*Research Article*

# Validity and Reliability of the Persian Version of Conner's Adult ADHD Rating Scales: Observer and Self-report Screening Versions

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## Abstract

**Purpose:** To adapt and assess the validity and Reliability of the Persian Observer and Self-report Screening Versions of Conner's Adult ADHD Rating Scales.

**Methods:** The Self-report Screening Version of the Conner's Adult ADHD Rating Scales (CAARS-S:SV) and Observer Screening Version of the Conner's Adult ADHD Rating Scales(CAARS-O:SV) were translated into Persian by two bilingual experts and after minor changes by an expert panel were back-translated into English and were confirmed for compatibility with the original version. The Persian version of CAARS-S:SV was completed by 80 patients with confirmed adult ADHD as well as 160 healthy adults without ADHD. The Persian version of CAARS-O:SV was completed by a family member of the patients and controls who had close observation on their behaviors. Participants in all groups repeated completing the Persian versions of CAARS-S:SV and CAARS-O:SV after two weeks. Two other instruments were completed in parallel with Persian versions of CAARS-S:SV and CAARS-O:SV to assess the concurrent validity. The content validity, concurrent validity, diagnostic accuracy, internal consistency and test-retest reliability of the two CAARS scales adapted in Persian were assessed using appropriate statistical methods.

**Results:** Internal consistency of both the CAARS-S:SV and CAARS-O:SV using Cronbach's alpha were recorded to be high for both scales including all four subscales within an alpha range of 0.82-0.97. Both CAARS-S:SV and CAARS-O:SV showed high test-retest reliability. Content validity of the Persian version of CAARS-S:SV and CAARS-O:SV were confirmed according to the modified kappa value above 0.76 for all items included in CAARS-S:SV and CAARS-O:SV. Concurrent validity of CAARS-S:SV and CAARS-O:SV was generally confirmed both for assessing inattentive symptoms, and hyperactivity/impulsive symptoms . Both CAARS-S:SV and CAARS-O:SV scales had an area under Receiver Operating Characteristic(ROC) curve above 0.88 for all subscales indicating high validity of the scales to be used as screening tools for adult ADHD.

**Conclusion:** Persian version of the CAARS-S:SV and CAARS-O:SV scales could be used as valid and reliable measures of adult ADHD-related symptoms and behaviors.

## Introduction

Attention deficit hyperactivity disorder (ADHD) is a disorder mainly affecting children. However, it is also relatively common in adults, with a prevalence reaching up to five percent in the general population [1]. Adult attention deficit hyperactivity disorder has gained increasing attention in recent years. Screening for adult ADHD could be of high value both for clinicians and health researchers. No doubt, a standard and valid screening tool would be needed to ensure feasibility of detecting the disorder in a wider range of clinical practice and research. Conners and colleagues have developed screening versions of the Conners' Adult ADHD Rating Scales (CAARS)[2].Various versions of CAARS tools are translated and used in several languages[3-11]. Developing validated Persian versions of CAARS tools are needed to be used in Iran. The aim of this study was to develop the Persian versions of Conner's Adult ADHD Rating Scales(CAARS-S:SV) and observer Screening version of the Conner's Adult ADHD Rating Scales(CAARS-O:SV) and assess their reliability and validity.

## Methods

Two versions of the available scales for screening of adult attention deficit hyperactivity disorder were translated into Persian and assessed for reliability and validity in a cross-sectional study conducted in 2012-2013 in Tabriz, Iran. These included Conner's Adult ADHD Rating Scale observer screening version (CAARS-O:SV) and Conner's Adult ADHD Rating Scale self-report screening version(CAARS-S:SV). These tools have previously been developed with 30 items each in English as part of the Conner's Adult ADHD Rating Scales (CAARS[TM]). These have been proved to be highly valid and reliable instruments measuring adult ADHD-related symptoms and behaviors [2].

### Participants

Four groups of participants were enrolled in present study.

1- *Patients with adult ADHD :* A total of 80 patients with confirmed diagnosis of adult ADHD were enrolled to complete Persian version of CAARS-S:SV. ADHD was diagnosed based on interviews made by a psychiatrist according to DSM IV-TR and Wender Utah criteria for adult ADHD. All those with an Axis I diagnosis were excluded from the study.

2- *Observers of the patients with adult ADHD:* A total of 80 participants were selected from among the family members of the patients through a convenient purposive sampling to select the most informant collaborating and reliable person complete the Persian version of CAARS-O:SV.

3- *Healthy controls:* A total of 160 participants were selected through a convenient sampling method from among accompanying persons of the patients in outpatient and inpatient referrals in Razi University Hospital. Razi University Hospital is a neurology/psychiatry hospital with patient referral from East Azerbaijan Province. Participants with known cognitive or psychiatric diseases were excluded from the study and all the participants underwent a psychiatric interview to enroll adult ADHD.

4- *Observers of the healthy controls:* A total of 160 participants were selected from among the family members of the control participants through a convenient purposive sampling to select the most informant collaborating and reliable person complete the Persian version of CAARS-O:SV.

All the participants of this study were educated to fill in the questionnaires provided for them according to the methodology of the study.

### Preparation of the Persian versions

The English versions of CAARS-S:SV and CAARS-O:SV scales were translated into Persian by two bilingual experts providing the first draft of the Persian versions of CAARS-S:SV and CAARS-O:SV scales after reaching dual agreement on the translation of English text. The draft then was checked by an expert panel of three psychiatrists, two epidemiologists and a psychologist with at least four years of experience with ADHD patients or clinical research in this field. Except for few minor changes, no major change was applied to the original instrument. For instance, in item 1 of the both scales, losing "to-do lists" which was expected to be a quite odd experience by Iranians, was replaced with losing "keys". The Persian translation agreed by the expert panel was then back-translated into English by another bilingual person and was compared for compatibility with the original version.

### Content validity

Content validity of the Persian versions was assessed through evaluating the instrument by field experts. They assessed all the items of the scales for clarity and relevance on a 4-point Likert-type scale. Modified Kappa was used as a modified content validity index [12].

### Concurrent validity

To assess the concurrent validity, two other instruments were completed in parallel with Persian versions of CAARS-S:SV and CAARS-O:SV. The first scale was Barratt Impulsiveness Scale(BIS) which is a 30-item self-report instrument developed to assess general impulsiveness and the second one was Mindful Attention Awareness Scale (MAAS) which is a 15-item self-report instrument to assess mindfulness is considered as a receptive awareness of and attention to what is taking place in the present [13,14]. To confirm the concurrent validity of the Persian versions of CAARS-S:SV and CAARS-O:SV, it was hypothesized that subscale B of CAARS screening version should be correlated with the BIS score. Moreover, it was hypothesized that subscale A of CAARS screening version should be correlated with MAAS score.

### Construct validity

The construct validity of CAARS have been previously assessed in two forms through investigating relationships between A: current ADHD symptoms assessed by the scale and childhood ADHD symptoms. B: current ADHD symptoms assessed by the self-report screening version and observer screening version[2]. In present study we had the opportunity to assess the second form through investigating potential relationship between the self-report and observer versions.

### Diagnostic value

To assess the diagnostic value of the Persian version of CAARS-S:SV and CAARS-O:SV scales , receiver operating characteristic curves were plotted considering the gold standard to be the psychiatric medical diagnosis according to the Diagnostic and Statistical Manual of Mental Disorders DSM-IV-TR and the Wender Utah criteria for the diagnosis of adult attention deficit hyperactivity disorder [15].

### Internal Consistency

Internal consistency of the scale was assessed for both scales and for all subscales (A, B, C, D) separately for those with a diagnosis ADHD as well as healthy people without adult ADHD.

### Test-retest reliability

Persian version of CAARS-S:SV was completed twice both by those with a diagnosis of adult ADHD and healthy controls within an interval period of two weeks. A high agreement and high correlation between the two measurements were hypothesized to exist as an indicator of test-retest reliability. The same procedure was done for the Persian version of CAARS-O:SV completed by the observers of ADHD and control group participants.

### Statistical Analysis

All the data were analyzed using Stata version 11 statistical software package. To describe the study sample, basic descriptive statistics such as means, standard deviations(SD) and frequencies were reported. Distribution of age between the groups was compared using independent t-test. Distribution of sex and educational level between the groups was compared using Chi-square test. Internal consistency was assessed using Cronbach's alpha. Test-retest reliability was investigated using intra-class correlation coefficient(ICC), Kandal's Tau and Pearson's correlation coefficient. The concurrent validity was assessed using Pearson's correlation coefficient between BIS score and subscale B of CAARS as well as between MAAS score and subscale A of CAARS. The content validity statistic used in this study was the modified content validity index(modified Kappa). This index is preferred to traditional I-CVI because it measures also the chance agreement. The index is presented as k* and is calculated as follows "according

to Polit *et al.* [12].

$$k^* = \frac{\text{I-CVI} - p_c}{1 - p_c}$$

Where Pc is reached through

$$p_c = \left[ \frac{N!}{A!(N-A)!} \right] .5^N$$

Where N= number of experts and A= Number agreeing on good relevance"

Construct validity was assessed using ICC derived assuming a two-way mixed effects model. The ICC was calculated based on individual unit of analysis(individual ICC) rather than average ICC. Moreover, the ICC was calculated under absolute agreement rather than under consistency of agreement.

The diagnostic value of the scales were assessed plotting ROC curves and calculating the area under curve. Through all statistical procedures, a *P-value* <0.05 was considered as statistically significant.

## Results

### *Participants*

Males comprised 133(55.4%) of all the participants without a significant difference in gender distribution between the ADHD and control groups. Mean age of the participants with a confirmed diagnosis of adult ADHD was 34.4(SD =7.1) years and mean age of the control group participants was 31.6(SD =8) years. No statistically significant difference was observed between the two groups with respect to age distribution. The subjects in control group had higher literacy levels compared with those who had adult ADHD (P<0.01).

### *Reliability assessments*

Internal consistency of the both the Persian versions of CAARS-S:SV and CAARS-O:SV using Cronbach's alpha were recorded to be high for both scales including all four subscales within a range of 0.82-0.97. The internal consistency didn't significantly vary with respect to gender. Details of internal consistency measures are given in Table 1.

Test-retest reliability was satisfactory with intraclass correlation coefficients (ICCs) above 0.9 for the Persian versions of both CAARS-S:SV and CAARS-O:SV subscales and raw total score. Both CAARS-S:SV and CAARS-O:SV showed high test-retest reliability assessed by Kendall's Tau and Pearson's correlation coefficient statistics. Details of these reliability statistics are given in Table2.

**Table 1.** Internal consistency of the Persian version of Conner's Adult ADHD Rating Scales(observer & self-report screening versions)

| Sample type | Scale type | Coefficients of internal consistency (Cronbach's alpha) | | | | |
|---|---|---|---|---|---|---|
| | | A* | B* | C* | D* | T* |
| Healthy control sample | CAARS-S:SV** | 0.84 | 0.82 | 0.89 | 0.83 | 0.92 |
| | CAARS-O:SV*** | 0.81 | 0.76 | 0.87 | 0.84 | 0.93 |
| Adult ADHD sample | CAARS-S:SV | 0.9 | 0.86 | 0.89 | 0.84 | 0.93 |
| | CAARS-O:SV | 0.88 | 0.87 | 0.91 | 0.84 | 0.93 |
| *A: DSM-IV inattentive symptoms B: DSM-IV hyperactivity/impulsive symptoms C: DSM-IV ADHD symptoms total D: ADHD index T: total raw score ** Conner's Adult ADHD Rating Scales: Self-report screening version ** *Conner's Adult ADHD Rating Scales: Self-report screening version | | | | | | |

**Table 2.** Test-retest reliability of the Persian versions of CAARS-S:SV and CAARS-O:SV subscales.

| | Conner's Adult ADHD Rating Scale Self-report Screening Version(CAARS-S:SV) | | | | Conner's Adult ADHD Rating Scale Observer Screening Version(CAARS-O:SV) | | | |
|---|---|---|---|---|---|---|---|---|
| Scale | Kendall's tau | | Pearson's correlation coefficient | | Kendall's tau | | Pearson's correlation coefficient | |
| | Coefficient | *P value* | Coefficient | *P value* | Coefficient | *P value* | Coefficient | *P value* |
| Subscale A | 0.81 | <0.0001 | 0.96 | <0.0001 | 0.84 | <0.0001 | 0.98 | <0.0001 |
| Subscale B | 0.83 | <0.0001 | 0.96 | <0.0001 | 0.87 | <0.0001 | 0.98 | <0.0001 |
| Subscale C | 0.86 | <0.0001 | 0.96 | <0.0001 | 0.89 | <0.0001 | 0.98 | <0.0001 |
| Subscale D | 0.86 | <0.0001 | 0.97 | <0.0001 | 0.86 | <0.0001 | 0.98 | <0.0001 |
| Total raw score | 0.88 | <0.0001 | 0.97 | <0.0001 | 0.91 | <0.0001 | 0.98 | <0.0001 |
| A: DSM-IV inattentive symptoms B: DSM-IV hyperactivity/impulsive symptoms C: DSM-IV ADHD symptoms total D: ADHD index T: total raw score | | | | | | | | |

### *Validity assessments*

Content validity of the Persian version of CAARS-S:SV and CAARS-O:SV was confirmed according to the modified kappa above 0.76 for all items included in CAARS-S:SV and CAARS-O:SV.

Concurrent validity of CAARS-S:SV and CAARS-O:SV was

generally confirmed both for assessing inattentive symptoms and hyperactivity/impulsive symptoms . A negative correlation coefficient equal to -0.75 was observed between MAAS single factor score and subscale A (DSM-IV inattentive symptoms assessed through ) of CAARS-S:SV(P<0.001). Similarly, a negative correlation coefficient equal to -0.72 was observed between MAAS single factor score and subscale A of CAARS-O:SV(P<0.001). A moderate and significant correlation existed

between subscale B score of CAARS-S:SV and the score assessed for Barratt Impulsiveness Scale (Pearson Coefficient= 0.55, P<0.001). A weak but significant correlation existed subscale B score of CAARS-O:SV and the score assessed for Barratt Impulsiveness Scale (Pearson Coefficient= 0.32, P<0.001).

Construct validity of the scales were confirmed according to the calculated ICCs. All subscales of CAARS scales in this study were above 0.7 except for subscale A that had an ICC equal to 0.68. The lower bounds of the 95% confidence intervals for all the calculated ICCs were above 0.5.

The diagnostic value analysis was done plotting ROC curves. The area under ROC curve was high enough to be considered as a main indicator of the high validity of the CAARS-S:SV and CAARS-O:SV scores for screening adult ADHD. Both CAARS-S:SV and CAARS-O:SV scales had an area under curve above 0.88 for all subscales. The subscale D, known as ADHD index, had the largest area under curve both for CAARS-S:SV and CAARS-O:SV (Figure 1).

Parametric ROC analysis conducted for ADHD index provided the ROC curve confidence band and 95% confidence intervals for the area under the curve were produced according to a significant parametric model with 19 post-estimation cutoffs (Figure 2). The estimated area under the curve for ADHD index was about 0.96 both for CAARS-S:SV and CAARS-O:SV.
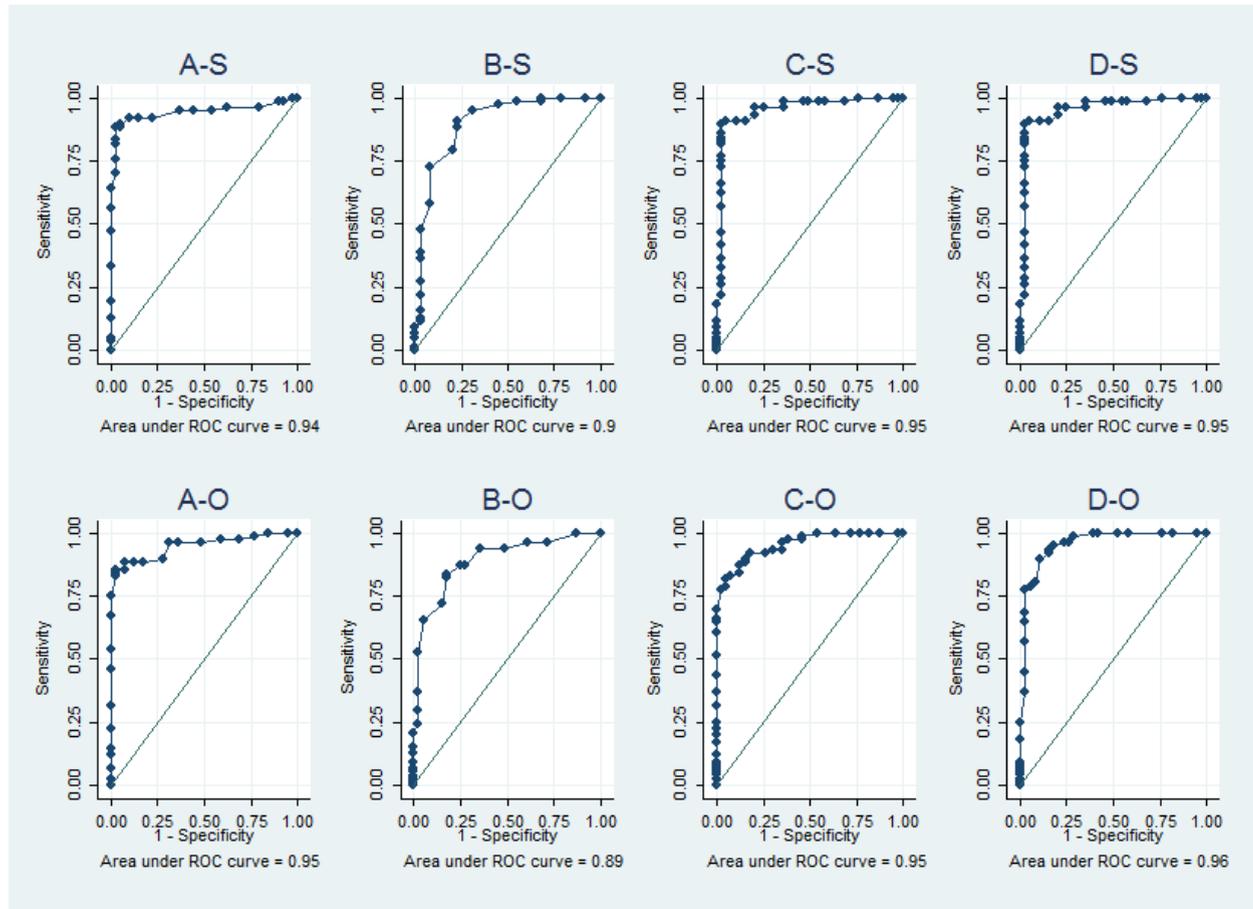


Upper row graphs: Persian self-report version of Conner's Adult ADHD Rating Scale(CAARS-S:SV)
Lower row graphs: Persian observer version of Conner's Adult ADHD Rating Scale(CAARS-O:SV)
A-S:DSM-IV   inattentive symptoms  assessed through  CAARS-S:SV
B-S: DSM-IV   hyperactivity/impulsive  symptoms  assessed through  CAARS-S:SV
C-S: DSM-IV   ADHD symptoms total    assessed through  CAARS-S:SV
D-S: ADHD index assessed through  CAARS-S:SV
A-O:DSM-IV   inattentive symptoms  assessed through  CAARS-O:SV
B-O: DSM-IV   hyperactivity/impulsive  symptoms  assessed through  CAARS-O:SV
C-O: DSM-IV   ADHD symptoms total    assessed through  CAARS-O:SV
D-S: ADHD index assessed through  CAARS-O:SV

**Figure 1.** Receiver operating curves representing diagnostic value of the Persian version of  CAARS-S:SV and CAARS-O:SV scores for screening adult ADHD.
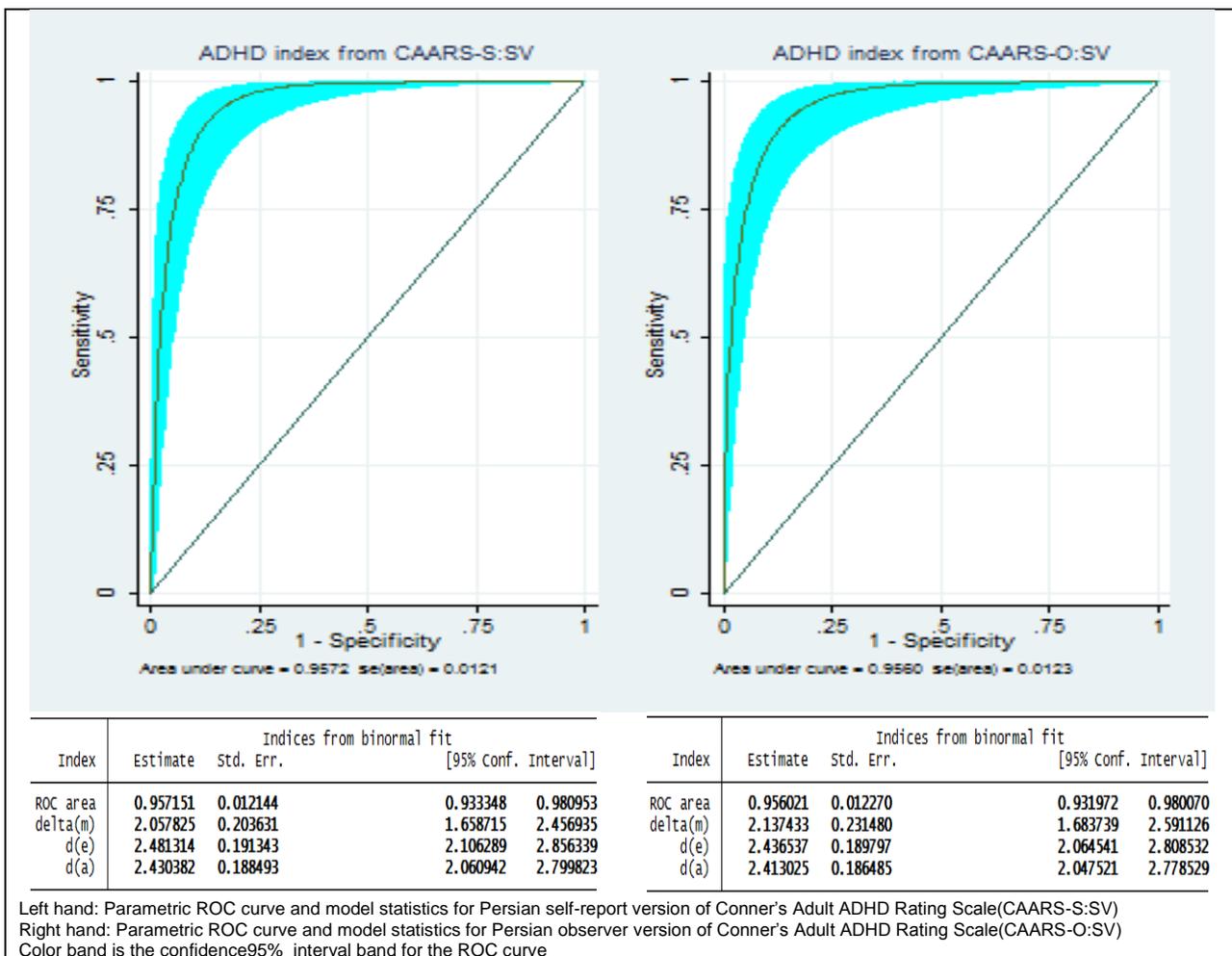
## Discussion

The psychometric assessment of the Persian Version of the two CAARS-S:SV and CAARS-O:SV scales showed approved the reliability and validity of them to be used for screening adult ADHD. With respect to reliability, the internal consistency of both the CAARS-S:SV and CAARS-O:SV were high for both scales. This high internal consistency existed not only for the whole scale but also for all the four subscales. Although several studies have been done on psychometric assessment of ADHD scales for childhood, very few studies have specifically done on adult screening versions of CAARS. The high internal consistency recorded for the Persian versions was consistent with previous studies on German and English adult versions which reported Cronbach's alpha to be above 0.8 for most subscales [2,10,11]. Test-retest reliability in our study was excellent and higher than the German versions.

Although not much necessary due to the wide spread of the CAARS tools, content validity was also assessed in this study based on the ratings of experts to prevent clarity or relevance loss due to translational restrictions. The results for content validity were also promising. To assess the content validity based on the expert views, traditional a consensus-based content validity index is being used in most studies. However, we used and alternative modified measure that takes into account the consistency of agreements [12].

Conners and colleagues themselves have assessed the construct validity through investigating relationships of CAARS with childhood symptoms and relationship between observer and self-report versions. In present study ,however, the authors only assessed the relationship between observer and self-report versions without asking about the childhood. This was because we thought enough and reliable information could not be achieved by investigating childhood status [2].

Both CAARS-S:SV and CAARS-O:SV showed high test-retest reliability. Content validity of the Persian version of CAARS-S:SV and CAARS-O:SV were confirmed according to the modified kappa value above 0.76 for all items included in CAARS-S:SV and CAARS-O:SV. Concurrent validity of CAARS-S:SV and CAARS-O:SV was generally confirmed both for assessing inattentive symptoms, and hyperactivity/impulsive symptoms . Both CAARS-S:SV and CAARS-O:SV scales had an area under Receiver Operating Characteristic(ROC) curve above 0.88 for all subscales indicating high validity of the scales to be used as screening tools for adult ADHD.



Left hand: Parametric ROC curve and model statistics for Persian self-report version of Conner's Adult ADHD Rating Scale(CAARS-S:SV)
Right hand: Parametric ROC curve and model statistics for Persian observer version of Conner's Adult ADHD Rating Scale(CAARS-O:SV)
Color band is the confidence95% interval band for the ROC curve

**Figure 2.** Parametric ROC curve and model statistics for ADHD index derived from the Persian screening versions of Conner's Adult ADHD Rating Scale.

In present study the discriminant validity was not investigated because due to high comorbidity of ADHD with other conditions it was hard to find appropriate tool for assessing discriminant validity. Christiansen et al. had hypothesized lack of correlations between ADHD scales and Beck Depression Inventory (BDI). In contrast, they had found a significant association between the two scales [10]. This could be expected considering the comorbidity of ADHD with depression [16]. We believe that BDI could be used to assess convergent validity of ADHD scales in adults. Our results assessing the concurrent validity of CAARS

screening versions was consistent with German study that similarly with us had found a significant association between BIS and ADHD scales. The relationships found between MAAS and ADHD scales was another fact confirming the concurrent validity of Persian versions of CAARS-S:SV and CAARS-O:SV.

An important finding confirming the validity of Persian versions of Conners' screening tool for ADHD was its high diagnostic value according to the large area under ROC curve in present study. Consistent with two previous studies the high diagnostic value of the scales is considered as an important indicator of the validity, but no doubt no questionnaire could independently replace the clinical decision making by the psychiatrist using mult-imethod assessments. The area under ROC curve in present study was found to highest for ADHD index(subscale D) that reconfirms the original findings of Conners et al. on its diagnostic value [2].

Here we recommend the Persian versions of CAARS-S:SV and CAARS-O:SV to be abbreviated as PCAARS-S:SV and PCAARS-O:SV respectively.

## Conclusion

PCAARS-S:SV  as the Persian self-report screening version  of the Conner's Adult ADHD Rating Scale,  and PCAARS-O:SV as the  Persian observer screening version   of the Conner's Adult ADHD Rating Scale  could be used as a valid and reliable for screening adult attention-deficit hyperactivity disorder   in populations speaking the Iranian Persian language. For application in populations speaking other variants of Persian language, some modification's may be needed.

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