

Concurrent and Discriminant Validity of the Farsi Translation of the Social Responsiveness Scale-Second Edition (SRS-2) and Social Communication Questionnaire (SCQ)

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Abstract

Objective: Early detection of autism spectrum disorder (ASD) can lead to earlier intervention and greater improvement of children's quality of life and performance; hence, the use of screening tools is essential to facilitate the diagnosis process. The aim of the present study was to determine the clinical and differential validity of Social Responsiveness Scale-Second Edition (SRS-2) and Social Communication Questionnaire (SCQ) in a group of children and adolescents with autism spectrum disorder compared to a normal developmental group.

Method: The study was conducted in Roozbeh Hospital involving 52 children with ASD and 53 typically developing (TD) children, aged between 4-12 years. Their parents completed the SRS-2 and SCQ. These children were also interviewed using the Childhood Autism Rating Scale, 2nd Edition (CARS-2) and Asperger Syndrome Diagnostic Scale (ASDS). After completion, the results were analyzed using the SPSS Version 18 software and a significant level of 0.05.

Results: The average age of children in the autism group was 7.5 ± 2.7 years, while in the typically developing (TD) children group, it was 7.7 ± 2.3 years ($P = 0.656$). A positive correlation coefficient was observed between the CARS questionnaire score, the SRS questionnaire score, the SCQ questionnaire score, and the ASDS ($P < 0.01$). In the SRS questionnaire, the area under the ROC curve was 0.976, and in the SCQ questionnaire it was 0.953, both of which had a good and significant diagnostic value ($P < 0.001$). A sensitivity of 0.942 and specificity of 0.811 for the cut-off point of 62.5 were obtained in the SRS questionnaire. Additionally, a sensitivity of 0.865 and specificity of 0.925 for the cut-off point of 15.5 were achieved in the SCQ questionnaire.

Conclusion: The SRS-2 and the SCQ are sensitive and specific tools for identifying and discriminating children with autism spectrum disorder.

Key words: *Autism Spectrum Disorder; Communication; Social Interaction Validity*

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The initial identification of infantile autism can be credited to Kanner's work in the 1940s (1). Autism spectrum disorder (ASD) is marked by qualitative deficiencies in social interaction, social communication, and restricted or repetitive behaviors and interests (2). Recent years have witnessed a noticeable increase in the prevalence of ASD. A review covering the years 1966 to 1998, involving four million subjects, identified 1,533 individuals with autism, yielding a median prevalence of 5.2 cases per 10,000 (3). Conversely, a systematic review in 2022, encompassing 71 studies from 2012 to 2021, revealed a wide-ranging global prevalence of autism, with a median of 100 cases per 10,000 (ranging from 1.09 to 436.0 cases per 10,000) (4). This rising prevalence places a greater demand on resources for assessment, diagnosis, treatment, and follow-up. Howlin and Asgharian noted that the diagnosis of autism spectrum disorder often faces significant delays compared to when parents initially raise concerns (5). Timely identification and appropriate interventions significantly enhance developmental outcomes for children with ASD (6). Consequently, there is a need for specific tools to screen and assess children at a high risk of ASD as early as possible. Among the widely used instruments for identifying potential ASD symptoms, two prominent screening questionnaires include the Social Responsiveness Scale-Second Edition (SRS-2) and the Social Communication Questionnaire (SCQ). The SRS-2, developed by Constantino and Todd, is a widely used instrument designed to measure autistic traits in individuals across the lifespan, including children, adolescents, and adults. Among the instruments being widely used to evaluate ASD such as ADOS, M-Chat, CARS, there are two well-known screening questionnaires, the Social Responsiveness Scale-Second Edition (SRS-2) and the Social Communication Questionnaire (SCQ). Numerous studies have reported strong psychometric properties for the SRS-2 (7-9). Additionally, studies have examined the normative properties of the SRS-2 in various countries and cultures, such as Spanish (7), Chinese (8), and German (10). In addition, Tehrani-Doost and colleagues conducted a study assessing the psychometric properties of the Farsi translation of the SRS-2 in a community group of school-aged children, yielding promising results (11). A study by Mirzakhani and colleagues found strong content validity (0.82) and content validity ratio (0.86) in a group of pre-school and school-age children with ASD, supporting the inter-rater reliability and internal consistency of the SRS-2 (12). The Social Communication Questionnaire (SCQ) is a 40-question assessment developed by Rutter and Lord, answered by primary caregivers to evaluate social communication in young children (13). Some studies have explored the normative properties of the SCQ in various countries and cultures (14-18). In the Iranian community population, there have been studies on the

Farsi translation of the SCQ. Sasanfar and Ghadami proposed that the SCQ can effectively differentiate between children with autism spectrum disorders and those with mental disabilities and behavioral disorders (19).

To our knowledge, there have been no published findings on the concurrent and discriminant validity of the SRS-2 and SCQ in an Iranian clinical population. Given the strong reliability and validity of the Farsi translations of the SRS-2 and SCQ in the community population of Iranian children, this study aimed to assess the clinical and differential validity of these questionnaires as two primary screening instruments for detecting ASD symptoms in a clinical group of children with ASD, in comparison to a group of typically developing (TD) children.

Materials and Methods

Utilizing a straightforward and convenient sampling approach, 52 children ranging from 4 to 12 years of age and diagnosed with ASD, were enlisted from referrals to the child and adolescent psychiatry clinic at Rouzbeh Hospital in Tehran, the capital of Iran. The ASD diagnoses were established by certified child and adolescent psychiatrists, adhering to the criteria outlined in DSM-5 (2).

The clinical group did not exhibit a history of significant psychiatric disorders. Meanwhile, the control group consisted of 53 typically developing children who were randomly selected from students attending two elementary schools and a kindergarten in Tehran. These control group participants were carefully matched with the ASD group in terms of age and gender and possessed no prior history of psychiatric disorders or previous engagement with mental health services. To assess both groups for psychiatric disorders, the Kiddie Schedule for Affective Disorders and Schizophrenia-Present and Lifetime version-DSM-5 (KSADS-PL-5) was employed. Individuals in the typically developing group who were found to have a psychiatric disorder or any additional ASD diagnosis within the ASD group were excluded from the study.

Procedure

The study's purpose was to communicate to both parents and children in both the clinical and control groups, and written consent was duly obtained from the parents. All parents were requested to fill out the SRS-2 and SCQ questionnaires concerning their children. In the clinical group, additional assessments were conducted, which included the Asperger Syndrome Diagnostic Scale (ASDS) and Childhood Autism Rating Scale, Second Edition (CARS-2) to evaluate both autistic and Asperger symptoms. Ultimately, a total of 105 questionnaires were meticulously completed for subsequent analysis.

It is important to note that this study received approval from the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.MEDICINE.REC.1398.134).

Rating Scales

1. Social Responsiveness Scale-2 (SRS-2)

The scale comprises a total of 65 items and can be readily completed by a caregiver, taking approximately 15-20 minutes to complete. The raw scores generated from the scale yield two primary subscales, namely "Restricted Interests & Behavior" and "Social Communication & Interaction." The latter encompasses four additional subscales, covering social awareness, social cognition, social communication, and social motivation (20). The SRS has high internal consistency (Cronbach's alpha = 0.76) and great discriminant validity (21). Sensitivity and specificity are 0.85 and 0.75, respectively, when 75 is considered as the cutoff (21, 22).

Regarding the cross-cultural validity and normative statistics of the Farsi version of the Social Responsiveness Scale-2 (SRS-2), investigations were carried out within mainstream elementary schools. These assessments demonstrated that the SRS-2 serves as a valid screening instrument for identifying social communication issues among Farsi-speaking school-aged children (11). Furthermore, the reliability of the SRS-2 was evaluated in a group of typically developing Iranian children in 2020 (9).

2. Social Communication Questionnaire (SCQ)

The SCQ is typically administered through a questionnaire that is filled out by a parent or caregiver of the child. This scale is designed to assess communication, social interaction, and repetitive behavior in children. It is available in two versions: lifetime and current. It is notably concise, consisting of 40 questions that can be answered with simple "yes" or "no" responses, typically taking less than 10 minutes to complete. In previous epidemiological research, a recommended cut-off score of 12 has been proposed to enhance the effectiveness of the SCQ when used in samples that represent the broader population (16). Sensitivity and specificity values were reported to be 0.65 and 0.73, respectively (23). Furthermore, the Farsi version of the SCQ has undergone prior validation to confirm its psychometric characteristics (19).

3. Childhood Autism Rating Scale (CARS-2)

The CARS-2 is a 15-item behavioral assessment tool specifically created to distinguish between children with intellectual disabilities who have autism syndrome and those who do not. It proves effective in the differentiation of children with autism from intellectually disabled ones who are educable. Additionally, the CARS-2 serves as a tool for clinically assessing the severity of autism, categorizing it as mild-moderate or moderate-severe (14). The Farsi translation of CARS has been utilized for both clinical and research settings. In the study conducted, the Cronbach's alpha coefficient for the Farsi version was determined to be 0.81, as reported by Tehrani-Doost and colleagues (data unpublished).

4. Asperger Syndrome Diagnostic Scale (ASDS)

The Asperger Syndrome Diagnostic Scale (ASDS) is a rating scale comprising 50 yes/no items, intended to assist in assessing the likelihood that a child or adolescent may have Asperger syndrome. This instrument yields an Asperger Syndrome Quotient (AS Quotient) that indicates the probability of an individual having Asperger syndrome (15).

The Farsi translation of the ASDS was carried out by Tehrani-Doost and colleagues (data unpublished). In a subsequent psychometric study using this Farsi version, they reported a Cronbach's alpha coefficient of 0.806, indicating strong internal consistency and reliability for the scale.

5. K-SADS-PL-5

The Kiddie Schedule for Affective Disorders and Schizophrenia-Present and Lifetime version-DSM-5 (K-SADS-PL-5) is a semi-structured interview tool used for evaluating psychiatric diagnoses in children and adolescents based on the DSM-5 criteria. It examines both current and lifetime psychiatric disorders and assesses symptom severity. The K-SADS-PL-5 is recognized for its strong inter-rater reliability and yields results that align with those obtained from semi-structured and fully structured child diagnostic interviews (24). The Farsi version of the K-SADS-PL-5 has undergone validation in Iran, as reported by Hojatitabar and colleagues (data unpublished), confirming its suitability and accuracy for use in this context.

Statistical Analysis

Statistical analysis was performed using SPSS 18.0. The frequency of the subscales was determined using descriptive statistics. An independent t-test was conducted to identify variations between the two groups of variables, and a Pearson correlation test was used to ascertain correlations between the scale variables. The diagnostic value of the SRS-2 and SCQ was evaluated by the ROC curve and area under the curve, sensitivity, specificity, and Youden statistics. The statistical significance of the tests was considered less than 0.05 ($P < 0.05$). To evaluate the discriminatory power of the SRS-2 and SCQ compared with the CARS and ASDS, a series of discriminant analyses were conducted. The comparative contribution of each instrument's scores in predicting membership in the AS versus TD groups was assessed. Subsequent analyses explored the ability of the SRS-2 and SCQ scores alone to classify those in the AS and TD groups.

Results

The participants consisted of 52 children with ASD and 53 TD children. The mean ages of the clinical and nonclinical groups were 7.2 ± 5.7 and 7.2 ± 7.3 years, respectively with no significant difference ($P = 0.656$).

1. Group Comparison on the SRS-2 and SCQ Subscales and Indices

To discriminate between the two groups, a t-test was conducted and the mean scores of all four subscales were calculated. Two indices of SRS-2 in the two groups are summarized in Table 1, showing significant differences between the groups with the scores for

"social motivation", "social communication & interaction", and "total scores" being notably higher in the ASD group compared to TD children ($P < 0.001$). Additionally, the total score of the SCQ also exhibited a significant difference between the two groups, with the ASD group scoring higher (Table 1).

Table 1. Group Comparison on the Social Responsiveness Scale-Second Edition (SRS-2) and Social Communication Questionnaire (SCQ) Subscales and Indices

Subscales/ Indices	ASD	TD	P-value
SRS-2	Mean & SD	Mean & SD	
Social Awareness	15.2 ± 4.0	8.1 ± 3.0	< 0.001
Social Cognition	22.2 ± 7.5	8.0 ± 5.0	< 0.001
Social Communication	41.5 ± 12.0	11.0 ± 7.3	< 0.001
Social Motivation	20.4 ± 6.6	7.6 ± 4.3	< 0.001
Social Communication & Interaction	99.5 ± 26.9	34.2 ± 16.3	< 0.001
Restricted Interests & Behavior	22.7 ± 7.6	6.4 ± 4.6	< 0.001
Total Score	122.2 ± 33.3	40.5 ± 20.0	< 0.001
SCQ Total Score	25.3 ± 7.0	8.0 ± 5.3	< 0.001

2. The CARS-2 Items in the Group with ASD

The means of total score of CARS-2 in the group with ASD is 42 ± 11.3 .

3. The ASDS Scores in the Group with ASD

The mean of raw scores of the ASDS in the group of children with ASD is 32.9 ± 6.7 .

4. Correlations among the SRS-2, SCQ, CARS-2 and ASDS Scores in Group with ASD

The results of Pearson correlation coefficient among the total scores of CARS-2, SRS-2, SCQ and AS quotient are shown in Table 2. As can be seen, significantly high positive correlations were among the four instruments' total scores.

Table 2. Correlations among the Total Scores of Social Responsiveness Scale-Second Edition, Social Communication Questionnaire, Childhood Autism Rating Scale and Asperger Syndrome Quotient

Total Score		CARS-2 Total Score	SRS-2 Total Score	SCQ Total Score	ASDS (AS Quotient)
CARS-2	R	1	0.805		
	P-value	---	< 0.001		
SRS-2	R	0.805	1		
	P-value	< 0.001	---		
SCQ	R	0.697	0.893	1	
	P-value	< 0.001	< 0.001	---	
ASDS (AS quotient)	R	0.687	0.651	0.691	1
	P-value	< 0.001	< 0.001	< 0.001	---

5. Comparison of the Areas under Curve (ROC) for the SRS-2 and SCQ

The ROC curve was utilized to evaluate the discriminative validity of the SRS-2 and SCQ separately. The area under the curve (AUC) values were 0.976 for

the SRS-2 ($P < 0.001$) and 0.953 for the SCQ ($P < 0.001$). The difference between these questionnaires was not statistically significant ($P = 0.252$). Figure 1 shows the diagnostic value of the two instruments ($P < 0.001$).

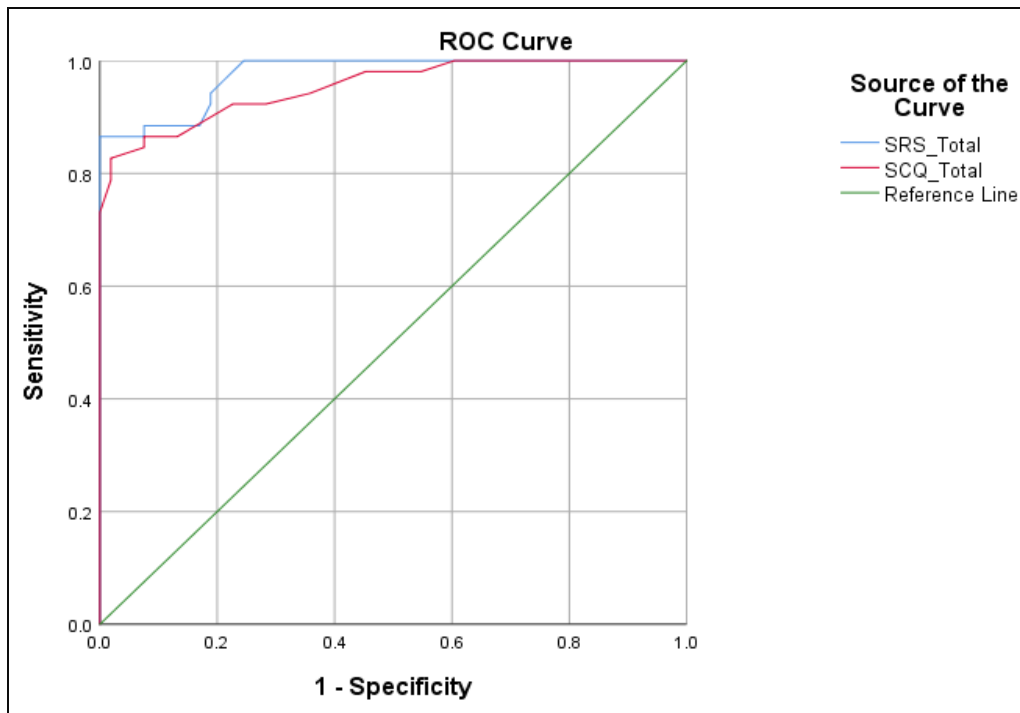


Figure 1. Comparison of the Areas Under the Curve - for Social Responsiveness Scale-Second Edition, Social Communication Questionnaire

6. Differential Validity of the SRS-2 Scores in ROC Analyses and Cut-off Performances

The validity, sensitivity, and specificity of the SRS-2 were evaluated, and the Youden index was applied to determine the optimal cut-off scores for discriminating the clinical group from the TD children (Table 3). The results demonstrated that the SRS-2 is an effective scale

for distinguishing children with ASD from TD children, with an AUC of 0.976, Youden's Index of 0.753, sensitivity of 94%, and specificity of 81%, when using a raw score of 62.5 as the cut-off point. The sensitivity and specificity of the SRS-2 were also examined in two different sub-groups, those children under and above 7 years of age.

Table 3. The Social Responsiveness Scale-Second Edition Cut-Off Points

Sample	Cut-off Points	Youden's Index	Specificity	Sensitivity
Total	61.5	0.754	0.792	0.962
	62.5	0.753	0.811	0.942
	65.5	0.715	0.830	0.885
Age < 7	65.50		0.857	0.731
	68.00		0.857	0.808
Age ≥ 7	61.00		0.958	0.889
	64.00		0.917	0.926

7. Differential Validity of the SCQ Total Score in ROC Analyses and Cut-Off Performances

The ROC curve was also used to find the balance between sensitivity and specificity that best suits the specific application or context. The Youden's index was also utilized to summarize the overall differential validity of the SCQ. As can be seen in Table 4, for cut-offs ranging from 15.5 to 17.5, the sensitivity varied

between 86% and 82%, whereas the specificity ranged between 92% and 98%. Within this range, the Youden index presented a narrow range of variation between 79% and 80.8%. Table 4 illustrates the sensitivity and specificity of the SCQ in two different sub-groups of children: those above 7 years and those under 7 years of age.

Table 4. The Social Communication Questionnaire Cut-Off Points

	Cut-off Points	Youden's Index	Specificity	1-Specificity	Sensitivity
Total	15.50	0.790	0.925	0.075	0.865
	16.50	0.771	0.925	0.075	0.846
	17.50	0.808	0.981	0.019	0.827
Age < 7	15.50		0.917	0.111	0.889
Age ≥ 7	15.50		0.821	0.038	0.962

Discussion

This study was designed to assess the concurrent and discriminative validity of two well-known screening questionnaires for autism spectrum symptomatology, namely the SRS-2 and SCQ in a clinical group of Iranian children with ASD compared to their TD counterparts. The results demonstrated that both instruments effectively differentiated children with ASD from the TD group. Additionally, the SRS-2 and SCQ exhibited high concurrent validity with each other and demonstrated good correlation with the CARS-2 and ASDS.

1. SRS vs SCQ in our Study

As mentioned above, this study supports the SRS and SCQ as dimensional measures to capture autistic symptomatology in children. Based on the ROC analyses, the parent SRS-2 and SCQ separated children with ASD from the TD group, showing high AUCs (a range of 0.90 to 1.00 suggests high accuracy) (25). Although the sensitivity of SRS-2 was greater than that of the SCQ, this difference was not significant, indicating high sensitivity for both in differentiating children with ASD. To detect the most suitable cut-off for each of the two questionnaires as general optimal tests, we chose the raw scores which were associated with ideal combination of sensitivity and specificity values (Youden's index). We established the raw score of 62.5 as the cut-off for the SRS-2, with a sensitivity of 94% and specificity of 81%. These values regarding the SCQ were in the sequence of 15.5, 86% and 92%. If the SRS is needed to be used as a screening test, the cut-off point of 61.5 is the best choice, with the highest sensitivity of 96%. Conversely, if performed as a diagnostic test, 84 would be the right SRS cut-off score, with the greatest specificity of 1. For the SCQ, these cut-off points are 13.5-15.5 and 17.5, respectively. Considering together, based on the recent study, it seems that the SRS can be used as a more sensitive and less specific instrument compared to the SCQ. This means that using the SCQ, the probability of false positive cases is lesser than with the SRS, while the SRS-2 generates far less ASD false negatives compared to the SCQ. Therefore, the SRS-2 might be viewed superior to the SCQ to generate suspicion of ASD among a group of Iranian children. On the other hand, the SCQ can be more appropriate for finding true positive cases in a

clinical population due to its higher specificity. However, Charman *et al.* (2007) used the SCQ and SRS to screen ASD among English 9–13-year-olds with and without autism. Based on their findings, the SCQ showed better performance compared to the SRS regarding AUC, sensitivity, and specificity (0.90 vs 0.77, 0.86 vs 0.78, and 0.78 vs 0.67, respectively) (26).

2. SRS: Our Findings vs other Studies

It appears that our findings regarding higher sensitivity of the SRS than its specificity are not consistent with some studies. It is mainly because our patients suffer from severe ASD compared with those in other studies. Another potential factor could be that participants may not have fully grasped the intention behind each question. Different values of sensitivity and specificity of these two scales have been reported in previous research. For example, Fombone *et al.* (2012) found the cut-off of 60 with a high sensitivity (92.5%) and specificity (92.6%) for the parent SRS, comparing a group of Mexican school-aged children with ASD with TD children (7).

A study using the SRS for assessing ASD symptoms in 4–9-year-old Vietnamese children showed a sensitivity of 93% and specificity of 98% for a cut-off point of 62 (27).

In a study by Bölte *et al.* in Germany, the SRS was considered as a suitable screening test in clinical population to assess autistic symptomatology with sensitivities of 0.74 to 0.80 and specificities of 0.69 to 1.00. The SRS total score of 85 showed a sensitivity of 0.73% and specificity of 0.81% for autism spectrum disorder compared to other clinical conditions (22).

However, consistent with our findings showing higher sensitivity than specificity values of the SRS, a study was conducted in a clinical group of children referred for assessment of autistic problems in Australia. They reported different cut-offs for the parent SRS when used as a diagnostic, screening or general optimal instrument, including the sequence of 89.5, 56.5 and 84. All these cut-offs were lower for the teacher-reported SRS in comparison with parents' ratings. The sensitivities of the SRS reported by parents and teachers were high (91 and 84), while the specificities were very low (8 and 41) (28). Nevertheless, almost all these studies support the clinical validity of the SRS in differentiating children with ASD from other children.

3. SCQ: Our Findings vs other Studies

Barnard-Brak *et al.* (2015) demonstrated that the sensitivity and specificity scores of the SCQ were lower than the scores reported by its creators. When they used the cut-off score of 15 in concordance with its developers, the achieved sensitivity and specificity values were 0.65 and 0.73. However, the cut-off score of 13 was found as the optimal value using a Youden index of 0.43 (23).

In a study conducted in Turkey, a comparison was made between children with ASD and children with intellectual disability. This study reported the best SCQ sensitivity (0.94) and specificity (0.84) values for the cut-off score of 14.5. The sensitivity of 0.86 and specificity of 0.78 for the cut-off of 15 was shown in the original SCQ validation document (29). In a study using the SCQ for toddlers in Mali, a fair diagnostic accuracy was reported (a specificity of 72% and sensitivity of 71%) (30).

Nonetheless, our recent study revealed that the sensitivity and specificity of the Farsi translation of the SCQ were consistent with previous research, indicating that the SCQ is a validated tool for confirming an autism diagnosis. Rudra *et al.* in 2014 also indicated higher values than the recommended cut-off of 15 (19.15 and 18.42) for both Bengali and Hindi samples with autism spectrum condition in India and supported diagnostic properties of the scale (31).

4. Concurrent Validity of SRS and SCQ

This study evaluated the concurrent validity of the SRS and SCQ as well. The highest association was found between the SRS and SCQ, followed by the SRS and CARS-2, as well as SRS and ASDS. The SCQ, CARS-2, and ASDS were also significantly correlated with each other. The correlation between the SRS-2 and SCQ in the recent study ($r = 0.89$) was much greater than those reported by Bölte *et al.* in 2008 ($r = 0.58$) (10) and 0.50 Bölte *et al.* in 2011 ($r = 0.50$) (22).

The significantly high association of the Farsi translation of the SRS-2 with the SCQ and Vineland Adaptive Behavior Scales (VABS) scales was also reported by Tehrani-doost *et al.* (2020) in a community group of Iranian Farsi-speaking school-age children (11).

Finally, the findings of the recent study confirmed the effectiveness of the SCQ and SRS-2 as appropriate tools for assessing the symptoms of ASD. Both scales showed high diagnostic value to distinguish children with autism from healthy children based on the high level of area under the curve. The inconsistencies between the findings of this research with other above-mentioned studies could be explained by a variety of statistical methods used to assess the psychometrics of the questionnaires. Moreover, different cut-offs in different studies have been detected based on cross-cultural adaptations, various aims of research, and the importance of false negatives and positives (19, 27, 32). Furthermore, the age range of children participating in different studies may be one of the variables influencing

the findings. It is noteworthy to consider the probability of false positive and negative cases when detecting cut-off values. Therefore, it is important to use the best values for cut-offs in concordance with the study aims and characteristics of the target population.

Limitation

It is important to note that this study had some limitations that should be taken into consideration. Firstly, the sample size was relatively small and only included children between the ages of 4 and 12 years old. Thus, it will be necessary to replicate these findings in larger samples with a wider age range. Secondly, the participants' understanding of some questions may have varied, as they had varying levels of education, ranging from elementary school to university degrees. Additionally, the TD group may not be the representative of the general population due to the recruitment methods used.

Conclusion

The translated and culturally adapted Farsi version of the SRS and SCQ exhibited good validity, reliability, and sensitivity for the diagnosis of children with ASD in Iran. However, further research is necessary to assess the psychometrics of the SRS and SCQ in children with varying degrees of ASD severity. Additionally, conducting more comprehensive studies across different age groups and exploring different cut-off points within sub-groups are recommended for future research.

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Conflict of Interest

None.

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