

# Factor structure of the Hospital Anxiety and Depression Scale in adolescent patients with chronic disease

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**Funding:**  
This study was funded by the research fellowships granted by the Spanish Association of Clinical Psychology and Psychopathology and the Spanish Federation of Family Therapy Associations, the VLC-BIOMED Program (Research Institute La Fe, Hospital Universitario y Politécnico La Fe and Universitat de València), a fellowship granted by the Valencian autonomous government and the European Social Fund for research and teaching staff training, and an Initiation Scholarship granted by Universitat de València.

**Conflict of interest:**  
None.

Received: 3-12-2018  
Accepted: 2-7-2019

## ABSTRACT

**Introduction.** The Hospital Anxiety and Depression Scale (HADS) is a screening instrument that assesses emotional symptoms in different populations and medical conditions. This study analyzes the psychometric properties and factor structure of the HADS in adolescents with chronic disease and the differences based on their medical condition.

**Method.** The HADS was administered to a sample of 302 adolescents with chronic disease. Exploratory factor analyses were done in a subsample of 100 adolescents, while confirmatory factor analyses were performed in the rest of participants (202) to examine the validity and reliability of the HADS (14 items); an analysis of variance for a single factor was also done to study differences among diseases.

**Results.** Patients were aged 12-16 years, with a similar sex ratio; 43 % had respiratory diseases and 47%, endocrine disorders. The original two-factor structure (anxiety and depression) showed adequate fit indices and incorporated a second-order factor (emotional distress). Three of the original items were removed, thus obtaining a new 11-item version. This showed adequate psychometric properties, and differences were observed between patients with type 1 diabetes mellitus and those with respiratory disease, but not in terms of short stature, in the depression factor.

**Conclusions.** The HADS displays an adequate reliability and validity in pediatric patients with chronic disease and is useful for the early detection of anxiety and depression in the health care setting.

**Key words:** factor structure, patient health questionnaire in the anxiety and depression scale, type 1 diabetes mellitus, chronic respiratory diseases, short stature.

<http://dx.doi.org/10.5546/aap.2019.eng.252>

**To cite:** Valero-Moreno S, Lacomba-Trejo L, Casaña-Granell S, Prado-Gascó VJ, et al. Factor structure of the Hospital Anxiety and Depression Scale in adolescent patients with chronic disease. *Arch Argent Pediatr* 2019;117(4):252-258.

## INTRODUCTION

The presence of a chronic disease (CD) during adolescence entails a major disturbance.<sup>1</sup> According to the bibliography, mental health problems during adolescence may have a negative effect on treatment compliance and the course of disease, thus causing medical complications in CD.<sup>2,3</sup>

Adolescents with chronic physical health problems usually describe anxiety and depression symptoms,<sup>4</sup> associated with more behavioral symptoms and hyperactivity<sup>5</sup> and a worse physical and psychological well-being.<sup>6</sup>

Research in the hospital setting has shown interest in identifying emotional symptoms to prevent the medical complications that may arise.<sup>7</sup> The Hospital Anxiety and Depression Scale (HADS)<sup>8</sup> is the most common instrument mentioned in the scientific bibliography and has been widely used to assess anxiety and depression symptoms in people with CD.<sup>9-12</sup> It is made up of 14 items, divided into two subscales: anxiety (HADS-A) and depression (HADS-D).<sup>8</sup> It also provides an emotional distress indicator based on adding the scores of both subscales.<sup>8</sup> The major contribution of the HADS, compared to other anxiety and depression measurement tools (Beck Depression Inventory [BDI] or Beck Anxiety Inventory [BAI]),<sup>13</sup> is its focus on cognitive aspects rather than on somatic ones, which is very important for patients with CD, whose symptoms may be confused with those of anxiety and depression that accompany the disease itself.<sup>8</sup>

The HADS has been adapted to multiple languages<sup>11,12,14-16</sup> and administered to patients with different physical conditions.<sup>9,11,16-21</sup> Although it was initially developed for people aged 16 to 65 years,<sup>9</sup> its use has been extended to other age ranges, from 10 to 85 years old.<sup>14,17,21-26</sup> This is because it provides adequate information, is easily understood and can be administered in a short time.<sup>27</sup>

Several publications have found adequate psychometric properties,<sup>21-23,28-30</sup> noting its appropriate internal consistency indices.<sup>26,30</sup> Its administration in children and adolescents, in populations other than the Spanish one, has displayed adequate psychometric properties for the overall emotional distress scale and for the HADS-A, but less robust for the HADS-D.<sup>25,30</sup> Likewise, studies conducted in this population have demonstrated that the HADS is a good predictor of anxiety and depression.<sup>31</sup>

Differences are observed with other methods used in relation to its factor structure.<sup>24</sup> However, most authors have highlighted that the structure is made up of two factors both in adults<sup>10,21-23,29</sup> and adolescents.<sup>30-32</sup> Although the HADS has been widely implemented worldwide in clinical practice and research, its use has been restricted to adults.<sup>11,12,16,18</sup> There are also studies carried out in adolescents, but in other countries.<sup>25,31</sup> At present, in Spain, there is no bibliography on the psychometric properties of the HADS in the adolescent population.

### Objectives and hypotheses

The objectives of this study were to analyze the instrument's factor structure in a sample of adolescents with CD, to test the scale's psychometric properties and dimensionality, and to assess the differences in anxiety and depression based on medical diagnosis. Based on the study objectives, the following hypotheses were proposed: H1, the instrument has a two-factor structure; and H2, patients with chronic respiratory disease (CRD) would have greater anxiety and depression than their peers with diabetes and short stature.

## METHOD

### Participants

The sample was made up of 378 participants. Of these, 76 were excluded because, when the medical records of interviewed patients were reviewed or when the health care providers were asked, it was noted that they did not meet

the following inclusion criteria: adolescent patients (12-16 years old) after at least 6 months of diagnosis and who did not have a previous psychological disorder or attention deficit hyperactivity disorder (ADHD) or cognitive impairment or intellectual disability.

### Instruments

HADS:<sup>8</sup> this is a questionnaire made up of 14 items, with a 4-point Likert-like scale, where 0 is the lowest score and 3, the highest one; it detects cognitive-related anxiety and depression symptoms (odd and even items, respectively) in the past week. Adding both subscales would provide an overall emotional distress score. In general, a higher score indicated a greater emotional involvement (higher levels of anxiety and depression).

### Design

The study had a cross-sectional design and was approved by the Ethics Committee of Universitat de València and the different committees of participating hospitals. Data were collected between 2015 and 2017, once legal guardians signed the informed consent. Participants attended the Department of Endocrinology or Pediatric Pulmonology at the hospitals located in the Valencian Community (Hospital General Universitario, Hospital La Fe, and Hospital Clínico Universitario). A psychologist who had received standard training was in charge of the assessment, and the same protocol was applied in the three conditions.

### Data analysis

The statistical analysis was done using the SPSS 23.0 software, the Structural Equation Modeling program (EQS, version 6.3), and the exploratory factor analysis (EFA) software (FACTOR 10.8.01).<sup>33</sup> The EFA was performed in accordance with the process recommended by Lloret-Segura,<sup>34</sup> using the unweighted least square (ULS) method, applying the parallel analysis and direct oblimin rotation, and setting the number of factors at two, as suggested by the instrument's original factor structure.<sup>8</sup>

Item properties were analyzed based on item-total correlation coefficients and variations in Cronbach's alpha coefficients, if items were removed. The psychometric properties were tested using the EFA, the confirmatory factor analysis (CFA), and Cronbach's alpha reliability and compound reliability (CR) coefficients. For

the CFA, Satorra-Bentler's robust correction ( $S-B\chi^2$ ) of maximum likelihood estimation (MLE) was used to adjust for the lack of multivariate normality. The suitability of the CFA was tested using  $\chi^2$  significance and S-B  $\chi^2$ .<sup>35</sup>

The goodness-of-fit indices of the proposed models were tested using the non-normed fit index (NNFI), the comparative fit index (CFI), and the incremental fit index (IFI). For these indicators, values above 0.90 were considered adequate.<sup>36</sup> The root mean square error of approximation (RMSEA) was also used, and these scores were required to be below 0.08 to be regarded as having an adequate fit.<sup>37</sup> To do the EFA and CFA, the total sample ( $n = 302$ ) was divided into two: group A ( $n = 100$ ) was used for the EFA and group B ( $n = 202$ ), for the CFA. The groups were selected at random, considering proportionality in relation to the participants' medical condition, age, and sex. The mean difference of the HADS scores was analyzed based on diagnosis (analysis of the variance [ANOVA] factor). The SPSS 23.0 software was used for these analyses.

## RESULTS

Participants were adolescents with CD aged 12-16 years (mean [M] = 13.52; standard deviation [SD] = 1.21); 58.3 % were males. A sample of 302 participants was obtained: 43 % ( $n = 130$ ) had a diagnosis of CRD, mostly bronchial asthma

( $n = 76$ ) and obliterative bronchiolitis ( $n = 14$ ) and, to a lesser extent, cystic fibrosis ( $n = 7$ ), primary ciliary dyskinesia ( $n = 4$ ) and other respiratory diseases, such as malacia or bronchiectasis ( $n = 29$ ). Type 1 diabetes mellitus (DM1) was observed in 25.2 % ( $n = 76$ ) of patients, while 31.8 % ( $n = 96$ ) had short stature as the main condition, not secondary to other pathology, and of genetic etiology. These conditions were selected because they are the most common CDs during childhood and adolescence, so the instrument's applicability could be greater.

The HADS was made up of 14 items distributed into two factors (anxiety and depression). After analyzing elements, items 7 and 14 were removed because they increased the alpha in the overall domain (emotional distress). In general, all domains showed acceptable coefficients, except for depression, which was below 0.70. Asymmetry and kurtosis were observed to verify the normal distribution of the item's score, as shown in *Table 1*. They were often higher than 2 or -2, which did not ensure the normal distribution of data.

Before performing the EFA and CFA, data adequacy was determined using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's sphericity test. The KMO (KMO = 0.73) and Bartlett's sphericity test ( $\chi^2 = 393.2$ ;  $df = 91$ ;  $p \leq 0.001$ ) showed adequate values, so the EFA and CFA were performed.

TABLE 1. Item and reliability analysis of the Hospital Anxiety and Depression Scale in a sample of adolescents with chronic disease

	M	SD	rjx	$\alpha-x$	A	K
<b>Anxiety: <math>\alpha = 0.77</math>; <math>\alpha</math> (leaving out item HADS7) = 0.78; CR = 0.79; CI = (0.74-0.82)</b>						
HADS1	0.99	0.77	0.60	0.72	0.81	0.80
HADS3	0.57	0.88	0.55	0.73	1.32	0.53
HADS5	0.93	0.75	0.52	0.74	0.78	0.84
HADS7	1.14	0.85	0.29	0.78	0.25	-0.69
HADS9	0.71	0.74	0.44	0.75	0.93	0.66
HADS11	1.03	0.84	0.50	0.74	0.55	-0.22
HADS13	0.59	0.67	0.57	0.73	0.97	0.88
<b>Depression: <math>\alpha = 0.61</math>; <math>\alpha</math> (leaving out items HADS4, HADS14) = 0.62; CR = 0.62; CI = (0.55-0.68)</b>						
HADS2	0.32	0.56	0.38	0.55	1.71	2.53
HADS4	0.19	0.52	0.26	0.59	3.25	11.89
HADS6	0.29	0.52	0.39	0.55	1.77	3.09
HADS8	0.49	0.67	0.33	0.57	1.38	1.91
HADS10	0.27	0.59	0.62	0.57	2.46	6.41
HADS12	0.27	0.55	0.45	0.52	2.17	4.89
HADS14	0.36	0.69	0.16	0.63	1.99	3.55
<b>Emotional distress: <math>\alpha = 0.80</math>; <math>\alpha</math> (leaving out items 4, 7, 14) = 0.81; CR = 0.84; CI = (0.78-0.84)</b>						

HADS: Hospital Anxiety and Depression Scale; M: mean; SD: standard deviation; rjx: item-total correlation;  $\alpha-x$ : Cronbach's alpha if the item is removed; A: asymmetry; K: kurtosis; CR: compound reliability; CI: confidence interval for Cronbach's alpha.

The EFA was estimated for group A ( $n = 100$ ) using the FACTOR software with the 14 items. When performing a parallel analysis, without setting the number of factors with eigenvalues equal to 1, data did not show agreement in relation to the number of factors. Thus, based on the 95<sup>th</sup> percentile, items were grouped into one domain and, setting at the mean, into two domains (anxiety and depression). After applying the EFA set to two factors, as suggested in the bibliography for the original instrument, items whose saturation was below 0.40 or above this value in more than one factor were removed: 3 items (4, 7, 14). Such factor resolution showed adequate fit indices (RMSEA = 0.05, CFI = 0.98). The explained variance for these 2 domains was 61.43 %. The analysis of correlations among the instrument's elements is shown in *Table 2*.

After considering the EFA results, the CFA was done for group B ( $n = 202$ ). The goodness-of-fit indices for the two-factor resolution in the 14-item version were inadequate. Therefore,

items with factor loading problems,  $\leq 0.30$  score, were removed, thus increasing the model's goodness-of-fit indices once the 3 items (4, 7, 14) were removed (*Table 3*). The same procedure was repeated for the single-factor resolution (emotional distress); the same number of items was removed, and the model improved. Results indicated that the two-factor resolution (anxiety and depression) and the single-factor model (emotional distress) had adequate model fit indices (RMSEA  $\leq 0.08$ ; CFI and IFI  $\geq 0.90$ ), although the two-factor model showed slightly better indices. Therefore, in view of the doubts regarding the number of factors in the instrument, a second-order factor (emotional distress) was estimated, and this model showed adequate fit indices (*Table 3*). Finally, a short 11-item instrument was obtained (*Table 4*).

Cronbach's alpha reliability and CR coefficients for each domain ranged between 0.78 and 0.84, which was within the minimum values ( $\geq 0.70$ ) mentioned in the bibliography, except

TABLE 2. Autocorrelations among the instrument's elements

Items	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1													
2	.07	1												
3	.54	.37	1											
4	.20	.41	.29	1										
5	.54	.31	.57	.30	1									
6	.48	.37	.50	.51	.37	1								
7	.24	.05	.01	.01	.33	.06	1							
8	.30	.33	.53	.18	.26	.12	.09	1						
9	.42	.23	.40	.31	.31	.33	.07	.22	1					
10	.03	.33	.33	.03	.12	.26	-.06	.34	.12	1				
11	.35	-.07	.38	.12	.39	.35	.38	.24	.20	.26	1			
12	.10	.53	.43	.39	.15	.57	-.13	.19	.45	.58	-.16	1		
13	.58	.42	.70	.44	.53	.46	.11	.63	.39	.27	.33	.33	1	
14	.01	.39	.17	.11	.01	.10	-.05	.19	.20	.44	.13	.02	.30	1

TABLE 3. Results of confirmatory factor analyses: goodness-of-fit indices of the confirmatory factor analysis for the two- and single-factor resolutions

Model	S-B- $\chi^2$	df	<i>p</i>	S-B $\chi^2$ /df	CFI	IFI	RMSEA
HADS 14 items (2 factors)	166.74	76	< .000	2.19	0.78	0.78	0.08
HADS 14 items (1 factor)	173.10	77	< .000	2.24	0.77	0.78	0.07
HADS 12 items (2 factors, leaving out items 14, 7)	90.68	53	< .001	1.71	0.89	0.89	0.06
HADS 12 items (1 factor, leaving out items 14, 4)	132.39	54	< .000	2.45	0.80	0.81	0.08
HADS 11 items (2 factors, leaving out items 14, 7, 4)	70.12	43	< .001	1.63	0.92	0.92	0.06
HADS 11 items (1 factor, leaving out items 14, 4, 7)	74.63	44	< .003	1.70	0.91	0.91	0.06
HADS 11 items (2 factors, with second-order factor)	72.01	42	< .002	1.71	0.91	0.91	0.06

HADS: Hospital Anxiety and Depression Scale; S-B- $\chi^2$ : Satorra-Bentler  $\chi^2$ ; df: degrees of freedom; S-B  $\chi^2$ /df: ratio between S-B  $\chi^2$  and df; CFI: comparative fit index; IFI: incremental fit index; RMSEA: root mean square error of approximation.

for the depression domain, which showed lower levels. The correlation between both domains was 0.60. Lastly, after removing items, new cut-off points were established to differentiate absence from probable case and from the presence of a clinical disorder, as indicated in the original instrument<sup>8</sup> (Table 5).

To assess the presence of differences among medical diagnoses, an ANOVA and a Games-Howell *post hoc* test were done because equal variances were not assumed. Significant differences were observed for the total score of the depression domain between patients with DM1 and those with CRD; the latter had higher scores ( $F = 3.27$ ;  $p = 0.04$ ) and a small effect size ( $\eta^2 = 0.02$ ).

## DISCUSSION

The HADS factor structure was explored in a sample of adolescent patients (12-16 years old) with CD, in its original version. When analyzing the factor structure (objective 1), the results proposed in the EFA were controversial in relation to the instrument's dimensionality (objective 2). When removing the items that generated an erroneous factor loading to establish a model that would meet the necessary fit indices as per the CFA, we chose a two-factor resolution

with a second-order factor, so H1 would be accepted (the instrument has a two-factor structure).

Most studies support a two-factor resolution,<sup>9,18,20,21,29</sup> although, since there were doubts about the instrument's dimensionality, we proposed a two-factor model with a second-order factor (emotional distress), and point out that, in samples of adolescents (early and late adolescence), this type of emotional disorders (anxiety and depression)<sup>2</sup> may be hard to differentiate.

Ultimately, and after performing a validity and reliability analysis, the final number of items was 11. The removal of items 4, 7, and 14 –which had abnormal factor loadings—<sup>23</sup> resulted in adequate reliability indices, except for depression, as observed in previous studies.<sup>24,30</sup> Item 14 showed the greatest complication in relation to factor loadings. As observed in some of the analyzed adapted versions,<sup>22</sup> it may have possibly lost its cultural relevance and ability to assess anhedonia because it also has a small discrimination power. In addition to removing this item, two other items were left out that helped to improve the instrument's structure and internal consistency.

In relation to objective 3, differences were

TABLE 4. Hospital Anxiety and Depression Scale, short version, administered to the study's sample of pediatric patients after removing items

### Hospital Anxiety and Depression Scale (HADS), short version

- I feel tense or "wound up" (item 1).
- I still enjoy the things I used to enjoy (item 2).
- I get a sort of frightened feeling as if something awful is about to happen (item 3).
- Worrying thoughts go through my mind (item 5).
- I feel cheerful (item 6).
- I feel as if I am slowed down (item 8).
- I get a sort of frightened feeling like "butterflies" in the stomach (item 9).
- I have lost interest in my appearance (item 10).
- I feel restless as I have to be on the move (item 11).
- I look forward with enjoyment to things (item 12).
- I get sudden feelings of panic (item 13).

TABLE 5. New cut-off points for the interpretation of the Hospital Anxiety and Depression Scale in adolescents

Anxiety factor	Depression factor	Emotional distress
0-6: normal-absence of anxiety	0-5.4: normal-absence of depression	< 15.5: absence of a clinical diagnosis of emotional distress
7-9: probable case of anxiety	5.5-7.5: probable case of depression	≥ 15.5: clinical problem of emotional distress
> 9: clinical problem of anxiety	> 7.5: clinical problem of depression	

observed in the level of depression between CRD and DM1. H2 was partially accepted, because patients diagnosed with respiratory disease had, in general, greater emotional problems.<sup>2</sup>

Our results help to support the use of the HADS in the population with chronic conditions because it extends its administration with adequate psychometric properties in the adolescent population, is useful as a screening instrument, and offers the opportunity to plan interventions targeted at this population. In addition, another relevant aspect is that it has allowed to assess, at the same time, anxiety and depression in three different types of disease that had not been assessed before, such as DM1, short stature, and CRD. However, further studies are required to demonstrate its psychometric properties in samples of adolescents with CD so as to provide greater evidence on its functioning.

In spite of the contributions mentioned above, our results may only be considered preliminary due to the study's limitations. It would be advisable to have a larger sample of adolescent patients; however, in general, in this type of studies in the hospital setting, final samples are usually small because it is difficult to obtain a sample of adolescent patients with a CD. Another limitation is the use of data that were obtained from questionnaires only; it would be advisable to use medical indicators (type of medical treatment, cortisol levels, number of hospitalizations) to cross-check data from the questionnaire. In addition, other informants, such as main caregivers or health care providers, would be necessary to check the correlation between the patients' perception and their closest environment. All these limitations must be taken into consideration in future studies.

The World Health Organization and the American Psychiatric Association suggest that it is necessary to focus the adaptation on CD in adolescence, not only from a medical perspective, but also in a multidimensional manner, thus reflecting the need of developing valid instruments for this type of population. Therefore, the importance of this study lies in that it has managed to demonstrate the factor structure of an instrument that is widely used worldwide but that, up to now, had not been implemented in the Spanish adolescent population. In this way, we have obtained a useful and easily interpreted diagnostic instrument to detect early emotional symptoms (anxiety and depression) in the population of adolescents with CD in the health

care setting that will guide future interventions and thus increase patients' emotional well-being. ■

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