Core Items Selection and Psychometric Properties of the Adult Attention-Deficit Hyperactivity Disorder Self-Report Scale-Chinese Short Version (ASRS-CSV)

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Abstract

Objective: This study aimed to develop and validate the Chinese Short Version of the Adult ADHD Self-Report Scale (ASRS-CSV), addressing the need for culturally appropriate diagnostic tools for Attention-Deficit Hyperactivity Disorder (ADHD) in the Chinese adult population.

Methods: Utilizing a combination of intergroup difference analysis, factor analysis, and network analysis, we identified core ADHD symptoms pertinent to the Chinese cultural context. The study involved two samples: a vocational and technical school sample (N=1144) and an internet sample (N=1654), comprising adults aged 16-25 years. Reliability, validity, and diagnostic efficacy of the ASRS-CSV were assessed through psychometric testing.

Results: The ASRS-CSV demonstrated high internal consistency (Cronbach' s alpha $>$ 0.9) and robust convergent validity (AVE $>$ 0.7). The scale' s diagnostic cutoff points were optimized, revealing high sensitivity and specificity for ADHD screening. Cross-cultural analysis highlighted differences in core ADHD symptoms between Chinese and Western populations, underscoring the scale' s cultural sensitivity.

Conclusion: The ASRS-CSV is a reliable, valid, and efficient tool for screening ADHD in Chinese adults, reflecting the socio-cultural nuances of ADHD symptomatology. Its development marks a significant advancement in the field of psychiatry, offering a tailored approach for ADHD assessment in China and contributing to the global discourse on cross-cultural psychiatric diagnosis.

Full Text

Preamble

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Abstract

Objective: This study aimed to develop and validate the Chinese Short Version of the Adult ADHD Self-Report Scale (ASRS-CSV), addressing the need for culturally appropriate diagnostic tools for Attention-Deficit Hyperactivity Disorder (ADHD) in Chinese adult populations.

Methods: Utilizing a combination of intergroup difference analysis, factor analysis, and network analysis, we identified core ADHD symptoms pertinent to the Chinese cultural context. The study involved two samples: a vocational and technical school sample (N=1,144) and an internet sample (N=1,654), comprising adults aged 16-25 years. Reliability, validity, and diagnostic efficacy of the ASRS-CSV were assessed through comprehensive psychometric testing.

Results: The ASRS-CSV demonstrated high internal consistency (Cronbach' s alpha > 0.9) and robust convergent validity (AVE > 0.7). The scale' s diagnostic cutoff points were optimized, revealing high sensitivity and specificity for ADHD screening. Cross-cultural analysis highlighted differences in core ADHD symptoms between Chinese and Western populations, underscoring the scale' s cultural sensitivity.

Conclusion: The ASRS-CSV is a reliable, valid, and efficient tool for screening ADHD in Chinese adults, reflecting the socio-cultural nuances of ADHD symptomatology. Its development represents a significant advancement in the field of psychiatry, offering a tailored approach for ADHD assessment in China and contributing to the global discourse on cross-cultural psychiatric diagnosis.

Keywords: ADHD, ASRS-CSV, psychometric validation, Chinese adult population, cross-cultural psychiatry

Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is a common neurodevelopmental disorder that begins in childhood and is characterized by persistent inattention, impulsivity, restlessness, and hyperactivity (Williams et al., 2023). The global prevalence of ADHD is approximately 5% (Cortese and Coghill, 2018), although rates vary across countries (Fayyad et al., 2017). Studies have shown that a substantial percentage of cases persist into adolescence and adulthood (Caye et al., 2016), with a meta-analysis finding a 2.5% prevalence of ADHD in adults aged 19-45 years (95% confidence interval: 2.1-3.1) (Somma et al., 2019). The early onset of the disorder and its frequent co-occurrence with other psychiatric conditions can mask core ADHD symptoms (Koyuncu et al., 2022; Luderer et al., 2021; Mucci et al., 2019; Adamis et al., 2023; Salvi et al., 2021). Additionally, adult recall of childhood symptoms may be biased, resulting in underrecognition of this disorder, which can have substantial impacts on personal health, quality of life, and impose burdens on families and society.

The Adult ADHD Self-Report Scale (ASRS) is one of the most widely used instruments for assessing ADHD in adults. It contains 18 questions based on DSM-IV criteria for adult ADHD symptoms and consists of two subscales, each containing nine items (Kessler et al., 2005). Six items were subsequently selected through stepwise logistic regression to form the ASRS short screener, which demonstrated good internal consistency in both adult and adolescent samples (Kessler et al., 2007; Sonnby et al., 2015; Green et al., 2019). Due to its strong psychometric properties, the ASRS has been adapted for use in many countries (Somma et al., 2019; Takeda et al., 2017; Vňuková et al., 2022; Pedrero Pérez and Puerta García, 2007; Zohar and Konfortes, 2010; Kim et al., 2013).

However, we observed differences in the selection of core ADHD symptoms across cultural contexts, such as disparities in attention deficit and hyperactivity/impulsivity items between studies conducted in the United States and Japan (Kessler et al., 2005; Takeda et al., 2017). This divergence may be attributable to differences in ethnic culture or varying cultural expectations regarding the expression of attention and impulsivity (Wernke and Huss, 2008). Therefore, although a translated version of the 6-item Chinese ASRS scale is currently available, revision based on the Chinese context remains necessary. While the reliability of the 18-item Chinese version of the ASRS has been validated in Taiwanese populations (Yeh et al., 2008), it is important to note that semantic understanding may differ among people from various geographical and cultural backgrounds. Furthermore, in practical research settings, reading lengthy text and answering numerous questions may be particularly challenging for individuals with ADHD symptoms. For large-scale population screening, concise scales are more appropriate.

Based on these considerations, we believe it is necessary to revise and simplify the Chinese version of the scale. In this study, we hypothesized that the core symptoms of ADHD may vary across different cultural contexts in China. Scale

simplification methods such as intergroup difference analysis, factor analysis, and network analysis serve distinct purposes in understanding disorders. Intergroup difference analysis divides participants based on diagnostic criteria, highlighting prominent symptoms in specific groups (Wood et al., 2021). Factor analysis simplifies scales by uncovering underlying factors and item associations (Williams et al., 2010). Network analysis examines item relationships, presenting mental disorders as dynamic systems with interconnected factors. Central items, indicated by higher centrality indices, reflect core concepts within the network (Liang et al., 2023).

In summary, this study examines the core symptoms of ADHD as assessed by the ASRS using a Chinese sample. To ensure robustness of the results, we employed intergroup difference analysis, factor analysis, and network analysis simultaneously.

Method

Participants

Sample 1: Centralized sampling was conducted from September 2022 to May 2023 at a vocational and technical school in Changsha City, Hunan Province, China. A total of 1,144 students completed questionnaires on a class basis after providing informed consent. All 1,144 distributed questionnaires were returned valid. The sample comprised 624 males (54.5%) and 520 females (45.5%), with ages ranging from 16 to 25 years (mean age = 18.75 $\pm$ 1.11 years).

Sample 2: An internet sample was recruited from June to October 2023, with participants providing informed consent before completing questionnaires. The sample included 1,654 participants (822 males [49.7%] and 832 females [50.3%]), aged 16-25 years (mean age = 19.02 $\pm$ 2.01 years).

The study was approved by the Medical Ethics Committee of the Second Xiangya Hospital of Central South University.

Measurement

The ASRS (Adult ADHD Self-Report Scale) is an assessment tool designed to evaluate symptoms of adult ADHD. It consists of 18 items divided into two sections: nine items assessing inattention symptoms and nine items evaluating hyperactivity-impulsivity symptoms. Each item presents five response options ranging from "never" to "almost always," with respondents selecting the option that best reflects their experiences over the past six months. The ASRS is a self-report questionnaire suitable for use in healthcare settings, educational institutions, and research studies. In this study, we used the 18-item Chinese version of the ASRS, which has demonstrated reliability with an overall Cronbach' s alpha coefficient of 0.954 (0.926 for the inattention factor and 0.938 for the hyperactivity-impulsivity factor).

The Patient Health Questionnaire (PHQ-9 & PHQ-2) are widely used screening tools for depression, assessing depressive symptoms over the past two weeks on a 4-point Likert scale (0 = not at all, 1 = several days, 2 = more than one week, and 3 = nearly every day) (Kroenke et al., 2001). The PHQ-9 contains nine items measuring depressive symptom severity, addressing all DSM-5-related symptoms, with scores ranging from 0-27 (Negeri et al., 2021). The PHQ-2 includes the first two items of the PHQ-9, assessing depressed mood and anhedonia, with scores ranging from 0-6 (Levis et al., 2020). Both self-report scales demonstrate good reliability and validity in adolescents and adults (Anand et al., 2021). In this study, we tested the correlational validity of the scales before and after simplification using both versions. The Cronbach' s alpha coefficients were 0.904 and 0.878, respectively.

The Generalized Anxiety Disorder scale (GAD-7 & GAD-2) are concise self-report tools measuring anxiety symptoms experienced during the past two weeks, each assessed on a 4-point Likert scale (0 = not at all, 1 = several days, 2 = more than one week, and 3 = nearly every day). The GAD-7 consists of seven items assessing anxiety-related symptom frequency, with scores ranging from 0-21 (Spitzer et al., 2006). The GAD-2 includes two items assessing the frequency of feeling nervous, anxious, or on edge and being unable to stop or control worrying, with scores ranging from 0-6. Both scales demonstrate good reliability and validity (Byrd-Bredbenner et al., 2021; Skapinakis, 2007). As with the depression scales, both versions were used to test correlational validity before and after simplification. The Cronbach' s alpha coefficients were 0.935 and 0.899, respectively.

Procedure

Step 1: Data Cleaning and Core Symptom Screening. In the initial data preparation stage, we used SPSS 22.0 and employed a single quality control question (requiring selection of "strongly agree") for effective data screening. Basic demographic variables such as age and gender were also recorded.

For core item selection, we utilized three methods within JASP 16.0. First, exploratory factor analysis was conducted using parallel analysis based on factor analysis with the minimum residual method. Rotation was set to oblique using the Bentler Q criterion, with analysis based on the correlation matrix. Output options included displaying only factor loadings greater than 0.4, along with KMO test, Bartlett' s test, Mardia' s test, structure matrix, factor correlations, additional fit indices, residual matrix, and parallel analysis. Factor loadings were presented in structure matrix form, illustrating the strength of relationships between items and factors. Items were sorted by factor loading strength, and three items were selected per factor.

Second, network analysis was performed using EBICglasso in the operation panel, with centrality tables included in the output. To ensure robustness, we conducted 1,000 bootstraps with "case" as the sampling type. Items were ranked

according to their centrality, and three items were selected per factor.

Third, intergroup difference analysis (independent samples t-test) was conducted. All samples were divided into high and low ADHD risk groups based on suggested cutoff values for the 18-item complete version. Difference testing was then performed between groups using a 95.0% confidence interval for location parameters, Cohen' s d for effect size, and the Brown-Forsythe option for equality of variances, which is robust for non-normally distributed or outlier-prone data. Items were ranked by the absolute value of Cohen' s d, and three items were selected per factor.

In the ASRS-CSV and DSM-5 comparative analysis, we employed expert consultation and assessed inter-rater reliability using three metrics: Cohen' s unweighted kappa, Fleiss' kappa, and Krippendorff' s alpha values.

Step 2: Expert Consultation. We invited ten psychiatrists from the Second Xiangya Hospital of Central South University to evaluate the content consistency of two revised scale versions with DSM-5 diagnostic criteria, item by item. They provided explanations of current problems and suggestions for modification (see attached materials for details).

Step 3: Psychometric Testing of the Short Version. We conducted reliability and validity testing for the generated 6-item scale using JASP 0.16. Correlation analysis assessed the relationship between the 18-item complete version and the 6-item abbreviated version. Confirmatory factor analysis examined additional fit measures, R-squared, average variance extracted (AVE), heterotrait-monotrait ratio (HTMT), and reliability. In the multigroup CFA, we conducted gender invariance testing using gender as the grouping variable, performing sequential tests to generate differences. All other settings remained at default values. The study flowchart is presented in Figure 1 [Figure 1: see original paper].

Results

Core Symptom Screening

Intergroup Difference Analysis. Based on standard referencing, participants were categorized into two groups using a score of 24 or higher as highly likely to have ADHD: a low-risk group (N=751) and a high-risk group (N=393). Group differences were examined across all 18 items, with means, standard deviations, t-values, p-values, and effect sizes (Cohen' s d) reported for both groups (Table 1). Cohen' s d values were ranked, and results indicated that from the perspective of intergroup difference analysis, the core items were item 3, item 6, item 8, item 12, item 13, and item 14.

Factor Analysis. The KMO test (MSA=0.961) and Bartlett' s test ($p<0.001$) indicated that the scale was suitable for factor analysis. Exploratory factor analysis (EFA) revealed that Factor 1 represents hyperactivity, Factor 2 represents

executive difficulties, Factor 3 represents attention difficulties, and Factor 4 represents impulsivity (Table 2). To select core items from this perspective, the top three items from the two factors explaining the most variance were chosen. Additionally, items exhibiting higher correlation with factors were identified based on the uniqueness index. According to this approach, the core items were item 6, item 7, item 8, item 12, item 13, and item 14 from the factor analysis perspective.

Network Analysis. In network analysis, we reported four centrality measures and presented frequencies of core items selected based on different centrality indices (Table 3). Generally, when networks contain both positive and negative edges, Expected Influence is preferred as the centrality measure. When all edges are positive, Strength is more commonly reported. Results indicated that core items selected by these two measures were consistent: item 6, item 7, item 8, item 12, item 14, and item 18 were identified as core items from the network analysis perspective.

By combining results from all three methods, we tentatively propose that items 6, 7, 8, 12, 13, and 14 constitute the core items of the ASRS.

Psychometric Testing of the Preliminary Version (ASRS-CSV)

Based on item selection results, we designated items 6, 7, and 8 as the Inattention factor and items 12, 13, and 14 as the Hyperactivity-Impulsivity factor. We then examined the psychometric properties of the newly generated short-form scale.

Reliability. Cronbach's α coefficients for each subscale and the total scale were 0.903, 0.908, and 0.914, respectively. Additionally, McDonald' s ω coefficients were 0.904, 0.909, and 0.943, respectively. These results indicate that the scale and its subscales exhibit high levels of internal consistency reliability.

Validity. Average Variance Extracted (AVE) values assess convergent validity by evaluating variance contributed by indicator items to their corresponding constructs. AVE values typically range from 0 to 1, with values exceeding 0.5 indicating good convergent validity. The AVE value for the Inattention factor was 0.757, and for the Hyperactivity-Impulsivity factor was 0.768, signifying strong convergent validity.

Concurrent validity involves evaluating measurement equivalence by comparing different versions of a tool. By examining correlations between versions, it is possible to assess whether the abbreviated scale measures the same construct. As shown in Figure 1, there was a high correlation ($r=0.953$, $p<0.001$) between the ASRS and ASRS-CSV and their factors, indicating excellent concurrent validity.

We selected PHQ-9 & PHQ-2 and GAD-7 & GAD-2 for calibration association validity testing, considering the high comorbidity between ADHD and depression/anxiety in clinical practice. Figure 2 [Figure 2: see original paper] demon-

strates that both ASRS and ASRS-CSV exhibit moderate to strong associations with anxiety and depression (r=0.435-0.461, p<0.001), signifying good calibration association validity.

Gender Invariance Testing. Measurement invariance ensures that the structural and metric properties of psychological scales remain consistent across different groups, making measurement results comparable. Meaningful between-group comparisons require established measurement invariance. Following Chen and colleagues' standards for invariance testing, and considering the uneven sample sizes between groups in this study, we applied relatively lenient criteria (ΔCFI $\leq$ 0.01; ΔRMSEA $\leq$ 0.01; ΔSRMR $\leq$ 0.025). In cases of conflicting criteria, changes in CFI were used as the primary criterion.

Results indicated that ASRS-CSV demonstrates strict invariance across male and female samples (Table 4), establishing a high level of measurement invariance.

Expert Correspondence on ASRS-CSV Applicability

We compared the six selected items with the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), the American psychiatric diagnostic manual. This study compared the generated items with Part A of DSM-5 diagnostic criteria for adult ADHD and reported correspondence between core items and diagnostic criteria (Table 5). We invited ten psychiatrists to assess consistency between diagnostic criteria and items, with response options of consistent, uncertain, and inconsistent. The expert panel demonstrated high concordance between DSM-5 and ASRS-CSV, with 90% of experts concurring that they exhibited congruence. Cohen's unweighted kappa (0.89), Fleiss' kappa (0.75), and Krippendorff' s alpha (0.82) all indicated favorable inter-rater consistency in this round of expert consultation.

In the first round of administration, participants reported that content items were lengthy and difficult to understand. An additional ten psychiatrists participated in a focus group discussing ASRS and ASRS-CSV relative to DSM-5 diagnostic criteria. The majority felt that scale items were too long and contained difficult words, potentially preventing individuals with higher ADHD traits from fully comprehending item content and thus affecting assessment results. They recommended simplifying the number and length of items using clear, consistent language, though several physicians advocated respecting the original scale version. Based on this feedback, we revised and rewrote the core items of the simplified Chinese version, generating the ASRS-CSVN. Ten independent psychiatrists evaluated the consistency of this revised scale with diagnostic criteria (Table 5). All ten agreed that ASRS-CSVN demonstrated good consistency with diagnostic criteria, was easier to understand, and was suitable for Chinese adult samples. Fleiss' kappa (0.84) and Krippendorff' s alpha (0.91) indicated favorable inter-rater consistency in this consultation round.

Psychometric Test of ASRS-CSVN

From a reliability perspective, Cronbach's α coefficients for each subscale and the total scale were 0.72, 0.68, and 0.81, respectively. For validity, AVE values were 0.501 for the Inattention factor and 0.502 for the Hyperactivity-Impulsivity factor, indicating strong convergent validity. The HTMT value for ASRS-CSVN was 0.861. Additional fit indices included: CFI = 0.99, TLI = 0.97, GFI = 0.99, RMSEA = 0.05, and SRMR = 0.02. For calibration association validity, ASRS-CSVN showed high correlation coefficients with PHQ-2 and GAD-2 (r=0.36-0.64, p<0.001), demonstrating strong external consistency. In conclusion, ASRS-CSVN exhibits excellent reliability and validity and can be used for self-assessment screening of ADHD in Chinese adults or adolescents.

Diagnostic Cutoff of ASRS-CSV

We used RStudio (version 2022.12.0) to conduct ROC analyses. As shown in Figures 3 [Figure 3: see original paper] and 4 [Figure 4: see original paper], employing an ASRS threshold of $ $16 as a reference point, ASRS-CSV demonstrated high diagnostic efficacy for Attention Deficit (AD) with AUC values of 0.938 in males and 0.933 in females, and for Hyperactivity Disorder (HD) with AUCs of 0.972 in males and 0.958 in females. Sensitivity and specificity details are provided in Table 6 . Based on the Youden index, a score of 5 or 6 on the ASRS-CSV represents an appropriate diagnostic cutoff.

Discussion

This study employed intergroup variance analysis, factor analysis, and network analysis to examine core ADHD symptoms in Chinese population samples and generated a simplified ASRS version. We propose that items 6, 7, 8, 12, 13, and 14 represent the core items of the ASRS, recommending a diagnostic threshold of 5 or 6 points. The revised ASRS-CSV and ASRS-CSVN scales demonstrate good reliability and validity, serving as reliable and valid assessment tools for screening and aiding ADHD diagnosis in Chinese populations.

This study provides a detailed revision of the Chinese ASRS scale, developing two versions (ASRS-CSV and ASRS-CSVN) to offer simplified Chinese measurement tools for large-scale ADHD screening. Furthermore, the study reveals cross-cultural disparities in core items compared to existing research. In the WHO-provided ASRS-6 version, core ADHD symptoms in American samples included "Does not follow through," "Difficulty organizing," "Avoids effort," "Forgetful," "Fidgeting," and "On the go," with two symptoms overlapping with our findings (Kessler et al., 2005). In Japan, a culture within the same East Asian region as China, researchers identified core ADHD items as "Careless mistakes," "Loses things," "Does not follow through," "Difficulty organizing," "Rules conversation one-sidedly,"and "Forgetful,"with only one item coinciding with our results (Takeda et al., 2017). ADHD, as a neurodevelopmental disorder, may be closely associated with the cultural environment in which patients are situ-

ated (Timimi and Timimi, 2015). Different cultures have varying expectations regarding adaptive behaviors and attention levels, and variations in cultural values and educational systems across China, the United States, and Japan likely influence ADHD symptom expression. Therefore, we recommend that cultural specificity be carefully considered when promoting shortened ASRS versions, and that cross-cultural invariance testing should be conducted.

From a methodological robustness perspective, this study employed three different methods to cross-validate core ADHD symptoms. Intergroup difference analysis, factor analysis, and network analysis represent three common approaches for scale simplification and data analysis, each offering unique advantages. Intergroup difference analysis allows researchers to swiftly identify symptoms exhibiting significant disparities among groups, providing a straightforward and intuitive tool (Takeda et al., 2017). Factor analysis unveils underlying symptom structure, grouping related symptoms into factors to simplify data and enhance interpretability (Williams et al., 2010). Network analysis permits exploration of disorder complexity, capturing interrelationships among symptoms and facilitating personalized treatment strategies. Network centrality reveals the pivotal role of specific symptoms (Bringmann et al., 2019). The synergistic application of these methods provides a more comprehensive understanding and yields deeper insights, underscoring the robustness of core symptoms within our sample and their consistency across different methods.

In summary, this study provides two simplified ASRS versions for ADHD screening. The first version (ASRS-CSV) is based on reduced entries from the original scale, offering more concise and accurate content while meeting DSM-5 diagnostic criteria. The second version (ASRS-CSVN) further reduces text length without changing original content meaning, enabling adolescents and individuals with reading difficulties to better understand scale content. Both versions contain the same content and are applicable to different scenarios, providing researchers flexibility to choose according to study populations and contexts.

Limitations and Prospects

While this study examines core ADHD symptoms within the Chinese population, it is imperative to acknowledge significant limitations that may impact interpretation and generalizability. First, reliance on a cross-sectional design limits observations to a single point in time. Longitudinal research would provide more comprehensive understanding of ADHD symptom development, changes, and core symptom stability. We encourage future studies to adopt longitudinal designs to assess ADHD characteristics more comprehensively.

Second, sample representativeness is paramount for generalizability. This study utilized specific samples that may restrict representativeness. Future research should expand sample size and diversity to better capture various segments of the Chinese population and validate our findings.

Finally, it is vital to recognize limitations of the three methods employed. Each

method possesses unique advantages and may not comprehensively capture all ADHD aspects. Future research could explore additional methods, such as Item Response Theory (IRT), to gain deeper understanding of ADHD' s multifaceted nature.

Despite limitations including cross-sectional design, sample representativeness, and self-report data, this study offers valuable insights into core ADHD symptoms within the Chinese population. These limitations provide a constructive path for future research to deepen understanding of ADHD and offer substantial support for enhancing clinical diagnosis and interventions.

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Note: Figure translations are in progress. See original paper for figures.