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Using Hospital Anxiety and Depression Scale (HADS) on patients with epilepsy: Confirmatory factor analysis and Rasch models

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ABSTRACT

Purpose: The problems of mood disorders are critical in people with epilepsy. Therefore, there is a need to validate a useful tool for the population. The Hospital Anxiety and Depression Scale (HADS) has been used on the population, and showed that it is a satisfactory screening tool. However, more evidence on its construct validity is needed.
Method: A total of 1041 people with epilepsy were recruited in this study, and each completed the HADS. Confirmatory factor analysis (CFA) and Rasch analysis were used to understand the construct validity of the HADS. In addition, internal consistency was tested using Cronbachs' α, person separation reliability, and item separation reliability. Ordering of the response descriptors and the differential item functioning (DIF) were examined using the Rasch models.
Results: The HADS showed that 55.3% of our participants had anxiety; 56.0% had depression based on its cutoffs. CFA and Rasch analyses both showed the satisfactory construct validity of the HADS; the internal consistency was also acceptable ($\alpha = 0.82$ in anxiety and 0.79 in depression; person separation reliability = 0.82 in anxiety and 0.73 in depression; item separation reliability = 0.98 in anxiety and 0.91 in depression). The difficulties of the four-point Likert scale used in the HADS were monotonically increased, which indicates no disordering response categories. No DIF items across male and female patients and across types of epilepsy were displayed in the HADS.
Conclusions: The HADS has promising psychometric properties on construct validity in people with epilepsy. Moreover, the additive item score is supported for calculating the cutoff.

1. Introduction

People with epilepsy are in high risk of having mood disorders: up to 55% of people with refractory epilepsy may have depression [1,2]. A study even found that the prevalence of people with refractory temporal lobe epilepsy having psychiatric disorders up to 70% [3]. Due to the high prevalence of mood disorders, people with epilepsy showed a higher suicide rate (12%) than the general population (~1%) [4]. As a result, measuring the mood disorder in terms of anxiety and depression is a critical topic for clinicians [5].

In order to tackle the mood disorder issues in people with epilepsy, some researchers claim the importance of validating useful screening instruments [2,6]. They finally suggested that Neurological Disorders Depression Inventory for Epilepsy (NDDI-E) [7,8], Hospital Anxiety and Depression Scale (HADS) [9], and Beck Depression Inventory (BDI) [10] are useful to screen depression for people with epilepsy. Some studies also showed that HADS is a promising tool to assess the depression for people with epilepsy [11–13], and the benefit of using HADS is that the instrument has no items relating to somatic symptoms, a confounder to the diagnosis [2].

However, the knowledge of using HADS on people with epilepsy seems to be insufficient in its psychometric evaluation. Specifically, all studies only focus on the ability of screening depression [2,8,11–13]. Therefore, we do not have the full picture of the psychometric properties for HADS on people with epilepsy, such as the construct validity and internal consistency. Also, we do not know whether the HADS has the ability to assess anxiety for people with epilepsy. For example, we do not know whether the descriptors of the

Abbreviations: HADS, Hospital Anxiety and Depression Scale; CFI, confirmatory factor analysis; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; SEM, structural equation model; TLI, Tucker–Lewis index; infit, information-weighted fit statistic; MnSq, mean square; outfit, outlier-sensitive fit statistic.

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response are appropriate; and whether male and female patients interpret the HADS similarly.

In addition to the traditional methods, Rasch analysis is an alternative to test psychometric properties of an instrument. The simplest Rasch uses a logistic equation ($Pi = [\exp(\theta - bi)]/[1 + \exp(\theta - bi)]$, where Pi denotes the probability of correct answer on item i, and bi denotes the item difficulty) [14] to estimate the underlying ability of a respondent, and the difficulty of each item. Other extensions of the Rasch analysis have been developed for different response scales (e.g., the ordinal and interval scales) [15,16]. Although Rasch analysis is not a statistical technique that the clinicians are familiar with [17], the benefits of using it include (a) separately estimating person ability and item difficulty; (b) assessing whether different groups interpret the same item in different ways; (c) testing the item validity and the unidimensionality of the entire instrument; (d) investigating the appropriateness of the response descriptors [18,19]. Therefore, some articles [20,21] suggest applying Rasch models along with traditional psychometric methods to examine the reliability and validity of an outcome instrument.

The aim of this study was to examine the construct validity and internal consistency of the HADS using advanced psychometric methods. Confirmatory factor analysis (CFA) and Rasch models were used to investigate the construct validity. Additional tests related to Rasch models were adopted to understand the appropriateness of the response descriptors and to examine the interpretation on HADS between male and female patients.

2. Methods

2.1. Participants and procedure

The study participants were epileptic patients who were referred to six neurologic centers in Tehran and Qazvin from July 2015 to through October 2015. The study measure was administrated by a trained nurse. Eligibility criteria included confirmed diagnosis of epilepsy by neurologist and being able to read and write Persian. Patients were excluded from the study if they had intellectual disability, cognitive impartment and did not agree to complete informed consent. The study protocol was approved by the research ethics committee of the Qazvin University of Medical Sciences. All participants gave their written informed consent.

2.2. Hospital Anxiety and Depression Scale (HADS)

Zigmond and Snaith [9] developed the 14-item HADS to measure the anxiety (7 items) and depression (7 items) of patients with both somatic and mental problems. The response descriptors of all items are *Yes, definitely* (score 3); *Yes, sometimes* (score 2); *No, not much* (score 1); *No, not at all* (score 0); except for items 7 and 10, which are scored reversely. A higher score represents higher levels of anxiety and depression: a domain score of 11 or greater indicates anxiety or depression; 8–10 indicates borderline case; 7 or lower indicates no signs of anxiety or depression. The two-factor framework of the HADS has been supported in cancer patients [22], HIV patients [23], and a general population of Norway [24]. The internal consistency of was good in both domains (0.80 in anxiety and 0.76 in depression) [24]. Moreover, the Iranian version of HADS has linguistic validity, acceptable internal consistency (0.78 in anxiety and 0.86 in depression), and satisfactory known-group validity (significant differences were found in different stages of cancer patients) [25].

2.3. Data analysis

Demographics of the participants were described using mean, SD, and frequency. In addition, we used three CFAs to examine the construct validity of the HADS: two one-factor models and one two-correlated-factor model. The one-factor models respectively had the latent construct of anxiety and depression, while the two-correlated-factor model simultaneously adopted the two constructs (anxiety and depression). Because the HADS is rated on a four-point Likert scale, we used diagonally weighted least squares (DWLS) estimator rather than using maximum likelihood (ML) estimator in the CFA. Moreover, we used the following cutoffs in different fit indices to determine an acceptable model: normed χ^2 (i.e., χ^2 value divided by the degrees of freedom) <3, comparative fit index (CFI) and Tucker–Lewis index (TLI) >0.95, root mean square of error approximation (RMSEA) and standardized root mean square residual (SRMR) <0.08 [26–29]. Rasch analyses were also used to test the construct validity in terms of unidimensionality of the HADS. Specifically, two rating scale models (RSM) were adopted: one for anxiety and another for depression. Two statistics, information-weighted fit statistic (infit) mean square (MnSq) and outlier-sensitive fit statistic (outfit) MnSq, were used to test the item fit. An item with infit or outfit MnSq out of the 0.5–1.5 range is misfit [21]. In addition to the construct validity, internal consistency of the HADS was also examined using classical test theory (i.e., Cronbach's α) and Rasch models (i.e., separation reliability), and acceptable value for internal consistency is >0.7 [19].

Based on Rasch analysis, each item has a difficulty value that suggests how hard/easy for the respondents to fulfill the item description. Also, each response descriptor has different difficulties, and we anticipated the difficulty increased by the rating score (i.e., score 3 is harder than score 2, score 2 is harder than score 1 to fulfill each item description, and so on). Therefore, we used the average and step measures of the descriptors to determine whether disordering threshold exists in the HADS. In addition to the monotonically increased difficulties, infit and outfit MnSq within 0.5 and 1.5 suggest no disordering [30]. Finally, we tested the differential item functioning (DIF) across gender. We used both statistical test and DIF contrast (the difficulty for male minus the difficulty for female) to understand whether male patients with epilepsy interpret any HADS items differently from the female patients, and a DIF contrast >0.5 indicates a substantial DIF [31]. That is, male and female patients interpret the same item in different ways. We also tested the DIF across two types of epilepsy (generalized vs. localization related).

Demographics were analyzed using SPSS 17.0 (SPSS Inc., Chicago, IL, USA); CFAs using lavaan package in the R software [32]; Rasch models using WINSTEPS [33].

3. Results

Table 1 also shows the demographic information and the clinical characteristics of the participants; specifically, the mean (SD) age of the participants was 39.1 (7.0) years with a mean educational year of 5.1 (1.2). Although all the patients filled out the HADS, some reported missing values: 42 did not fully answer the anxiety domain of the HADS; 47 did not fully answer the depression domain of the HADS. Because the number of patients with missing values was little ($<5\%$), their HADS data were excluded in both CFA and Rasch models. Of those who ($n = 999$) had fully answered the anxiety domain of the HADS (response rate = 96.0%), 33.8% ($n = 352$) had anxiety and 21.5% ($n = 224$) were borderline case based on the suggested cutoff. Of those who ($n = 994$) had fully answered the depression domain of the HADS