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Original Article

Psychometric Properties of the Persian Version of the Comprehensive Autism Trait Inventory (CATI)

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Abstract

Objective: The present study aimed to culturally adapt and psychometrically evaluate the Comprehensive Autism Trait Inventory (CATI) for use within the Iranian society, thereby facilitating cross-cultural research on autistic traits.
Method: This cross-sectional survey included 1,013 Iranian adults (70.1% female), aged 15 to 50 years (M = 24.91, SD = 5.47), recruited through convenience sampling. The translation of the CATI into Persian was developed based on a carefully implemented forward and backward translation procedure through bilingual experts. Discrepancies were resolved by a panel of psychologists and psychometricians to ensure semantic and conceptual equivalence. The broad autism phenotype questionnaire (BAPQ), a tool designed to measure traits associated with the broad autism phenotype, was also administered to measure convergent validity. In order to assess internal consistency, Cronbach's alpha was calculated, while construct validity was evaluated through confirmatory factor analysis (CFA) and Pearson correlations with BAPQ scores.
Results: CFA confirmed that all items aligned meaningfully with their intended factors, supporting the persian CATI's six-factor structure and indicating a good model fit (CFI = 0.93; RMSEA = 0.047; χ^2 / df = 3.25; GFI = 0.90; SRMR = 0.059). The average variance extracted (AVE) was 0.45 for both the components and the overall scale. Correlations between CATI subscales and the BAPQ ranged from 0.03 to 0.40, demonstrating acceptable convergent and divergent validity. The reliability of the six-factor model was verified by Cronbach's alpha (0.84) and McDonald's omega (0.82).
Conclusion: The Persian version of the CATI shows sound psychometric properties for evaluating autistic traits in the Iranian population. These findings support utility of CATI in research settings and highlight the importance of culturally adapted assessment tools for improving diagnosis and intervention across diverse contexts.

Key words: *Autism; Factor Analysis; Psychological Tests; Surveys and Questionnaires; Validity and Reliability*

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Autism, also known as autism spectrum disorder (ASD), is a developmental condition that usually develops early in life, involving atypical social communication and interaction, with specific interest and/or repetitive behavior (1). ASD occurs across all racial, ethnic, cultural, and socioeconomic groups, with prevalence rates steadily increasing over the past two decades (2). As stated by the Centers for Disease Control and Prevention (CDC), one out of 59 children has been diagnosed with ASD (3). The ASD prevalence rate in West Asia was 0.35% (4), and in Iran, 95 cases per 10,000 people were identified according to surveys (5). Although extensive research has been conducted on autism, most studies have been carried out in Western, high-income countries. As a result, most assumptions concerning the diagnosis, treatment, and understanding of autism have not been properly studied in non-Western and lower-income settings. Autism diagnoses rely on observable behavior, and while the core traits of autism are thought to be universal, recent research also suggests that culture subtly shapes the way in which those traits are expressed, identified, or reported (6). Social norms, cultural values, and stigma can establish whether or not certain behavior is seen as normal or as evidence of autism, and affect the way autism is identified in communities (6). For example, research validating autism screening tools in Asian countries like Japan has found that, unlike in the US, a person's interest in peers does not reliably indicate autism within Japanese communities (7).

A growing body of evidence emphasizes that ASD, as a dimension of psychopathology, is not limited to the full spectrum of diagnosable symptoms, but includes behavioral and cognitive characteristics whose severity can vary from subthreshold forms—known as autistic traits—to full ASD (8). This dimensional view is fundamentally linked to different theoretical perspectives on the nature of autism—how it is defined, what causes it, and how it develops over time. According to one viewpoint, autism is categorically distinct from typical neurodevelopment, and relying on broad, nonspecific outcome measures, it may obscure a precise understanding of the condition. There is also the view—perhaps best captured by the liability threshold model—that autism represents one end of a spectrum of traits distributed across the general population. An often-overlooked perspective is that both positions in this debate may hold partial truths and contribute meaningfully to our understanding (9). Alternatively, studying broader trait variation need not undermine efforts to investigate distinct subgroups or more narrowly defined categories. The issue of how quantitative traits align with current models of autism merits deeper investigation in future research (10). However, research findings indicate that autistic traits are common in the general population and vary widely in both intensity and expression (11). In other words, alongside clinically diagnosed autism, it is widely acknowledged that many people who do not qualify for an autism diagnosis still exhibit traits and behaviors that are qualitatively comparable to autistic characteristics. The 'subthreshold' autistic symptoms were first identified in the parents and family members of children with autism (12). The term Broad Autism Phenotype (BAP) was introduced in the 1970s and is considered as an indicator of genetic and familial predisposition to autism (13). It pertains to the manifestation of autistic symptoms or specific personality traits that resemble, but do not fulfill, the diagnostic criteria for autism among relatives of individuals with ASD (14). Compelling data support this notion, demonstrating that close family members of individuals with autism who do not have the formal diagnosis themselves exhibit elevated rates of stereotyped behaviors and social difficulties (15). Initially, such behavior was detected in the parents and immediate family members of autistic children (16). The general population is increasingly encountering these purported "subthreshold" autistic symptoms (17). Finally, it can be argued that autistic traits represent a collection of attenuated autistic symptoms present in the general population (18).

To gain a better understanding of the pattern and impact of autistic characteristics in the general population, the rate of related behaviors has been examined using a number of standardized questionnaires. Therefore, several different approaches are available to assess autistic traits. The Autism Family History Interview (AFHI) was developed in 1990s to investigate the characteristics of autism traits among family members and relatives of individuals with autism (19). Recently, the Subthreshold Autism Trait Questionnaire (SATQ) has been applied to measure autistic traits (20) and consists of 160 items. Also, the Autism-spectrum Quotient (AQ) has been designed to evaluate autistic traits (21). However, the approaches reviewed above are not based on the DSM-5 criteria for autistic traits and require specific training for practitioners, which makes them difficult to adopt on a widespread scale. The time-consuming nature and requirement for specialized training is a limitation of these approaches. Given the varied nature of autism, it is essential to explore the different as well as shared aspects of certain dimensions of autism. It is also essential to avoid taking a "broad brush" approach, which considers all autistic persons as if they were a single group. It is important to note that some autism assessment tools are primarily used for screening purposes and are typically implemented as threshold or binary categorization measures, whereas the Comprehensive Autism Trait Inventory (CATI) is more commonly used to assess continuous trait scores, making it more suitable as a quantitative trait measure (22). Another concern with the questionnaires (AQ and SATQ) is that they have been used mostly on clinical populations, which has led to difficulties in obtaining an adequate sample size, taking into account the significant

overlap with other autism-associated conditions, and forming appropriately matched comparison groups. The CATI assesses autistic traits in the general population based on the diagnostic criteria for ASD described in the DSM-5. The criteria consist of social and non-social bifactors. The social components comprise social interactions (SOC), communication (COM), and social camouflage (CAM), whereas the non-social factors consist of repetitive behavior (REP), cognitive rigidity (RIG), and sensory sensitivity (SEN). The CATI is a reliable tool for assessing autistic traits among the general population, and its psychometric properties have been evaluated across many English-speaking nations (12). Nevertheless, research regarding the psychometric characteristics of CATI within the Iranian setting remains insufficient. This study aimed to evaluate the psychometric properties of the CATI within the general population of Iran.

Materials and Methods

Study Design

This cross-sectional study was conducted between August and December 2024 in several central and northern cities in Iran (Tabriz, Tehran, Rasht, Esfahan). It involved the translation process and cultural adaptation of the CATI, as well as an assessment of its psychometric features.

Translation Process

For the translation and cultural adaptation of the measurement tool, the authors applied Beaton's intercultural adaptation criteria. This well-established approach is widely used to develop reliable and valid instruments for cross-cultural research, especially in self-report assessments (23). First, for the forward translation, the authors engaged two psychology experts with PhDs who were fluent in both Persian and English to translate the CATI scale from English into Persian, independently. The initial translations were discussed in a group, and discrepancies were resolved through discussion until consensus was reached; in cases of persistent disagreement, a third independent reviewer provided mediation. For the back-translation, two bilingual professors specializing in the education of exceptional children and two linguists performed the translation from Persian back into English. This team carefully compared the original and back-translated versions item by item to ensure semantic equivalence. Cultural equivalence was ensured by carefully adapting idioms and culturally specific references to reflect Iranian sociocultural norms while maintaining the original constructs. For example, expressions that did not directly translate were rephrased in a way that preserved conceptual meaning. After the scale was finalized and approved, its face validity was evaluated through qualitative interviews with 20 psychology students and professors. These interviews included a debriefing phase to explore participants' perceptions of the questionnaire. They were asked to consider whether the items and response options were clear, appropriate, and relevant to their academic experiences. Participants were also invited to comment on the clarity, ease of completion, and overall comprehensiveness of the questionnaire. Following this, a pilot test was conducted with 30 randomly selected participants who completed the scale. The results indicated that none of the respondents reported any confusion or ambiguity in the questionnaire items. To evaluate content validity, both the Content Validity Ratio (CVR) and Content Validity Index (CVI) were utilized. Twenty experts participated in the validation, consisting of ten professional experts and ten lay experts. There was a 100% response rate, and all participants submitted their evaluations within the specified timeframe. The group of professional experts included academic staff, i.e., lecturers and researchers in psychology, who had 5 to 15 years of professional experience. The lay experts were individuals with first-hand experience in clinical assessment procedures, and each had between 10 and 15 years of practical experience to bring to the panel. The overall CVI for the CATI was 0.98, indicating excellent content validity.

Participants

A total of 1112 participants completed the research questionnaires; however, 99 were excluded due to ineligibility, yielding a final response rate of 91.09%. A total of 1013 individuals aged between 15 and 55 years were included in the final analysis. The participants had an average age of 24.91 years (SD = 5.47). The gender distribution revealed that 70.1% were female and 29.9% were male. Regarding educational qualifications, 12% of participants had not completed high school, 31% had completed high school and received a diploma, 47% had a bachelor's degree, 8% had a master's degree, and 2% had achieved a PhD.

Procedure and Data Collection

Using convenience sampling, we distributed the survey link via social media platforms targeting users in five central and northern Iranian cities, which were Tabriz, Tehran, Rasht, Esfahan and Mashhad. These cities were selected due to their demographic diversity, relatively high internet penetration, and population density. These urban centers include a mix of socioeconomic backgrounds, ethnic groups, and educational levels, which allowed us to capture a broader range of perspectives. Also, these cities were selected due to the researchers' existing access to relevant populations through online networks. While the study's participants may not fully represent all Iranians—particularly those in rural areas—the selected cities provide a reasonable approximation of the country's urban population structure. Convenience sampling was employed due to practical constraints, including limited time, financial resources, and accessibility during data collection. Given these limitations, distributing the survey online via social media offered a feasible and efficient approach to reach

a large number of participants. Data collection was conducted through an online questionnaire hosted on the Porsline platform (http://www.porsline.ir). Participation was entirely voluntary, and all respondents were assured of confidentiality. Prior to beginning the survey, participants were informed of their right to withdraw at any time and were asked to provide informed consent. To maximize participation, we offered an additional incentive: participants could provide an email address if they wished to receive feedback on their autism trait scores. The authors used specific criteria to exclude incomplete and ineligible questionnaires from the analysis. Responses displaying suspicious patterns—such as selecting the same option for all items (e.g., "Neither agree nor disagree") or completing the questionnaire in an unusually short time, indicating inattentiveness—were excluded. Additionally, in cases where multiple submissions from the same respondent were identified, only the most complete response was retained, and the duplicates were excluded.

Instruments

Comprehensive Autism Trait Inventory (CATI)

This questionnaire, developed by English *et al*. (12), assesses autism-related traits in the general population using the DSM-5 diagnostic criteria for ASD. The questionnaire consists of two primary subcomponents—social and non-social elements—identified through factor analysis. The social component encompasses SOC, COM, and CAM, while the non-social component includes REP, RIG, and SEN. The full measure comprises 42 items. Each item is presented as a statement rated on a five-point Likert scale with the following response options: 'Definitely disagree,' 'Somewhat disagree,' 'Neither agree nor disagree,' 'Somewhat agree,' and 'Definitely agree. The items are designed with both positively and negatively keyed statements, and approximately 25% are reverse-scored. The original CATI has demonstrated acceptable reliability ($\alpha = 0.95$) with consistently strong subscale reliability (all $\alpha > 0.81$). It shows moderate predictive validity for autism classification (0.62) and established measurement invariance across genders (12).

The Broad Autism Phenotype Questionnaire (BAPQ)

The BAPQ has two forms: self-report and informant-report formats. It consists of 36 items that are equally distributed across three 12-item subscales. Structured interview assessments were used to develop these subscales—specifically, social aloofness and rigidity were derived from the Modified Personality Assessment Schedule-Revised (MPAS-R), while pragmatic language difficulties were adapted from the Modified Pragmatic Rating Scale (PRS-M). Respondents rate items on a six-point Likert scale ranging from 'very rarely' to 'very often,' deliberately omitting a neutral midpoint to elicit more definitive responses. The BAPQ demonstrated excellent internal consistency ($\alpha = 0.94$) and showed good diagnostic accuracy, with both sensitivity and specificity exceeding 0.70 for identifying broad autism phenotype features (21).

Statistical Analyses

Descriptive statistics, as well as validity and reliability evaluations of the CATI questionnaire, were performed using SPSS-26, Lisrel 8.80, and Mplus-7. The questionnaire's internal consistency and reliability were assessed using Cronbach's alpha coefficient. Convergent validity was utilized to evaluate the association between CATI and related variables. In contrast, confirmatory factor analysis (CFA) was utilized to evaluate the scale's validity. The Mplus software was employed to evaluate the invariance of gender measurement.

Results

The demographic data analysis showed that among the participants, 710 (70.1%) were female and 303 (29.9%) were male. Of the total participants, 712 (70.3%) were aged between 15 and 30 years, and 514 (50.7%) held a bachelor's degree. Additionally, 149 male participants (49.2%) were employed, while only 70 female participants (9.9%) were employed. Descriptive statistics for the test items indicated that the skewness and kurtosis values fell within acceptable limits for assuming univariate normality (see table 1). Hair *et al*. (24) pointed that values between -2 and +2 are generally considered acceptable.

Table 1. Descriptive Statistics for the Comprehensive Autism Trait Inventory (CATI)

Sample (N)	Subscale	M	SD	Range	Skewness	Kurtosis
Male (303)	Total scale	69.74	15.78	91	0.132	0.019
	SOC	9.50	4.63	24	-0.043	-0.455
	COM	8.73	3.74	19	-0.101	-0.114
	CAM	9.84	3.01	15	-0.288	-0.109
	RIG	17.34	4.75	23	-0.183	-0.444
	REP	11.89	4.92	24	-0.007	-0.057
	SEN	12.41	4.59	23	-0.089	-0.146
Female (710)	Total scale	67.40	16.74	117	0.037	0.466

SOC	8.43	4.74	23	0.269	-0.329
COM	8.60	3.93	20	0.127	-0.284
CAM	10.12	3.03	16	-0.459	0.084
RIG	17.59	4.80	28	-0.337	0.033
REP	10.36	5.08	24	0.073	-0.578
SEN	12.28	4.84	24	-0.117	-0.222

Note: N: Number; M = Mean; SD = Standard Deviations; SOC: Social Interactions; COM: Communication; CAM: Social Camouflage; RIG: Cognitive Rigidity; REP: Repetitive Behavior; SEN: Sensory Sensitivity.

As shown in Table 2, significant correlations are observed between the elements and the total questionnaire scores across genders. The findings demonstrated that internal consistency of all components is nearly the same for both sexes, and there is little difference between men and women in terms of overall score consistency. Also, the internal consistency of the CATI is acceptable.

Table 2. Internal Consistency of the Comprehensive Autism Trait Inventory (CATI)

Sample (N)	SOC	COM	CAM	RIG	REP	SEN	Total Score
Total Sample (1013)	0.723	0.634	0.558	0.684	0.704	0.653	0.840
Men (339)	0.728	0.661	0.512	0.657	0.660	0.663	0.841
Women (674)	0.726	0.601	0.580	0.691	0.706	0.634	0.834

Note: N: Number; SOC: Social Interactions; COM: Communication; CAM: Social Camouflage; RIG: Cognitive Rigidity; REP: Repetitive Behavior; SEN: Sensory Sensitivity.

The internal consistency for the overall sample was strong for the SOC (Cronbach's alpha = 0.72) and REP (Cronbach's alpha = 0.71) subscales, moderate for the COM (Cronbach's alpha = 0.63), RIG (Cronbach's alpha = 0.68), and SEN (Cronbach's alpha = 0.65) subscales, and insufficient for the CAM subscale (Cronbach's alpha = 0.55). Cronbach's alpha for the entire scale was 0.84, indicating robust internal consistency.

Table 3 shows the interconnections among the CATI components. A positive but slight correlation is observed among all six measures. The strongest relationship was found between REP and SEN, while the weakest correlation was observed between SOC and RIG.

Table 3. Correlations between the Comprehensive Autism Trait Inventory (CATI) and the Broad Autism Phenotype Questionnaire (BAPQ)

Factors	SOC	COM	CAM	RIG	REP	SEN	CATI	BAPQ
SOC	1							
COM	0.439**	1						
CAM	0.096**	0.279**	1					
RIG	-0.064*	0.184**	0.454**	1				
REP	0.317**	0.470**	0.311**	0.264**	1			
SEN	0.291**	0.473**	0.351**	0.369**	0.502**	1		
CATI	0.611**	0.705**	0.706**	0.645**	0.722**	0.741**	1	
BAPQ	0.201**	0.373**	0.374**	0.033	0.398**	0.349**	0.383**	1

Note: SOC: Social Interactions; COM: Communication; CAM: Social Camouflage; RIG: Cognitive Rigidity; REP: Repetitive Behavior; SEN: Sensory Sensitivity. ** P < 0.01, * P < 0.05

The correlation between the overall CATI score and its components with the BAPQ was examined to evaluate convergent validity, as outlined in Table 3. The findings demonstrate a significant and positive correlation ($r = 0.39$; $P < 0.01$) between the aggregate score of the CATI components and the total score of the CATI questionnaire. The correlations ranged from modest to high. The most considerable significant link is found between the REP component and the overall BAPQ score ($r = 0.39$; $P < 0.01$), whereas the least considerable significant association is noted between the SOC component and the overall BAPQ score ($r = 0.20$; $P < 0.01$). No significant correlation exists between the RIG component and the overall BAPQ score ($r = 0.03$; $P < 0.05$).

Confirmatory Factor Analysis

To conduct CFA and evaluate the validity and reliability of this scale, the original model utilized single-factor CFA, with the CATI variable regarded as a latent variable and the questions functioning as indicators. In the second model, a first-order CFA was conducted, using each CATI subscale as a first-level latent variable and the questions inside each subscale as indicators or observable variables. In the third model, a second-order CFA was employed to evaluate the capacity of the CATI subscales to measure the overarching latent variable; the CATI. Thus, CATI was regarded as the primary first-level latent variable, while the subscales were classified as second-level latent variables, with the questions in each subscale serving as indicators or observable variables. The study was conducted using the LISREL software and the maximum likelihood method, comparing the three models, with the results detailed below. To assess the sufficiency of each model, the following fit indices were utilized: Chi-square ($\chi 2$), Comparative Fit Index (CFI) > 0.90, Goodness-of-Fit Index (GFI) > 0.9, Root Mean Square Error of Approximation (RMSEA) < 0.08 (good fit) and < 0.1 (acceptable fit), Tucker-Lewis Index > 0.90 and Standardized Root Mean Square Residual (SRMR) < 0.08 (25). Based on Table 4, the findings showed that neither the single-factor model nor the second-order model achieved an adequate fit. In contrast, the first-order model demonstrated an acceptable fit, with CFI and GFI values approaching 0.90, and RMSEA and SRMR values below 0.08. Overall, the first-order measurement model exhibited better fit indices compared to the alternative models. Consequently, the first-order CFA model was chosen and subsequently evaluated and adjusted regarding factor loadings.

Table 4. Fit Indices of Comprehensive Autism Trait Inventory (CATI) Measurement Models

Model	Chi-Square	df	X2/df (< 5)	RMSEA (< 0.08)	SRMR (< 0.08)	GFI (> 0.90)	CFI (> 0.90)
Single-factor model	9225.26	819	11.26	0.101	0.092	0.70	0.80
First-order measurement model	3836.36	804	4.77	0.061	0.088	0.85	0.87
Second-order measurement model	5451.98	813	6.80	0.075	0.089	0.80	0.86
Modified first-order measurement model	1668.07	512	3.25	0.047	0.059	0.90	0.93

Factor loading represents the correlation between an item and its underlying factor. A loading greater than 0.30 typically indicates a moderate correlation between the item and the factor. In contrast, loadings below 0.30 are usually too weak to be considered significant or useful for interpretation (26). Initially, the model parameters (factor loading significance) were assessed, leading to the exclusion of indicators with factor loadings below 0.30 (27) from the final analysis (items with factor loadings under 0.30: Question 30 for SOC, Questions 19 and 23 for COM, Questions 3, 6, and 22 for CAM, Question 20 for REP, Question 36 for SEN). Figure 1 displays the outcomes of the first-order factor analysis subsequent to the exclusion of items with factor loadings below 0.30.

Measurement Invariance

Multi-group confirmatory factor analysis method was conducted in Mplus to assess measurement invariance across genders (men and women). In data analysis, we adhered to the methodology suggested by Vandenberg and Lance (28). The process of testing measurement invariance begins by comparing the configural model to a model with equal factor loadings across groups, known as the metric invariance model. If metric invariance is supported, the next step is to compare it with a model that also assumes equal item intercepts, referred to as the scalar invariance model. While less commonly used, the scalar model can further be tested against a strict invariance model, which adds the constraint of equal error variances across groups. As each level of invariance imposes more constraints, the overall model fit typically decreases. However, if the model fit statistics indicate that the increased parsimony (simplicity) of a more constrained model justifies the slight reduction in fit compared to a more complex model, the more parsimonious model is considered to be acceptable and supported by the data.

Three invariance models were employed for this investigation. The configural model solely examines the structural and loading patterns of components between the two identical groups and serves as the foundational paradigm for decision-making. In the metric (weak) model, both the structure and the factor loadings are assumed to be equivalent across the two groups. In the scalar (strong) model, it is assumed that the intercepts, together with the structure and factor loadings, are identical across the two groups. The ΔCFI index was employed to assess the significance of the reduction in fit. In this procedure, the value derived for ΔCFI in relation to the preceding step must be less than the threshold value of 0.01. If at any point the ΔCFI value exceeds 0.01 and complete invariance is not achieved, partial weak and partial strong invariance are employed after liberating the parameters or the covariance among the mistakes of the items (29).

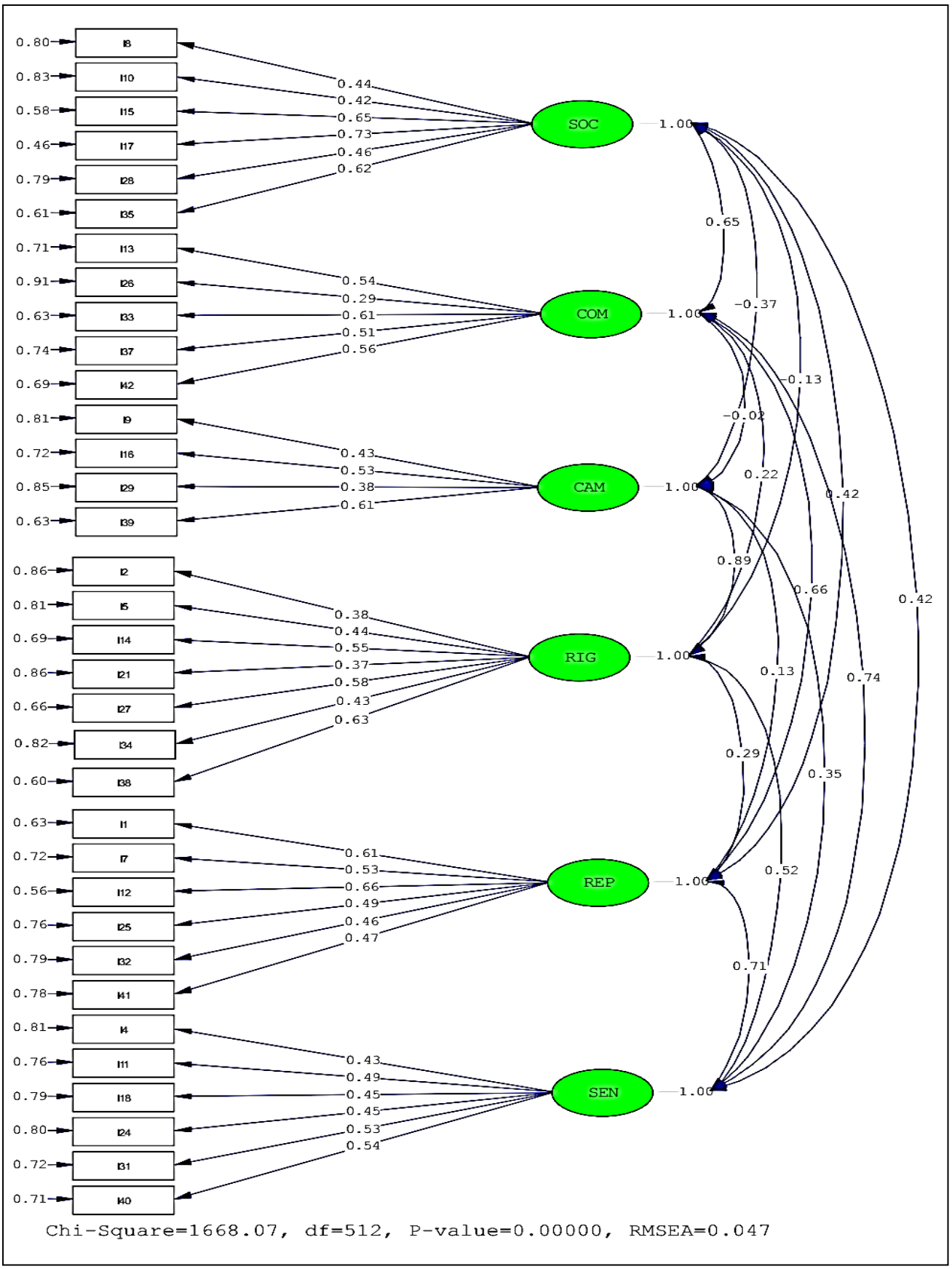

Figure 1. Confirmatory Factor Analysis Model of the Comprehensive Autism Trait Inventory (CATI)

Table 5. Measurement Invariance of the Comprehensive Autism Trait Inventory (CATI) across Gender

Models	N	X^2 / df	RMSEA	90% C.I.	CFI	SRMR	ΔCFI	ΔNCI
Single group CFA-Original six factor model								
male	339	832.55 / 512	0.043	0.038-0.048	0.85	0.067		
female	674	1370.27 / 512	0.050	0.047-0.053	0.81	0.062		
Single group CFA (Modified)								
male	339	2838.87 / 4561	0.039	0.033-0.045	0.89	0.065		
female	674	1080.75 / 504	0.041	0.038-0.045	0.88	0.057		
Multiple group CFA								
Configural		2202.82 / 1024	0.048	0.045-0.050	0.826	0.064	-	-
Metric		2246.98 / 1052	0.047	0.045-0.050	0.824	0.065	***0.002***	***0.004***
Scalar		2306.51 / 1080	0.047	0.045-0.050	0.819	0.065	***0.005***	***0.002***

Note. RMSEA = Root mean square error of analysis; 90% C.I.= 90% confidence interval of RMSEA; CFI = Comparative fit index; SRMR = standardized root means square residual; ΔCFI and ΔNCI are in italics and bold

Table 5 summarizes measurement invariance test results for the CATI. The model demonstrated a satisfactory fit. The difference in ΔCFI between the metric model and the configural model is not substantial. The calculated value for ΔCFI and ΔNCI is less than the threshold value of 0.01. This outcome signifies the metric factor invariance between the two groups of girls and boys. In the scalar (strong) model, the value of ΔCFI and ΔNCI is less than the threshold value of 0.01. Consequently, the comparison of the scalar model with the metric model demonstrates scalar invariance between the two groups.

Discussion

This study aimed to examine the psychometric properties of the CATI in a sample of Iranian adults. The findings demonstrate that the CATI possesses acceptable psychometric properties, confirming its reliability and validity for use with Iranian adults. In addition to validating the CATI, this study contributes to the growing body of research on autism traits in the general population around the world by expanding its applicability beyond Western contexts. Previous research conducted by Meng *et al.* (30), Freeth *et al.* (31) and Alhwaiti (32) in China, UK, India, Malaysia and Saudi Arabia, respectively, support the conclusions of the current study and align with its findings.

The findings of this study indicate the significance of the CATI as an efficient tool for evaluating autism markers in the Iranian population. The CATI demonstrates established validity and reliability in terms of its psychometric features. Certain questions (3, 6, 19, 20, 30-33) were omitted from the scale as part of the process of refining it. This was done in accordance with the results of the CFA performed on the six factors, which indicated that the factor loadings were lower than the predetermined threshold of 0.30. While the CATI demonstrates acceptable psychometric properties overall, it is important to acknowledge certain limitations, such as the low correlation of the RIG component (r = 0.03) with the BAPQ total score and the removal of several items due to low factor loadings. These findings highlight the heterogeneous nature of autistic traits and support the growing recognition that autism may consist of multiple subtypes and varied trait expressions (33). As such, relying solely on total scores may obscure meaningful variability at the subscale level. More consistent and insightful conclusions may be achieved by focusing on subscale-level analyses rather than total-scale interpretations. This perspective does not critique previous research but rather aims to refine our approach for future studies.

The primary scale model was validated through the use of CFA, which revealed that the optimal model consisted of six factors. These factors were as follows: SOC, COM, CAM, REP, RIG, and SEN (as shown in Figure 1). The results confirm good fit indices for the six-factor structure, indicating strong correspondence between the theoretical model and empirical data. Also, we observed a low correlation (r = 0.03) for the RIG component with the BAPQ total score (as shown in Table 2). A potential explanation is that RIG reflects restricted and repetitive behaviors-fundamental autism features that may manifest less prominently in neurotypical populations (34). Given the study's focus on a non-clinical sample rather than clinically diagnosed individuals, the attenuated associations may reflect lower baseline prevalence of autism-related traits in the general population.

The measure's substantial validity is evidenced by the significant correlation between the overall score on the BAPQ in this study and the scores of the subcomponents of the CATI factors. Moreover, with the three proposed subscales of the BAPQ, the CATI offers distinct

evaluations of six various trait characteristics linked to autism. Therefore, the CATI enables assessment of a more comprehensive range of autistic traits than previous single-scale measures. Its total score covers a wider phenotypic spectrum, offering improved precision in distinguishing between low and high trait levels, while minimizing measurement error. Unlike instruments such as the BAPQ that may underestimate traits like sensory sensitivity, the CATI provides more accurate characterization (2). Our final analysis examined gender differences in CATI scores, consistent with established findings of autism's 3:1 male-to-female prevalence ratio and greater symptom severity typically observed in males on measures like the AQ (21). There is growing recognition that autism may manifest differently in females, suggesting the actual gender difference in prevalence could be smaller than traditionally reported (35). Consequently, it can be said that gender differences can be better spotted through using the CATI in a relatively representative sample, examining disparities in component structure, as well as overall scale and subscale mean scores. As a result, analyses were conducted utilizing the sample specified for this study. Table 3 illustrates that the robust invariance result signifies the CATI six-factor model fits equally well for both male and female participants. Moreover, the scale met strict invariance criteria, confirming that scores are directly comparable across genders and enabling meaningful interpretation of sex difference.

The demand for valid and reliable instruments to assess this condition within the general population and to identify influencing factors is more pronounced than ever. Over the past decade, a significant increase has been observed in the number of individuals diagnosed with ASD, accompanied by a shift in the attitudes of professionals and the understanding that autism impacts individuals across a spectrum of varying degrees. Thus, the development of novel techniques for autism is an essential undertaking. These new instruments should combine contemporary psychometric approaches with evolving ASD research. They must also evaluate both the advantages and limitations of previous testing. In conclusion, considering that the CATI is grounded in the DSM-5, comprises six factors, assesses multiple dimensions of individual characteristics, employs fewer questions than alternative assessments while encompassing more dimensions, necessitates no specialized training for users, and maintains measurement invariance across genders, it can be asserted that this questionnaire is among the most comprehensive instruments for evaluating autism traits within the general population.

Limitation

The current study, similar to others, has limitations. Most notable is its cross-sectional design, where longitudinal data collection would enhance the validity of the findings. Moreover, reliability of the findings could have been assessed using the test-retest method, alongside Cronbach's alpha. As test-retest reliability was not assessed, we cannot be certain about the stability of CATI scores over time. Therefore, researchers using the CATI in future studies should interpret results with caution and consider evaluating score stability in their own samples. The study's other limitations include self-reporting and a sample limited to a specific region of the country. The current study did not assess the social and economic status of the participants, despite the potential influence of these factors on the research outcomes. In spite of these constraints, the current study provides substantial contributions to the discipline. Our findings offer substantial support for the CATI's effectiveness in evaluating autism traits in non-Western societies. The CATI is simple to administer, making it an essential instrument for researchers and clinicians. Therefore, its ease of administration and evaluation, makes it an effective choice for screenings in educational and community environments, where time and resources are frequently constrained.

Conclusion

The findings of this study suggest that the CATI is a promising and applicable tool for measuring autistic traits, particularly in non-clinical and general population samples. Given its strong psychometric properties, the CATI appears well-suited for use in population-based screening, epidemiological research, and studies investigating the prevalence and distribution of autistic traits across different demographic groups. Moreover, its brevity and ease of administration make it a practical option for use in educational settings and large-scale community assessments. In the context of Iran, the CATI holds potential as a culturally appropriate instrument for identifying individuals with elevated autistic traits, thereby informing both early detection efforts and research on neurodevelopmental diversity in broader societal contexts. However, certain limitations must be acknowledged. The absence of a test-retest reliability assessment and the lack of a clinical population for determining cutoff points limit the conclusions about the stability and diagnostic utility of the scores over time. The relatively low correlation between some subscales (e.g., RIG) and AQ trait dimensions suggests the need for further research. Future research should aim to evaluate reliability of the CATI in clinical populations, assess its test-retest reliability, and explore its performance across diverse cultural contexts and age groups. These steps are essential to confirm the tool’s robustness and generalizability.

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Conflict of Interest

None.

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