS). We assessed the dimensionality of the HADS in a large international sample of patients with ischaemic heart disease (IHD) using confirmatory factor analysis (CFA). The analysis of an international sample enabled the current study to broaden knowledge gained from existing studies with small, regional samples.
Methods: Data from the HeartQoL study of patients with IHD (n = 6241, 22 countries speaking 15 languages) were analyzed using CFA.
Results: CFA indicated a hierarchical bifactor solution, with mostly strong item loadings on a general factor (explaining 73% of the variance), and weak to very weak loadings on orthogonal depression (16%) and anxiety (11%) subscales. The bifactor model fits the data significantly better than both the original bidimensional model and Dunbar's higher-order three-factor model.
Conclusion: These results, from a large international sample of patients with IHD, suggest that the HADS scale is dominated by a single general distress factor. Although the best CFA model fit was a hierarchical bifactor solution, the subscales had weak item loadings, providing little psychometric evidence of the ability of the HADS to differentiate anxiety and depressive symptoms. It is argued that clinicians and researchers working with patients with IHD should abandon the HADS and use alternative measures of depression and anxiety.

Introduction

Studies involving post-myocardial infarction patients have shown that 20% have major depression [1], while Frasure-Smith et al. have established a prevalence of 5.3% for Generalized Anxiety Disorder (GAD) in patients with stable coronary artery disease [2]. The relevance of the presence of anxiety and depression in cardiac patients has repeatedly been shown in systematic reviews; both are associated with higher death rates and poorer prognoses in general in cardiovascular disease [3–5].

Zigmond and Snaith originally developed the Hospital Anxiety and Depression Scale (HADS) in order to assess anxiety and depression in a medical setting without potential confounding from physical symptoms [6]. It has since been used prolifically in clinical and research settings [7]. More recently, however, the HADS has been shown to have poor content validity. The exclusion of somatic items, use of colloquial British expressions (such as "'butterflies' in the stomach"), and emphasis on anhedonia mean that the assessed symptoms do not accurately reflect the diagnostic criteria for major depressive disorder or GAD [8–10]. Doyle et al. found that only 4 of 13 diagnostic symptoms for major depression were assessed by the depression subscale [9]. Maters et al. further demonstrated that the colloquial British expressions used mean, that translation of the HADS is problematic, and that several different versions of the HADS can exist in one language leading to interpretation issues [10].

Previous reviews of the literature support the psychometric validity of the HADS as a bidimensional questionnaire for assessing separate factors of anxiety and depression [7,11], and a recent meta-analysis demonstrated adequate case-finding ability for the depression and anxiety subscales [12]. However, controversy has arisen regarding the scale's purported bidimensional structure and the ability of the HADS to distinguish anxiety and depression in both cardiac and other populations.

Cosco et al. recently reviewed analyses of the structure of the HADS and found that only half of the included studies reported two-factor structures [13]. Even among these, the majority featured anomalous factor loadings, for example, depression items loading on the anxiety factor. The authors found heterogeneous factor structures within and across a variety of sample populations including cardiac, cancer and non-clinical. They concluded that the evidence to support the originally

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proposed bidimensional anxiety-depression structure is insufficient [13]. As a result, Coyne and van Sonderen called for the abandonment of the HADS as a scale for measuring anxiety and depression [14].

However, Norton et al. suggested that the presence of an overarching general distress factor may explain the inconsistent results regarding the latent structure of the HADS, and pointed to two alternative hierarchical models (higher-order and bifactor) which are said to represent hierarchical dimensionality structures [15]. The higher-order model, proposed by Dunbar et al. [16], is based on the Tripartite theory of anxiety and depression [17] and is currently the most-widely supported three-factor structure [13]. Tripartite theory posits anxiety and depression as lower-level constructs in a tripartite structure [18], with a higher-order general distress factor termed Negative Affectivity (NA) [17]. Norton et al. also suggested bifactor models involving a general factor, such as distress, upon which all items load, and more specific group factors upon which related items load. In contrast to higher-order models, the general factor is at the same level as the group factors, and as a result the variance explained by the general factor can be separated from the other factors [19].

Norton et al. went on to explore 10 alternative models for the HADS, including Dunbar's higher-order model [16] and two bifactor models, using meta-confirmatory factor analysis. This demonstrated that a bifactor structure (one general factor and two group factors) consisting mostly of a general distress factor, which accounted for over 70% of the variance, provided the best solution [19]. This was true across community and cardiovascular disease samples and various language groups. The bifactor model provided a more optimal solution than any previously considered structure [19]. Norton et al. concluded that these results indicate that the HADS taps into autonomic arousal and anhedonia as originally intended but is saturated by the presence of strong general factor [19].

Anxiety and depression are frequently comorbid conditions [20,21], and share symptoms [22], making them difficult to distinguish. It may be that the strong general factor found by Norton et al. [19] is a product of the strongly connected symptoms of anxiety and depression in accordance with the network model of psychiatric symptoms [23].

Although Norton et al. used multiple samples and papers from different countries, their study largely used a meta-analysis approach relying on summary statistics [19]. Notably, 61% of published studies from the Cosco et al. review [13] were omitted due to inability to obtain summary data, and this may have biased the findings.

The aim of this paper is to assess the dimensionality of the HADS in a large, international sample of patients with ischaemic heart disease (IHD) by employing CFA to test the validity of the originally proposed bidimensional structure as well as two hierarchical models: Dunbar's higher-order model [16] and the bifactor model [19].

Methods

Participants

Participants for this analysis were drawn from the HeartQoL Project [24] The objective of the HeartQoL Project was the development of a new health-related quality of life scale specific to IHD [24]. Patients with IHD (either angina, myocardial infarction or ischaemic heart failure) across 5 regions (Eastern, Southern, and Western European regions, Scandinavia and an English-speaking region including the UK, Ireland, Australia, Canada and the USA) were enrolled in the HeartQoL Project between 2002 and 2010. In the cross-sectional survey phase, data on various patient reported outcome measures (including the HADS) were collected across 54 sites in 22 countries where 15 languages (Norwegian; Swedish; Danish; Dutch; French; Flemish; German; Italian; Portuguese; Spanish; Polish; Russian; Ukrainian; Hungarian; and English) are spoken [24].

For the confirmatory factor analysis (CFA) 6109 of the 6241 participants were retained following the use of pooled correlation matrices.

Materials

The HADS is a 14-item self-report measure with a four-point scale [6]. The scale is comprised of two seven-item subscales designed to assess anxiety and depression (HADS-A; HADS-D), and uses a mixture of negative and positive items and varying response options. Even-numbered items are designed to measure depression while odd-numbered items are said to measure anxiety. Sample items include "I feel tense or wound up" (HADS-A), with response options ranging from "Not at all" to "Most of the time"; and "I look forward with enjoyment to things" (HADS-D), with responses ranging from "As much as I ever did" to "Hardly at all".

Where HeartQoL investigators had access to a HADS translation in their own language, this was used (although it is unclear what version was used if several were available) [10]. If no appropriate translation was available, investigators used the Outcomes Trust backwards and forwards approach to translations and the HADS was translated into that language from the English version. All participants were given the measure in their language of preference [24]. Cronbach's alphas for both the overall scale ($\alpha = .87$) and anxiety and depression subscales ($\alpha = .81, \alpha = .79$) were high indicating good internal consistency.

Analysis of scores in the clinical setting suggests that a score of 0 to 7 for either subscale could be considered as being in the normal range while scores above this suggest possible or probable 'caseness' [25].

Statistical analysis

All statistical analyses were carried out using AMOS version 21.0.

Confirmatory factor analysis (CFA).

CFA was employed to confirm the best model of fit. All HADS items were correlated and the resulting pooled matrix was analyzed. The three models below were tested (see Fig. 1):

- Zigmond and Snaith's originally proposed bidimensional structure [21]
- Dunbar et al.'s [16] higher-order model.
- The hierarchical bifactor structure which emerged from Norton et al.'s recent meta CFA [19].

The maximum likelihood method was used to examine the covariance matrices of the items. Several indices were used to assess the model fit of the three models tested. The statistics usually reported in CFA are χ^2 (with degrees of freedom and p-value), goodness-of-fit index (GFI), comparative fit index (CFI) and root mean square error of approximation (RMSEA) [26]. The χ^2 statistic is an overall test of how well the hypothesized model fits the data and a significant χ^2 indicates a model that does not fit the data well. Because the χ^2 statistic assumes multivariate normality and is affected by large sample size (i.e. a model with relatively good fit for a large dataset can still be rejected), additional indices of fit (i.e. TLI, GFI, CFI, SRMR and RMSEA) must be used to make a judgement regarding the fit of the model. The Tucker–Lewis index (TLI) is a relative fit index. It is relatively unaffected by sample size [27] and values over .90 or .95 are considered acceptable [28]. The GFI and CFI should have values over 0.95 and the RMSEA value should be below .05 [26]. Akaike's information criterion (AIC) is a modification of the standard goodness-of-fit χ^2 statistic that includes a penalty for complexity. This index is useful for making comparisons among two or more models, with lower values indicating better fit. The Bayesisan information criterion (BIC) is closely related to AIC and also penalizes model complexity based on the number of parameters. Again lower values are preferred. The SRMR (Standardized Root Mean Residual) is a descriptive fit index, a cutoff value close to .08 is recommended and lower values indicate better fit [28].

Relative fit of the models was assessed by examining change in chi-square values across the models ($\Delta\chi^2$). However, this test is sensitive to sample size, and is likely to reach the threshold for significance in large samples. Accordingly, Cheung and Rensvold [29] have argued that

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