



The psychometrics of the Hospital Anxiety and Depression Scale supports a shorter -12 item- version



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ABSTRACT

The diagnosis of patients suffering from both anxiety and depression is complex due to mixed effects of the two disorders. This complexity has hardened the task to find an adapted treatment for these patients. Consequently, several instruments, known as depression anxiety scales, have been developed and are now used internationally by physicians to determine the diagnosis of anxiety and depression and treat the patients accordingly. This study aims at testing the consistency and reliability of one of the main anxiety and depression scale which is composed of 14 items, the Hospital Anxiety and Depression Scale (HADS). We have used explanatory factor analysis (EFA) and factor extraction by principal component analysis (PCA) with orthogonal varimax (Kaiser Normalization) rotation on a cohort of 9706 French depressed patients. The relevance of the 14 items included in the HADS was also scrutinized by measuring the internal consistency and reliability of the global HADS removing each item one by one. Our conclusion is that the HADS could potentially gain in consistency in the detection of anxiety, notably through the revision of two of the anxiety items.

1. Introduction

Anxiety disorders and depressive disorders are highly prevalent conditions that frequently co-occur (Pini et al., 1997; Rodney et al., 1997; van der Veen et al., 2015). The lifetime prevalence of anxiety disorders and major depression among adults worldwide have been reported to be respectively 28.8% and 16.6% (Kessler et al., 2005). Individuals affected by both anxiety and depressive disorders concurrently have generally shown greater levels of functional impairment, reduced quality of life, and poorer treatment outcomes compared with individuals suffering from only one disorder (Lamers et al., 2011).

The diagnosis of these conditions is complicated by the presence of mixed anxiety and mood states (Furukawa, 2010) as well as substantial overlap in physical and emotional symptoms of the disorders. There is a high rate of co-morbid anxiety and depressive disorders in population-based samples (Simon et al., 1999). Three international studies have highlighted that depression is significantly associated with every type of anxiety disorder (Kessler et al., 2010); the highest association rates are observed in patients with generalized anxiety disorder and the

lowest in those suffering from agoraphobia and specific phobias. Moreover, the appearance of both depression and anxiety appears to lead to a poorer response to treatment than either disorder occurring individually (Ledley et al., 2005; Stein et al., 2008; Woody et al., 1999). Because of this high level of complexity, anxious distress was included as a subtype of major depression in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) (Vahia, 2013).

It has consequently appeared to be a necessity to develop instruments capable of assessing disorders in patients, in order to identify nonresponders, detect residual symptoms, reduce dropout from treatment, help patients recognize improvement and detect seasonal variation (APA Work Group, 2016; Bush et al., 2005). Physicians have then developed many scales and no less than 10 only for depression such as Hamilton Depression Rating Scale (HDRS), Montgomery-Asberg Depression Rating Scale (MADRS), Raskin Depression Rating Scale (RDRS), Beck Depression Inventory (BDI) (Sharp and Lipsky, 2002). Scales vary in length from a single item to more than a hundred items. There are different types of scales; copyrighted or public domain scales, self-report questionnaires or scales assessed by physicians. Most of them

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have been used in clinical trials throughout the world and translated into different languages. Some have been designed to measure depression in specific populations such as patients who are postpartum, geriatric, or patients suffering from nonpsychiatric medical illnesses. Others assessing the DSM-5 criteria have been developed and found to be valid and reliable in measuring depression severity, although most of them are prior to DSM-5 and do not fully assess the diagnostic criteria for unipolar major depression. The DSM offers indeed standard criteria for the classification of mental disorders while scales are more appropriate for monitoring level of symptoms and their improvement or deterioration. Moreover, the DSM is reviewed every 10 years while scales are usually not updated.

Amongst all scales, the Depression and Anxiety Stress Scale (DASS) and the Hospital Anxiety and Depression Scale (HADS, *Appendix*), which are used worldwide, are able to measure both anxious and depressive symptoms. The DASS, originally designed in 1995 by Lovibond P.F and Lovibond S.H (Lovibond and Lovibond, 1995) is potentially the most useful instrument for the assessment of patients with co-occurring depression and GAD symptoms, or when discrimination among mixed anxiety and depressive symptoms is unclear (Antony et al., 1998). It has been demonstrated to be accurate in its assessment of global anxiety, and able to separate anxiety from depressive symptoms. The DASS is a 42-items questionnaire which takes between 5 and 10 min to fill.

The HADS, developed in 1983 by Zigmond and Snaith (Zigmond and Snaith, 1983), is a 14-items scale which presents many advantages. First the HADS is used by all types of doctors such as general practitioners or specialists. Second to prevent from misdiagnosis, all symptoms of anxiety or depression relating also to physical disorder, such as dizziness, headaches, insomnia, anergia and fatigue, were excluded (Bjelland et al., 2002). Finally, the HADS is quick to complete, between 2 and 5 min.

In this study, our focus is on HADS; Our goal is to assess the psychometric characteristics of the HADS in a large sample of outpatients suffering from depression. We bring insights into the following interrogations:

- (I) How are the factor structure, discriminant validity and the internal consistency of HADS?
- (II) How does HADS perform as a case finder for anxiety disorders and depression?
- (III) How does HADS agree with other self-rating instruments used to rate anxiety and depression?

Answering these questions will help to know if the HADS is still up to date to allow a specific diagnosis of depression or anxiety with the current DSM-5, knowing that the HADS has been originally developed thanks to the DSM-III.

2. Methods

2.1. Patients

The patients were required to be older than 18 years, speak fluent French, possess a social security number, and give informed written consent. Exclusion criteria were a diagnosis of bipolar disorder and the use of a mood stabilizer during treatment. All antidepressants (in accordance with the French Food and Drug Administration) were accepted in order to reflect usual clinical practice.

2.2. Doctors

4.849 General practitioners (Gorwood et al., 2008) were contacted via mail in France and asked to participate in a short-term follow-up protocol of depressed patients. 3.375 (69.6%) agreed to participate. At least two contacts (usually via phone call) were made to each general practitioners. At the end of the study, 1844 general practitioners

(38.0%) had included at least one patient. The participating general practitioners were experienced (mean age = 49.9), 7.8% were practicing in hospitals, 46.6% in private practice, and 45.6% in group practice.

They were asked to measure depression and anxiety two times; a first time at the first visit, before any modification of the treatment and at the second visit to measure the effect of the treatment prescribed. Indeed, at the end of the first visit, the general practitioner had two options: either he prescribed an antidepressant if the patient had never received any in the past or the general practitioner switched from one antidepressant to another if the patient had already received one in the past.

2.3. Instrument

The HADS (Zigmond and Snaith, 1983) is a self-report instrument which allows to measure symptom severity and is characterized by its rapidity and simplicity of rating. The HADS is a 14-item scale with 2 subscales. A 7-item subscale called HADS-A, explore anxiety symptoms and a 7-item subscale called HADS-D, explore depressive symptoms. Each item on the questionnaire is scored from 0–3, resulting in a total score comprised between 0 and 21 for either anxiety or depression. The HADS uses a scale and therefore the data returned from the HADS is ordinal.

The cut-off points for caseness of anxiety or depression have been explored in several studies. Bjelland et al. (2002) has identified a cut-off point of 8/21 for anxiety or depression using a systematic review of 747 studies. For HADS-A this study gave a specificity of 0.78 and a sensitivity of 0.9. For HADS-D this study demonstrated a specificity of 0.79 and a sensitivity of 0.83. Therefore, in our study, we used similar cut-off as Bjelland et al. meaning that a patient with a score above 8 for the HADS-A is considered anxious and a patient with a score above 8 for the HADS-D is considered depressed. Moreover, in this systematic review most factor analysis demonstrate a two-factor solution in good accordance with the HADS subscales for HADS-A and HADS-D, respectively. The correlations between the two subscales varied from 0.40 to 0.74 (mean 0.56). Cronbach's alpha for HADS-A from 0.68 to 0.93 (mean 0.83) and for HADS-D from 0.67 to 0.90 (mean 0.82).

2.4. Statistical analysis

The dataset was checked for completeness and normality using the Kolmogorov-Smirnov test (Ghasemi and Zahediasl, 2012).

For exploratory factor analysis (EFA), factor extraction using principal component analysis (PCA) with orthogonal varimax (Kaiser Normalization) rotation were used (Corner, 2009).

Then we have performed a confirmatory factor analysis (CFA). CFA (Brown, 2015; Kline, 2011) is a special case of structural equation modeling (SEM), applied to latent variable assessment. CFA allows us to (i) assess the structure of the HADS - do the HADS-A items load for the anxiety factor and the HADS-D items load for the depression factor? (ii) evaluate the fitness / appropriateness of the factor model - is the model with the 14 items better than alternatives? (iii) evaluate the weights of each item - do they contribute equally?

Finally, the internal consistency of the overall dimension (14-items) and of each dimension individually (HADS-D, HADS-A) were computed thanks to Cronbach's alpha scores (Tavakol and Dennick, 2011). We expect the items in the anxiety subscale to contribute to the anxiety dimension while the items in the depression subscale should capture the depression dimension. Cronbach's alpha is supposed to increase when the correlations between the items increase. We calculated successively the internal consistency of:

- the global HADS and of the HADS-D and the HADS-A
- the HADS-D and the HADS-A after removing each item one after the other.

Table 1
Clinical characteristics of Patients with Major Depressive Disorder at the first and the second visit ($N = 9706$).

Characteristic	Assessment		Analysis	
	Visit 1 (mean)	Visit 2 (mean)	<i>t</i>	<i>p</i>
Number of DSM-IV criteria for depression	6.62	3.25	112.5	<0.0001
HADS-D score	19.16	15.16	99.44	<0.0001
HADS-A score	18.58	15.43	86.27	<0.0001
HADS score	37.74	30.60	106.7	<0.0001

DSM-IV: Patients with 5–6 out of 9 criteria are considered to be depressed.

All significant results were based on $p < 0.05$. Analyses of the data were carried out using R-studio Version 1.1.423.

3. Results

3.1. Sample

A total of 9706 depressed patients entered the study.

Subjects were excluded if the data characterizing the patient was not correctly or completely saved. Women comprised 70.37% of the final sample, and the average age of the sample was 48.02 years ($SD = 14.09$). This was the first episode of depression for 49.64% of patients, the second episode for 25.30%, and between the third and thirteenth episode for the remaining patients (25.06%).

The second visit was on average 42 days after the first visit (between 3 and 20 weeks). At the second visit, the number of depressive symptoms from the list of DSM-IV criteria decreased, in accordance with the decrease in the number of anxious and depressive symptoms using the HADS (Table 1).

3.2. Data screening

First of all, we have decided to perform the statistical analysis using only the dataset collected at the first visit.

Regarding the sample size ($N = 9706$), we have decided to split the dataset: the training dataset ($N = 4853$) was used to perform all psychometric analyses, and a validation dataset ($N = 4853$) was used to (i) provide an unbiased evaluation of the fitness of the model, (ii) confirm the results found with the training dataset, and (iii) avoid overfitting.

The minimum amount of dataset for factor analysis was satisfied with a sample size of 4853, providing a ratio of over 340 patients per item.

3.3. Exploratory factor analysis

Initially, the factorability of the 14 HADS items was examined. First, it was observed that 9 of the 14 items correlated with at least one other item, suggesting reasonable factorability (Supplementary materials S.1). Secondly, the Kaiser-Meyer-Olkin (Kaiser, 1974) measure of sampling adequacy was 0.81, above the commonly recommended value of 0.6, and Bartlett's test of sphericity (Tobias and Carlson, 1969) was significant ($\chi^2 = 9081$, $p < 0.0001$). Given these overall indicators, factor analysis was deemed to be suitable with all 14 items.

Principal components analysis was used because the primary purpose was to identify and compute composite scores for the factors underlying the HADS. Initial eigenvalues indicated that the first two factors explained respectively 23.6% and 10.2% of the variance. The third factor had eigenvalues just over one, and explained 8.9% of the variance (Fig. 1).

The two-factor solution, which explained 33.8% of the variance, was preferred because of: (i) its previous theoretical support; (ii) the

'leveling off' of eigenvalues on the screen plot after two factors displayed; and (iii) the insufficient number of primary loadings and difficulty of interpreting the third factor and subsequent factors.

In order to proceed to a more detailed analysis focusing on the contribution of each item to the overall variance of the two sub-scales HADS-A and HADS-D, the factor loadings of the two constructs were examined following the orthogonal varimax rotation with Kaiser Normalization (Table 2). Most of the items were strongly loaded and clustered for each of the two factors. However, the items 4 and 6 respectively corresponding to "I can sit at ease and feel relaxed" and "I feel restless and have to be on the move" display particularly low cross the two factors. A contribution of at least 0.3 (Nordin, 2017) is desirable for each of the factor construct.

3.4. Confirmatory factor analysis

Two confirmatory factors analysis have been performed. One with all the 14 items and one with the abbreviate instrument (without the items 4 and 6 of the HADS-A). As we can see, the model fit better the dataset after removing the items 4 and 6 (Table 3). Indeed, the Akaike information criterion (AIC), the standardized root mean square residual (SRMR) and the root mean square error of approximation (RMSEA) are lower with the abbreviate instrument compare to the whole instrument, while the Comparative fit index (CFI) is higher with the abbreviate instrument compare to the whole instrument.

3.5. The internal consistency analysis

The Cronbach's alpha for the global HADS was 0.71, and 0.70 and 0.53 for the HADS-D and for the HADS-A respectively. The HADS-D and the HADS-A after removing each item one after the other is shown in Table 4.

We highlighted that, the internal consistency is much higher when the item 4 or/and the item 6 of the HADS-A are removed. Regarding the HADS-D, the internal consistency is quite consistent and robust in time.

3.6. Evaluation of the model fit using the validation dataset

We performed the same statistical analysis using the validation dataset. The results are similar to those found using the training dataset and particularly for the CFA and internal consistency. Indeed, items 4 and 6 of the HADS-A appear not to assess anxiety symptoms as much as the other items of the HADS-A do.

The Cronbach's alpha for the global HADS was 0.65 and 0.66 and 0.41 for the HADS-D and the HADS-A, respectively (Supplementary materials S.2; S.3).

4. Discussion

The focus of the study is on the Hospital Anxiety and Depression Scale; we intend to assess a systematic psychometric analysis using EFA, CFA and Cronbach's alpha on a unique sample of 9.706 French depressed patients. Our study allows us to conclude that the HADS scale is a relevant case finder for anxiety and depression disorders.

Our results are consistent with the literature and more specifically with the systematic review from Bjelland et al. described above as we highlight a correlation between the two sub-scales close to 0.44 and a Cronbach's alpha for HADS-D at 0.66 and for HADS-A at 0.41 in the validation data.

The originality of our study is twofold; (i) the size of our sample, with 9706 French patients suffering from depression, and (ii) the validation dataset which allow us to confirm and extrapolate our results. This study highlights that the HADS is better to assess depressive symptoms rather than anxious symptoms.

As far as the two anxiety items that stand out are concerned, one could wonder whether these two items: "I can sit at ease and feel

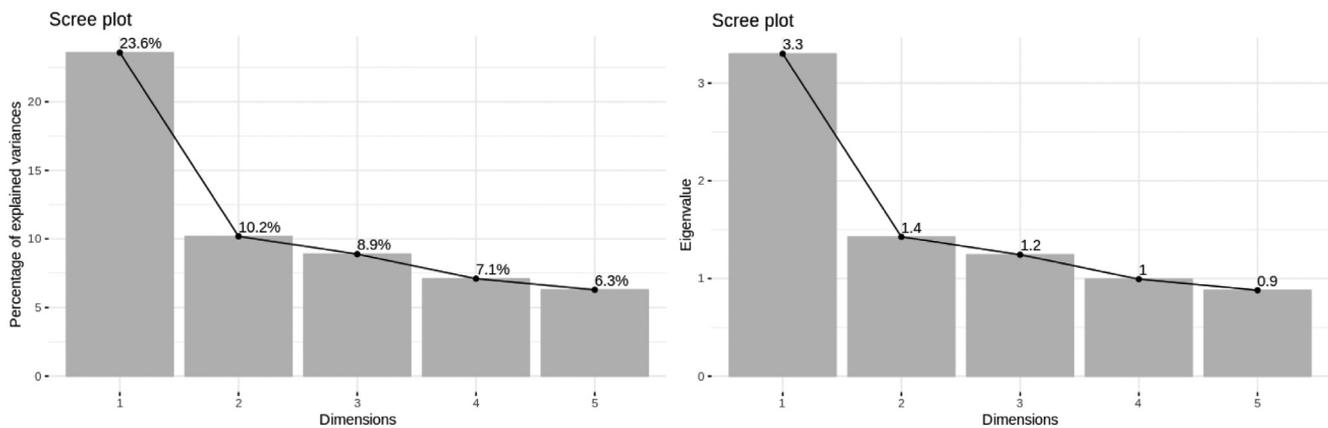


Fig. 1. Screen plots reporting the percentage of variance explained by each factor and the eigenvalues.

Table 2

Summary of exploratory factor analysis results using principal component analysis with varimax rotation for the HADS (N = 9706).

Items of anxiety	Depression	Anxiety
I feel tense or wound up = A1.1	.16	.44
I get a sort of frightened feeling as if something bad is about to happen = A1.2	.12	.50
Worrying thoughts go through my mind = A1.3	.25	.66
I can sit at ease and feel relaxed = A1.4	.57	.25
I get a sort of frightened feeling like butterflies in the stomach = A1.5	.10	.70
I feel restless and have to be on the move = A1.6	.15	< 0.1
I get sudden feelings of panic = A1.7	< 0.1	.54
Items of depression		
I still enjoy the things I used to enjoy = D1.1	.45	.15
I can laugh and see the funny side of things = D1.2	.48	.14
I feel cheerful = D1.3	.57	.14
I feel as if I am slowed down = D1.4	.36	.12
I have lost interest in my appearance = D1.5	.37	.14
I look forward with enjoyment to things = D1.6	.64	.15
I can enjoy a good book or radio or TV programme = D1.7	.55	.19

Factor loadings < 0.1 are deleted.

relaxed” and “I feel restless and have to be on the move” are fully understood by patients and should remain in the HADS. The item “I can sit at ease and feel relaxed” does not appear to be specific to anxiety as a lot of depressed patients have a high score on this item. One may also wonder whether anxiety should not be considered as a symptom rather than a disease since it is related to various diseases such as depression, obsessive-compulsive disorder, social phobia, etc. Consequently, it is difficult to find a reliable scale for measuring anxiety.

In the literature, factor analysis performed on data collected using English and German versions of this scale confirm a two-dimensional structure (Herrmann, 1997).

In the evaluation carried out by Untas et al. (2009) on the French version of the HADS scale, the exploratory factorial analysis have confirmed the two-dimensional structuring proposed originally in 1983 by Zigmund and Snaith (1983). The correlation between HADS-D and

Table 4

The internal consistency of the HADS after removing items one after the other using Cronbach's alpha.

Items of anxiety	Cronbach's alpha if item deleted
I feel tense or wound up = A1.1	.51
I get a sort of frightened feeling as if something bad is about to happen = A1.2	.42
Worrying thoughts go through my mind = A1.3	.49
I can sit at ease and feel relaxed = A1.4	.58
I get a sort of frightened feeling like butterflies in the stomach = A1.5	.40
I feel restless and have to be on the move = A1.6	.60
I get sudden feelings of panic = A1.7	.43
Items of depression	
I still enjoy the things I used to enjoy = D1.1	.66
I can laugh and see the funny side of things = D1.2	.67
I feel cheerful = D1.3	.65
I feel as if I am slowed down = D1.4	.68
I have lost interest in my appearance = D1.5	.69
I look forward with enjoyment to things = D1.6	.63
I can enjoy a good book or radio or TV programme = D1.7	.64

HADS-A was moderate ($r = 0.47$). However, the factor analysis performed on the French version by Razavi et al. (1989) released three factors as well as Friedman et al. (2001) study in 2001 one factor only specific for the items “depression”, and the item “anxiety” spread over two factors (4 items for what was called psychological anxiety and three items for “psychomotor instability”).

Given the divergence of results in the literature, it would be relevant to carry out multicenter studies with scales assessing depression and anxiety. This would pursue the goal of (i) reducing the number of scales currently measuring anxiety and depression (ii) evaluating the efficiency of the scale compared to the one of the gold standard DSM-5 (iii) finally better apprehending symptoms anxiety which are currently poorly understood and confused with other pathologies, such as anxiety.

Table 3

The fitness of the model comparison for the whole model with the 14 items and the model after removing the items 4 and 6 from the HADS-A.

	Fit model with all the 14 items	Fit model without items 4 & 6 of the HADS-A	Cut-off criteria for acceptable fit (Schreiber et al., 2006)
AIC Akaike information criterion	99,654	83,275	Smaller the better; good for model comparison
CFI - Comparative fit index	0.864	0.929	≥ 0.95
SRMR - Standardized Root mean square residual	0.049	0.039	≤ 0.08
RMSEA - Root mean square error of approximation	0.058	0.047	< 0.06

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2019.02.074](https://doi.org/10.1016/j.psychres.2019.02.074).

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