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Psychometric Properties of the Persian Version of Brown Attention Deficit Disorder Scale (BADDS)

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Abstract

Background: Attention deficit hyperactivity disorder (ADHD) is a common neurodevelopmental disorder. Various factors can delay the timely diagnosis of adult ADHD. The brown attention deficit disorder scales (BADDS) is a consistent measure of attention deficit disorder (ADD) across the life span.
Objectives: This article aims to examine the reliability and validity of a Persian version of the BADDS.
Methods: A total of 100 participants were enrolled in this descriptive study by convenience sampling. Cases were recruited from the adult ADHD outpatient clinic of Roozbeh psychiatry hospital in 2019. Controls were from the caregivers of patients presenting to Roozbeh general psychiatry outpatient clinic. The conners adult ADHD rating scale was used to measure concurrent validity.
Results: Cronbach's Alpha was 0.979 for the test ranging from 0.888 to 0.942 for the clusters. Also, the intra-class coefficient (0.977) confirmed strong internal stability. For the cut-off point of 55, the sensitivity was 96%, and the specificity was 74%. Our study demonstrated a significant relationship between the C scale and the D scale of the Conner's test and the total score of the BADDS questionnaire ($r = 0.61$ and $r = 0.64$, respectively), verifying the concurrent validity of the instrument. Construct validity was evaluated by the *t*-test. All five clusters' total and subtotal scores were significantly higher in the patients compared to the controls.
Conclusions: The Persian version of BADDS is reliable and valid and can be used in clinical settings.

Keywords: Attention Deficit Disorder with Hyperactivity, Surveys and Questionnaires, Validation Study

1. Background

Attention deficit hyperactivity disorder (ADHD) is a common neurodevelopmental disorder characterized by a pervasive and lifelong pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning and development (1). Until recently, ADHD was considered a disorder with symptoms presenting only during childhood. This assumption gradually proved to be wrong with the increasing recognition that the symptoms continue to adulthood in most cases (2). Today, the prevalence of ADHD among the adult population is estimated to be around 2.5% to 3% (3, 4), although referrals and diagnosis are much lower. Many obstacles interfere with the timely diagnosis of adult ADHD, and many health care professionals remain unfamiliar with the diagnosis and cannot refer suspicious cases to specialists for further investigations (5). In addition, the literal application of the Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria for ADHD in adult cases (1) leads to underdiagnosis and misdiagnosis as presentations in adults are quite different (6). Furthermore, overlapping symptoms of internalizing disorders such as anxiety or depression, with their high comorbidity rates with adult ADHD, can complicate case detection (7, 8).

Association between ADHD and deficits in executive functions has already been established (9, 10). Accordingly, ADHD is recognized a cognitive disorder involving a pattern of chronic difficulties in executing various daily tasks. Affected individuals have problems carrying out goal-directed activities, planning, self-management, problem-solving, working memory, sustaining attention, and behavioral inhibition. As an individual with ADHD grows older, impairments in executive functions become more prominent compared to attention deficits presenting in childhood. Consequently, the patient experiences difficulties completing college or achieving career milestones, as academic and occupational demands limit their ability to compensate for their deficits (11). Adults with ADHD often report strained and unstable relationships due to poor emotional regulation, listening, and social skills (12). Unfortunately, this course of events occasionally

leads to damaged self-esteem and the development of destructive behaviors, such as substance abuse and dangerous driving habits (13, 14).

A comprehensive diagnostic assessment for adult ADHD currently includes conducting a thorough clinical evaluation performed by an experienced clinician, direct observations, and multiple measures to screen, evaluate, and monitor symptom changes.

The Brown Attention Deficit Disorder Scales (BADDS) is a consistent measure of attention deficit disorder (ADD) across the life span developed in 1996, which screens for and explore the executive cognitive functioning associated with ADHD based on Thomas Brown's cutting-edge model of cognitive impairment in ADD (15). The primary purpose of this scale is to identify a range of symptoms beyond the "inattention" criteria for ADHD in the diagnostic and statistical manual of mental disorders (DSM) (1), assessing additional cognitive and affective impairments associated with attention deficit. These instruments can be used as screening tools in suspected individuals as part of a comprehensive diagnostic assessment of attention deficit and as a tool for monitoring treatment effectiveness.

The BADDS questionnaire comprises 40 self-report items categorized into five main clusters of associated symptoms (organizing and activating work, sustaining attention and concentration, sustaining attention and effort, managing affective interference, and utilizing working memory and accessing recall) (15). A threshold interpretation scale is used to determine an individual's likelihood of attention deficit disorder. In the supplementary section, the manual contains additional questions about the patient's function and a screener for prevalent comorbid diseases such as mood and anxiety disorders, which facilitates a more accurate and comprehensive diagnosis.

In Iran, few studies have investigated the prevalence, neuropsychology, and burden of ADHD (16-18) in the general population and clinical settings. Mental health literacy has also been studied insufficiently (19). Few validated clinical instruments are available to clinicians to evaluate adult ADHD patients. In this study, we examined the psychometric properties of a Persian version of the BADDS questionnaire- a well-known instrument-to fill the gap mentioned above. Besides helping make a diagnosis, this questionnaire uniquely identifies the main areas of executive dysfunctions (the presumed underlying ADHD deficits) and daily life impairments. This can be of great importance in determining directions of non-pharmacological management of ADHD.

2. Objectives

The BADDS questionnaire is considered a valuable instrument in diagnosing and following up on adult ADHD cases. To use this instrument for Iranian patients, we aimed to develop a Persian version and evaluate its psychometric properties.

3. Methods

3.1. Study Design and Sample

This descriptive study aimed to investigate the psychometric properties of the Persian version of the BADDS questionnaire. Key elements studied included test-retest reliability, internal consistency, and validities (content, concurrent, and construct). Sensitivity and specificity were also calculated. All consent procedures and survey instruments used in this study received approval from the ethics committee of the Tehran University of Medical Sciences according to the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The BADDS questionnaire has five items; considering a sample of 10 respondents for each group of items, we calculated a sample size of 50 for the patients and healthy controls.

3.2. Eligibility Criteria, Sources, and Methods of Selection of Participants

In this study, 100 participants were enrolled (65% female). We used convenience sampling to recruit 50 patients who met the inclusion criteria (explained further) from the adult ADHD outpatient clinic at Roozbeh psychiatry hospital in 2019. All patients were interviewed by the same adult ADHD expert psychiatrist using structured clinical interview for DSM-5-research version (SCID-5-RV) (20), who confirmed the diagnosis according to the DSM-5 criteria and ruled out any concurrent comorbid major psychiatric disorders (schizophrenia, major mood disorder, and substance use disorder).

Inclusion criteria comprised (1) age 18 years or older; (2) confirmed case of adult ADHD by an experienced psychiatrist (diagnostic gold standard); and (3) consenting to participate after being briefed about the study (84% accepted to participate). Suffering from psychiatrist-confirmed comorbid major psychiatric disorders (including schizophrenia, major mood disorder, and substance use disorder) was considered a major exclusion criterion (14 patients were excluded, 71 percent due to comorbid MDD). Using the non-random sampling technique, we enrolled 50 participants (30 females and 20 males) selected amongst the caregivers of patients presenting to Roozbeh

general psychiatry outpatient clinic as the healthy control group. The same psychiatrist interviewed the volunteers to rule out ADHD or other major psychiatric disorders in the control group.

3.3. Instruments

3.3.1. Original Questionnaire: The Brown Attention-Deficit Disorder Scale

The Brown Attention-Deficit Disorder Scale is a 40-item self-report questionnaire designed as a screening tool that is also applicable for monitoring treatment outcomes in patients with attention deficit disorder. The subjects should mark each question on a 4-point scale (0 = never, 1 = once a week or less, 2 = twice a week, 3 = almost daily). Converting total scores to T-scores is optional (21). The BADDS has 5 clusters. Each cluster score is calculated by summing up the scores of the corresponding items. The clusters are: Activation (items: 2, 3, 10, 11, 13, 19, 21, 27, 39), attention (items: 1, 4, 5, 6, 8, 23, 26, 32, 36), effort (items:12, 14, 16, 17, 22, 25, 34, 37, 40), affect (items: 9, 18, 20, 24, 29, 30, 31), and memory (items: 7, 15, 28, 33, 35, 38). A score higher than 55 is highly probable for ADHD; in a score between 40 and 54, ADHD is probable but not definite, and in scores lower than 40, ADHD diagnosis is unlikely (the translation process is explained further in detail).

3.3.2. The Conners Adult ADHD Rating Scale (CAARS)

We used the Conners Adult ADHD Rating Scale (CAARS) to measure concurrent validity. This self-report instrument comprises 66 questions that address ADHD symptoms (inattention, hyperactivity, impulsivity), emotional lability, and problems with self-concept and are scored on a 4-point scale (0 = not at all, never; 1 = just a little, once in a while; 2 = pretty much, often; 3 = very much, very frequently). The scores of CAARS are presented in four subscales: A stands for inattention, B stands for hyperactivity and impulsivity, C stands for a combination of inattention and hyperactivity/impulsivity, and D is an index score of a group of other symptoms.

The established high validity and reliability of the CAARS questionnaire have made it suitable for verifying the concurrent validity of other attention-deficit assessment tools, justifying its use in the current study. The screening version has been translated into Persian and was used in the present research (22, 23).

3.4. Translation Process and Procedure

Having obtained permission from the original developer, we followed a 5-step methodology according to the World Health Organization guideline for translation of foreign instruments (24):

The first step was the original forward translation, in which two bilingual psychiatry trainees independently translated the questionnaire into Persian. After consulting with two senior psychiatrists experienced in adult ADHD, the team reached a consensus on the translation of each item.

In the second step, to establish content validity, we organized an expert panel of 10 university faculty members (all psychiatrists and clinical psychologists) to evaluate the level of understandability of each statement and the semantic and content equivalence between English sentences and their Persian counterparts. Each item was rated on a scale from 1 to 5 (higher scores indicating higher appropriateness and relevance). Items scoring below four were considered unacceptable and were revised (4 items).

For pilot testing (the third step), ten ADHD patients read the modified Persian questionnaire and rated the comprehensibility and clarity of each item. The patients reported no ambiguity or incomprehensibility.

The fourth step was back-translation. In this step, two bilingual translators who had not seen the original English instrument and were unfamiliar with the field of mental health translated the modified Persian questionnaire back into English. This step confirmed the correct translation of the content from the original version in the translation.

In the final step, equivalence testing, an expert panel of 6 university faculty members compared the original and back-translation versions of the BAADS. They rated content equivalence using a 5-point Likert scale to measure translation quality. After minor revisions, the expert committee finalized the Persian version, confirmed the content validity, and declared the questionnaire suitable.

After obtaining informed consent, we instructed participants to answer the Persian version of BAADS and CAARS under the supervision of a trained clinical psychologist (the control group were only required to fill the BAADS). Simultaneous completion of the two questionnaires provided us the opportunity to determine concurrent validity.

To obtain test-retest reliability, we asked the same patients to complete the BAADS questionnaire for a second time during their next visit two weeks later. During these two weeks, the psychiatrist withheld medication prescription and dose adjustments (unless side effects had emerged) to maintain a stable condition and lower the risk of measurement errors.

3.5. Statistical Analysis

Data extracted from the filled questionnaires were analyzed using SPSS-19. Cronbach's Alpha (α) was calculated for internal consistency. The Pearson Correlation Coefficient and Spearman Correlation Coefficient were used for

measurement of test-retest reliability for each question and cluster.

Content validity was confirmed through expert group opinion. The concurrent validity of the Persian version of BADDS (total score and each of its five clusters) was tested by its Pearson correlations (r) with the complete scales and subscales (C and D) from the validated Persian CAARS questionnaire. Furthermore, construct validity was evaluated based on the results of the BADDS questionnaire with the clinical interview (viewed as the diagnostic gold standard).

Also, sensitivity and specificity were calculated using the ROC curve method. Furthermore, based on the ROC curve, we introduced other cut-offs suitable for the Persian version of the BAADS questionnaire.

4. Results

4.1. Demographic Data

In this survey, we enrolled 100 participants (65% female). The patient and control groups' mean age (mean ± SD) was 29.90 ± 6.34 and 30.58 ± 4.79, respectively. The eldest participant was 51 years old, and the youngest was 19 years old. The differences in age and gender between the two groups were statistically insignificant (P = 0.78 and P = 0.29, respectively) (Table 1).

Table 1. Demographic Characteristics of Patients and Control Group

Variables	Patients	Controls	P Value
Age (mean ± SD)	29.90 ± 6.34	30.58 ± 4.79	0.780
Gender (Female/Male)	30/20	35/15	0.290

4.2. Validity

For assessing the content validity, we relied on the expert group judgment. The experts scored each item on a scale from 1 to 5 (higher scores indicating more comprehensiveness and relevance). Items with an average score below four were considered unacceptable and were revised (4 items). Finally, the content validity index (CVI) was calculated for each item which was 1 for all items.

We tested the concurrent validity of the Persian version of the BADDS questionnaire (total score and five clusters) by comparing it with the total and subscale scores of the validated Persian CAARS questionnaire using Pearson's correlation coefficient (r). Our study demonstrated a significant relationship between the C and the D scales of the Conner's test and the total score of the BADDS questionnaire (r = 0.61 and r = 0.64, respectively), verifying the concurrent validity of the instrument. Pearson correlation coefficient between the C and D scales of the Conner's test and each cluster of the brown questionnaire are demonstrated in Table 2.

We evaluated the construct validity using the *t*-test to compare the results between the patients and the controls. All five clusters' total score and subtotal score were significantly higher in the patients (the average total score was 33 points higher in the patient group, Table 3).

4.3. Reliability

We used test-retest reliability and internal consistency to assess the stability of the Persian version of the BADDS questionnaire.

To measure each question's test-retest reliability and each cluster, we used the Spearman Correlation Coefficient for each question and Pearson Correlation Coefficient for each cluster, respectively. We found a strong correlation (ranging from 0.93 to 0.65) among 36 out of 40 questions, demonstrating a high test-retest reliability of the BADDS questionnaire. The remaining four questions indicated a moderate correlation (ranging from 0.57 to 0.65). These four items were as follows:

- Doesn't seem to be listening, and other complaint about it (0.571).

- Receives criticism for not working up to potential (e.g., "could do so much better if only…would try harder or work more consistently") (0.608).

- Loses track in the required reading of what has just been read and needs to read it again; understands the words, but what was read "just doesn't stick" (0.596).

-"Spaces out" involuntarily and frequently when required reading; keeps thinking of things that have nothing to do with what is being read (0.596).

The calculated correlation coefficients from the total score and the cluster scores also indicated the stability of the test (ranging from 0.81 to 0.92).

We used Cronbach's alpha (α) and the intraclass correlation coefficient (ICC) to assess the internal consistency. Table 4 tabulates the coefficient alpha and intraclass coefficient we calculated for the total score and each cluster separately. Cronbach's alpha for the test was 0.979, and for the clusters, ranged from 0.888 to 0.942, indicating an excellent internal consistency. Also, the intraclass coefficient of the test was 0.977, which confirms the strong internal stability of the BADDS questionnaire.

4.4. Sensitivity and Specificity

We calculated the sensitivity and specificity using the ROC curve method. According to the curve, at the cut-off point of 55, the sensitivity was 96%, and the specificity was 74%. If we consider 70 as the cut-off point, the sensitivity will be 92%, and the false positives will fall to only 2%.

Table 2. Pearson Correlation Coefficient Between the Scale of CAARS and Each Cluster of BADDS

Variables	BADDS Total Score	Activation	Attention	Effort	Affect	Memory
Conner's A [a]	-	0.490**	0.334*	0.384**	0.450**	Not significant
Conner's B [b]	-	0.370**	0.304*	0.347*	Not significant	Not significant
Conner's [c]	0.61	0.552**	0.468**	0.548**	0.402**	0.351*
Conner's [d]	0.64	0.569**	0.478**	0.388**	0.570**	0.406**

Abbreviation: BADDS, Brown Attention Deficit Disorder Scale; CAARS, The Conners Adult ADHD Rating Scale.
[a] Inattention symptoms.
[b] Hyperactivity/impulsivity symptoms.
[c] Combined symptoms.
[d] Index symptoms.

Table 3. Comparison in Clusters of Brown Attention Deficit Disorder Scale (BADDS) Between Patients and Controls by Implementing the *t*-test

Variables	Patient Average Score	Control Average Score	P Value	DF	*t*
Total	86.26	53.22	0.000	77.62	20.45
Activation	80.72	52.52	0.000	81.05	18.30
Attention	80.78	53.64	0.000	98	19.34
Effort	85.90	53.86	0.000	77.98	17.76
Affect	78.46	54.42	0.000	77.88	11.57
Memory	74.26	52.40	0.000	61.76	12.11

Table 4. Internal Consistency According to Intraclass Correlation and Cronbach's Alpha

Variables	Cronbach's Alpha	Intra Class Correlation	Value	Df1	Df2	Sig.
Total score	0.979	0.977	48.281	99	3861	0.000
Activation	0.922	0.912	12.766	99	792	0.000
Attention	0.942	0.935	17.211	99	792	0.000
Effort	0.933	0.931	14.939	99	792	0.000
Affect	0.883	0.876	8.554	99	594	0.000
Memory	0.869	0.864	7.638	99	495	0.000

5. Discussion

We evaluated the psychometric properties of a Persian version of BADDS. This rating scale demonstrated favorable results regarding various forms of validity (content, concurrent, and construct).

As our findings demonstrated, this rating scale had a good test-retest reliability for each question and cluster with high internal consistency (Cronbach's Alpha for the test was 0.979, and for the subgroups, ranged from 0.888 to 0.942, and the intraclass coefficient of the test was 0.977).

The original version of the BADDS questionnaire yielded remarkable psychometric properties. The Cronbach Alpha coefficient (r = 0.95) for the total score and cluster subtotal scores (r = 0.79 - 0.92) indicates high internal consistency. The intercorrelation coefficients among the five clusters ranged from 0.63 to 0.85 in the adult participants, indicating a high reliability. The overall Kappa score for clinical application was also measured and reported as 0.85. Furthermore, the test-retest reliability demonstrated a high correlation between the first and the second administration (r = 0.87). Concurrent validity was also high. Sensitivity and specificity were 96% and 94% respectively, with a cut-off point of 55 (25-27).

The BADDS has been translated into languages other than English too. Psychometric properties of a French version were evaluated among 259 adults by Romo et al. The internal consistency seemed adequate (alpha: 0.8 - 0.9) (28). Similarly, in a Portuguese version, BADDS had a good internal consistency (Cronbach's alpha of 0.95) and fair sensitivity (72%), and specificity (88% accuracy). Its discriminant validity for people with substance abuse was also demonstrated (29).

Solanto et al. evaluated BADDS in 93 adults who presented with ADHD. It was observed that the memory clus-

ter has a high sensitivity for ADHD (90%). However, it had a low specificity (70%). They concluded that BADDS could be of assistance in demonstrating the severity of the executive dysfunctions. Still, it cannot accurately differentiate ADHD from other psychiatric comorbidities such as mood or anxiety disorders (30).

Similarly, BADDS demonstrated high sensitivity and proved most valuable for the clinical diagnosis of ADHD. However, its specificity was low, particularly in the presence of depression symptoms. Reasonable reliability with Cronbach's alpha between 0.685 and 0.809 was reported (31).

In 2002, Rucklidge et al. examined the psychometric properties of BADDS in 91 adolescents. Patients with ADHD scored higher in the clusters of activation, effort, and attention compared to the control group and those with learning disorders. Unlike the two abovementioned studies, a false negative of 46.7% for patients below the cut-off of 55 was reported, which demonstrated its limited utility for the identification of the patients (32).

In a review conducted in 2006, BADDS was introduced as a comprehensive instrument for diagnosing ADHD which covers different psychopathological syndrome scores and functional disabilities (33).

Using BADDS in clinical settings can be quite valuable in two ways: first, it facilitates identification and referral of potential cases by clinicians, given the fact the level of expertise of practicing clinicians varies depending on the geographical locations. Secondly, this rating scale offers a general outline of the possible areas of executive mismanagement that could greatly assist in planning non-pharmacologic interventions (e.g., coaching, CBT). This is particularly important for neuropsychological assessment in settings with limited resources. It also can assist in the design and implementation of non-pharmacological treatments according to the patient's executive function profile. Furthermore, BADDS has been used as a measure of executive function in many pharmacological studies on adults with ADHD (34, 35).

In children with ADHD, executive dysfunctions may persist in adulthood (17). It has been shown that considering both executive function impairments and DSM criteria for ADHD can strengthen the diagnosis in clinical practice. In a study by Silverstein et al., a strong correlation between ADHD symptoms and executive dysfunction was found, and authors suggested screening for executive dysfunctions in patients with ADHD (36). It has been revealed that executive dysfunction observed in rating scales impairs the quality of life of adults with ADHD. However, such contribution cannot be obtained by neuropsychological batteries (37).

5.1. Strengths and Limitations

This study had several strengths and limitations. It was the first study that used BADDS in a clinical setting with a healthy control group. Moreover, parallel use of CAARS facilitated comparison between these two tests. Furthermore, we found it a reliable and valid instrument to be used both for the diagnosis and treatment planning of adults with ADHD as it sheds light on the potential executive dysfunctions. Yet, this study did not lead to any further conclusions on how accurately specific executive dysfunctions may be involved in the clinical presentations. This study relied on self-report measures and clinical interviews, which might have led to underdiagnosis. Application of executive function tests and interviews with the caregivers are suggested for further studies. As a caveat, we excluded those patients with comorbid conditions. Therefore, this needs to be considered in actual clinical settings where adult ADHD patients may present with concurrent comorbidities. Thus, the study of the discriminant validity of this instrument in patients with comorbidities is highly recommended. Also, a potential referral bias cannot be refuted as Roozbeh hospital is a nationally-known referral center. Finally, a larger sample size could provide more reliable data for a more robust conclusion.

5.2. Conclusions

In conclusion, we found that the Persian version of BADDS was reliable and valid and can be used in clinical settings to diagnose and assess executive dysfunctions. The development of a profile of executive dysfunctions can lead to better planning of non-medication interventions like CBT and coaching

Footnotes

Authors' Contribution: Study concept and design, Javad Alaghband-rad, Hedieh Arshiani, Valentin Artounian; Acquisition of data, Hedieh Arshiani; Analysis and interpretation of data, Hedieh Arshiani, Mahtab Motamed; Drafting of the manuscript, Hedieh Arshiani, Mahtab Motamed, Javad Alaghband-rad, Valentin Artounian; Critical revision of the manuscript for important intellectual content, Javad Alaghband-rad, Mahtab Motamed; Statistical analysis, Hedieh Arshiani; Administrative, technical, and material support: Mahtab Motamed, Valentin Artounian; Study supervision, Javad Alaghband-rad, Valentin Artounian.

Conflict of Interests: The authors declare no conflict of interest.

Data Reproducibility: The data presented in this study are openly available in one of the repositories or will be available on request from the corresponding author by

this journal representative at any time during submission or after publication. Otherwise, all consequences of possible withdrawal or future retraction will be with the corresponding author.

Ethical Approval: The study protocol was approved by the local ethics review committee of the Tehran University of Medical Sciences (IR.TUMS.MEDICINE.REC.1397.553; link: ethics.research.ac.ir/EthicsProposalView.php?id=31707)

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