# Reliability, Validity and Responsiveness to Change of Persian Version of "Children-Scale for Hostility and Aggression: Reactive and Proactive (C-SHARP)" in Children with Autism Spectrum Disorders

Sasan Ghorbani Kalkhajeh[1], PhD; Kamal Shakhi[2], MSc; Behnaz Dindamal[3], MSc; Farzad Faraji-Khiavi[3,4], PhD

[1]Department of Public Health, School of Health, Abadan University of Medical Sciences, Abadan, Iran
[2]Rehabilitation Administration, School of Rehabilitation Sciences, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran
[3]Department of Health Services Management, faculty of Public Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran
[4]Social Determinants of Health Research Center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

**Correspondence:**
Farzad Faraji-Khiavi, PhD;
Department of Health Services Management, faculty of Public Health, Ahvaz Jundishapur University of Medical Sciences, Postal code: 61357-15751, Ahvaz, Iran
**Tel:** +98 61 33738269
**Fax:** +98 61 33738282
**Email:** faraji-f@ajums.ac.ir
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**Abstract**

**Background:** Aggressive behaviors are the most critical and common challenges shown by children with autism spectrum disorders (ASD) through their life. Children- scale for hostility and aggression: reactive and proactive (C-SHARP) is a comprehensive instrument for measuring aggressive behaviors. No instruments have been developed for measuring aggression in children with ASD or other developmental disabilities in the Persian language; therefore, this study aimed to assess the reliability, validity and responsiveness to change of Persian version of C-SHARP in children with ASD.

**Methods:** This is a psychometric study with three phases including translation process, assessment of the validity and reliability, and responsiveness to change. World health organization (WHO) guidelines for translation and adaptation process were used to translate the C-SHARP. To evaluate the psychometric properties of the instrument, we performed a cross-sectional study on 162 children with ASD and dimensionality and convergent validity, internal consistency, and composite reliability were used. In order to measure responsiveness, we performed a comparative study in the form of a free-gluten dietary intervention, and gamma correlation coefficient was used to correlate change the scores with GRS.

**Results:** Cronbach's alpha coefficients were reported greater than 0.85 for all subscales and the composite reliability coefficient for C-SHARP was 0.94. Root mean square error of approximation (RMSEA) was 0.052 which confirmed robust construct of C-SHARP Persian version. Average variance extracted (AVE) for total C-SHARP was >0.50. Gamma correlation coefficient was 0.77, indicating excellent responsiveness to change of the instrument.

**Conclusion:** The current study approved the reliability, validity, and responsiveness to change of the Persian C-SHARP in children with ASDs. Persian C-SHARP can be used in clinical and research settings to assess aggression.

## Introduction

Autism spectrum disorders (ASDs) are a group of pervasive developmental disabilities known as the most prevalent, serious, and yet unknown disorders during childhood.[1, 2] In recent decades, the prevalence of ASD has increased dramatically, leading to claims of an autism "epidemic".[3, 4] According to the epidemiological data of the World Health Organization (WHO), the occurrence of ASD is 1/160.[5] It is estimated that the prevalence of ASD in 2014 was 2.24%, which was three times higher than the 2000 estimation.[6] Studies from Italy,[7] Australia,[8] and Oman[9] also showed a significant increase in the prevalence of ASD. In Iran, the estimated prevalence of ASD for 6-18 years old individuals is approximately 1.60/1000.[10] Another study in Iran shows that the prevalence of ASD among 5-year-old children is estimated 6.26 per 10,000.[11]

ASD is characterized by having lifelong difficulties in social communications and interactions, and repetitive behaviors.[12-17] In addition to aforementioned deficits, aggressive behaviors (including aggression towards others and themselves, biting, pinching, breaking things, tripping others, and hitting others) are the most critical and common challenges shown by children with ASD through their life; also, these misbehaviors have some adverse effects on their lives.[18]

Aggression is clearly associated with negative outcomes for children with ASD, including impaired social relationships, placement in restrictive school or residential settings, use of physical intervention, and increased risk of being victimized.[19] Hill et al. estimated that the prevalence of aggressive behaviors was between 8 to 68 percent among those diagnosed with ASD.[20] The results of a study on 1380 children with ASD indicated that 56% of the subjects, as reported by parents, demosntrate some degree of current physical aggression toward caregivers (32% toward non-caregivers), while 68% had a history of physical aggression toward caregivers (49% toward non-caregivers).[21]

Aggressive behaviors can also contribute to school provider burnout, leading to probable impact on the quality of education.[22] Aggression also contributes to negative outcomes for caregivers of youth with ASD, including increased stress levels,[23] financial problems, lack of support services, and negative impact on day-to-day family life and well-being.[24] Farmer and Aman also reported that the prevalence of aggressive behaviors in a population with developmental disabilities, especially children with ASD, was more than the general samples.[25] Furthermore, a previous research reported that aggression could be the main cause of parental stress and increased the risk of physical abuse.[12]

Another study conducted by Hill et al. reported that aggressive behavior problems were the primary factors which influenced residential placement and health care interventions.[20] Aggressive behavior problems also might cause limitations for financial situation of families having ASD children. Therefore, assessing the aggression level and its extent and frequency would help the parents, caregivers, and therapists find out why these children are demonstrating these types of behaviors; it can also help the therapists to establish suitable interventions aiming to decrease a given aggressive behavior.[20]

One of the factors involved in the intensity of symptoms such as hyperactivity, stereotyped movements, self-mutilation, and aggression in autistic children is an increase in the level of peptides entering the central nervous system in these children. A hypothesis has been suggested that some diets can improve them. It is suggested that a gluten-free (GF) diet may reduce the common symptoms of the disease because of the possibility that gluten may stimulate the opioid system.[26-28]

Several measurement scales of aggressive behaviors have been developed to assess the aggressive behaviors such as child behavior checklist, including New York teacher rating scale for disruptive and antisocial behavior, and overt aggression scale developed for measuring aggression in typical children. Meanwhile, one of the instruments designed to measure aggression in children with intellectual disabilities was Developmental Behaviors checklist, in which only one subscale would be assessed as aggression even though aggression was a construct including many verbal, covert, hostility, and physical aspects.[25, 29]

Children-scale for hostility and aggression: reactive and proactive (C-SHARP) is a comprehensive instrument for measuring aggressive behaviors containing fifty-one questions which were loaded on 5 various subscales: verbal aggression (12 questions), bullying (12 questions), covert aggression (10 questions), hostility (9 questions), and physical aggression (8 questions). The instrument (C-SHARP) measures the frequency, severity, and degree of provocation of behavior.[25, 29, 30] Studies by Farmer and Aman on the psychometric features of C-SHARP concluded that the instrument had excellent internal consistency ranging from 0.74 to 0.92 for all subscales;[29] also, they conducted anther study showing that the 51 items were loaded on five groups, and most of the items had factor loadings greater than 0.4.[25]

By reviewing the related literature about C-SHARP, we concluded that the following three reasons made the instrument an excellent and comprehensive one for measuring the aggression compared to other instruments. First, all the available instruments were initially designed for normal development of children, so these instruments could not be used for children

with developmental disabilities because of different question constructs of the instruments. The second reason was that C-SHARP has multifactorial construct including five subscales, which were mentioned above; however, many of the commonly and widely used instruments only covered two or three types of aggression. Finally, the third reason was that the ability of the instrument to show a behavior is either reactive or proactive.[25, 29]

To the best of our knowledge, no instruments have been developed for measuring aggression in children with ASD or other developmental disabilities in the Persian language. Therefore, the primary objective of this study was to check the cross-cultural adaptation of the C-SHARP; besides, as to secondary objectives, it aimed to assess the validity and reliability of the Persian version of C-SHARP; in addition, we aimed to measure responsiveness to change after a dietary intervention.

## Methods

This is a psychometric research conducted in 2019; it contained three phases including translation process, assessment of the validity and reliability, and responsiveness to change of the Persian version of C-SHARP.

### Instrument

C-SHARP is a 51-item and multifactorial scale including the following five subscales to assess aggression: verbal (12 items), bullying (12 items), covert (10 items), hostility (9 items), and physical aspects (8 items); it was developed by Farmer and Aman.[25]

### Phase 1: Translation Process

World health organization (WHO) guidelines for translation and adaptation process were used to translate the C-SHARP. Implementation of this method included: 1) Forward translation, 2) Expert panel Back-translation, 3) Pre-testing and cognitive interviewing, and 4) Final version.[31] At first, C-SHARP was translated into the Persian language by one academic translator who was expert in the field of ASD and other developmental disabilities. The ranslated version was reviewed by the authors of the current study. No difficulties in meaning and spelling of translation was found., Then this translated version was distributed among a limited number of parents of ASD children (n=30) to detect any existing problems in terms of meaning or understanding the questions of C-SHARP (pilot study). Parents had no misunderstanding with C-SHARP content. After that, the Persian version of C-SHARP was translated into English by an English native speaker living in Iran who had a PhD degree in Persian literature (Backward

translation) and the final version was ready.

### Phase 2: Psychometric Properties

One hundred sixty-two children diagnosed with ASD participated in this cross-sectional study to assess the validity and reliability of the Persian version of C-SHARP. These children participated in the study from 300 families who were registered in welfare organization of Ahvaz for their ASD children, and their parents singed informed consent for their participation. In addition, they met study inclusion criteria as follow: diagnosis of ASD and other developmental disabilities (according to medical diagnosis in welfare organization records) and age of 15 or younger. The exclusion criteria were severe movement difficulties and existence of more than one ASD child in the same family. Demographic characteristics were collected including data on gender, intelligence quotient (IQ), and residential placement.

In this study, internal consistency was estimated by calculating standard Cronbach's alpha coefficient. Internal consistency was considered as acceptable if the alpha coefficient equals to or was greater than 0.70. Alpha coefficients >0.80 and 0.90 were considered as good and excellent internal consistency reliability.[32] Furthermore, composite reliability (CR) of the Persian version of C-SHARP was evaluated for further test of the reliability of the scale construct, and if CR equaled to or was greater than 0.70, it was considered as an acceptable level for reliability.[33]

Dimensionality and convergent validity were assessed to approve the validity of the instrument. Confirmatory factor analysis with maximum likelihood estimation was performed to estimate the factor loadings to approve the factorial construct of the instrument. The acceptable lower threshold for any factor loadings should be ≥0.40 to keep the item on the scale. Also, to confirm the goodness-of-fit indices, the five-factorial model of the Persian version of C-SHARP, the root mean square error of approximation (RMSEA), standardized root mean residual (SRMR), and comparative fit index (CFI) were used. According to Hu and Bentler, the goodness-of-fit indices for RMSEA, SRMR, and CFI was close to 0.06, 0.08, and 0.95, respectively.[34] Moreover, the average variance extracted (AVE) was calculated for measuring the convergent validity of the Persian version of C-SHARP, which can be assumed acceptable if the level of AVE equals to or is greater than 0.50.[33] Confidence interval for phases 2 and 3 was considered 95%.

### Phase 3: Responsiveness to Change

Responsiveness to change is the ability of an instrument to detect the minimally important difference (MID) in a patient's health status through a period of

time. To assess the responsiveness to change of the Persian version of C-SHARP, was used a comparative study in the form of a free-gluten dietary intervention within three months for forty-four children with ASD to investigate whether the free-gluten diet has effects on aggression before and after the intervention. All parents who accepted to implement a free-gluten diet were included in this phase.

At first, the parents of children completed the C-SHARP for their children before the intervention began (pre-intervention). Then, after 12 weeks, parents were asked to complete the instrument again (post-intervention). The scores for pre- and post-interventions were calculated and considered as change score in this stage. Also, global rating scale (GRS) was given to the parents two times at the begining and 12 weeks after the dietary intervention. Then, They were asked to rate if their children's behaviors improved or not on a Likert scale ranging from 1 indicating very much worse, 2 much worse, 3 a little worse, 4 no change, 5 a little better, 6 very better, 7 very much better. After that, the children were classified into two groups as improved and absence of improvement according to the GRS scores.[35] Cases whose score changes were more than 10% were considered as improved.

Gamma correlation coefficient was estimated between C-SHARP and the reference standard (GRS), which represents how change in one measurement (C-SHARP) could be correlated by the change with GRS. Gamma correlation coefficient ≥0.75, between 0.5 to 0.75, 0.25 to 0.5, and <0.25 was interpreted as good to excellent, moderate to good, fair and poor or no relationship, respectively.[36] Data were analyzed using $SPSS_{v22}$ and $AMOS_{v24}$.

*Ethical Issues*

After receiving ethics code from the Research Ethics Committee of Abadan School of Medical Sciences, the researchers introduced themselves to the study settings (Autism Centers in Khuzestan, Iran). In addition, before the beginning of research phases, informed consent was obtained from the parents of these children. The participants were clearly briefed that they had the right to withdraw from the study at any time even after signing the informed consent. The parents were informed about the aims of the study and confidentiality of their personal information.

## Results

The demographic characteristics of the participants is shown in Table 1. More than 86 percent (140) of the participants were male. 12.34% of children had IQ less than 50, and 19.75% had IQ above 70. The mean of children's age was 9±6 and 115 individuals lived in urban areas.

The mean score for all five subscales of C-SHARP and the total score of the instrument, Reliability Coefficients (Cronbach's alpha & CR), and AVE that indicate the convergent validity are presented in Table 2.

Internal consistency of C-SHARP indicates that, except hostility, all subscales had Cronbach's alpha coefficients greater than 0.90. Moreover, the composite reliability coefficient for C-SHARP was 0.94, with a range of 0.91 (hostility) to 0.98 (physical aggression). The highest level of AVE calculated for physical aggression subscale was 0.85, and all of subscales had AVE amounts >0.50.

The result of CFA is represented in Table 3. The factor loadings of all questions were loaded greater than 0.40, and the RMSEA, SRMR, and CFI were

**Table 1:** Demographic characteristics of the participants

| Characteristics | Groups | No. (Percent) |
|---|---|---|
| Gender | Male | 140 (86.4%) |
| | Female | 22 (13.6%) |
| IQ* | > 70 | 32 (19.75%) |
| | 50-70 | 39 (24.07%) |
| | <50 | 20 (12.34%) |
| | Not reported | 71 (43.8%) |
| Residential placement | Urban | 115 (70.9%) |
| | Rural | 47 (29.1%) |

*Intelligence quotient

**Table 2:** Distribution, Reliability Coefficients, and AVE* of C-SHARP**

| Subscales | Mean±SD*** | Cronbach's alpha coefficients | CR**** | AVE* |
|---|---|---|---|---|
| Verbal | 1.57±0.66 | 0.94 | 0.95 | 0.63 |
| Bullying | 1.59±0.61 | 0.92 | 0.93 | 0.56 |
| Covert | 1.61±0.65 | 0.90 | 0.92 | 0.55 |
| Hostility | 1.83±0.68 | 0.87 | 0.91 | 0.54 |
| Physical | 1.73±0.81 | 0.97 | 0.98 | 0.85 |
| C-SHARP** | 1.66±0.68 | 0.92 | 0.94 | 0.68 |

*Average variance extracted; **Children- scale for hostility and aggression: reactive and proactive; ***Standard deviation; ****Composite reliability

**Table 3:** Factor loadings for the Persian version of C-SHARP

| Items/Subscales | Verbal | Bullying | Covert | Hostility | Physical |
|---|---|---|---|---|---|
| Broods or pouts | 0.45 | | | | |
| Crowds others | 0.92 | | | | |
| Hurtful statements | 0.83 | | | | |
| Uses headlock | 0.87 | | | | |
| Profanity to shock | 0.82 | | | | |
| Calls names | 0.84 | | | | |
| Makes insulting comments | 0.80 | | | | |
| Verbally teases | 0.85 | | | | |
| Hurtful words behind backs | 0.45 | | | | |
| Encourages ganging up | 0.90 | | | | |
| Verbally threatens | 0.85 | | | | |
| Sexual comments | 0.83 | | | | |
| Breaks others' things | | 0.85 | | | |
| Takes others' things | | 0.65 | | | |
| Shoves or pushes | | 0.52 | | | |
| Crowds others | | 0.61 | | | |
| Throws objects | | 0.80 | | | |
| Steals | | 0.45 | | | |
| Breaks own things | | 0.90 | | | |
| Charges at others | | 0.77 | | | |
| Spits | | 0.82 | | | |
| Baiting others | | 0.76 | | | |
| Hits others with objects | | 0.81 | | | |
| Hits or shoves Sneers | | 0.86 | | | |
| Sneers | | | 0.79 | | |
| Sneaky | | | 0.60 | | |
| Broods or pouts | | | 0.74 | | |
| Hurtful statements | | | 0.84 | | |
| Overly argumentative | | | 0.45 | | |
| Physically teases | | | 0.89 | | |
| Steals | | | 0.48 | | |
| Denies behavior | | | 0.85 | | |
| Makes excuses | | | 0.85 | | |
| Glare | | | 0.88 | | |
| Resentful | | | | 0.86 | |
| Is quick to anger | | | | 0.88 | |
| Broods or pouts | | | | 0.81 | |
| Impulsive Reaction | | | | 0.41 | |
| Shouts angrily | | | | 0.89 | |
| Gets mad when caught | | | | 0.86 | |
| Slow to cool off | | | | 0.42 | |
| Defensive: personal space | | | | 0.68 | |
| Grouchy | | | | 0.77 | |
| Pinches | | | | | 0.93 |
| Bites others | | | | | 0.92 |
| Trips others | | | | | 0.94 |
| Head-butts others | | | | | 0.90 |
| Pulls hair | | | | | 0.94 |
| Scratches others | | | | | 0.95 |
| Gets revenge | | | | | 0.92 |
| Tries not to get caught | | | | | 0.92 |

Fit indices: RMSEA*: 0.065; SRMR**: 0.052; CFI***: 0.97

*Root mean square error of approximation; **Standardized root mean residual; ***Comparative fit index

0.065, 0.052, and 0.97, respectively.

Forty-four children took part in the responsiveness analysis; according to their parents, in 29 cases, the severity of the children's aggression was decreased following a dietary intervention. The mean score of pre- and post-intervention and the change score for both improved and not-improved groups were calculated. The gamma correlation between the change score and GRS was 0.77 (Table 4).

**Table 4:** Gamma correlation, mean scores of pre-intervention, post-intervention and change for C-SHARP

| Scale | Pre intervention Mean±SD* | Post intervention Mean±SD* | Change score Mean±SD* | Gamma correlation coefficient |
|---|---|---|---|---|
| C-SHARP** | | | | 0.77 |
| Improved | 1.51±0.41 | 0.36±0.14 | 1.13±0.5 | - |
| Unimproved | 1.14±0.28 | 1.0629±0.87 | 0.07±0.8 | - |

*Standard deviation; **Children- scale for hostility and aggression: reactive and proactive

## Discussion

The current study was conducted to assess the psychometric properties and responsiveness of the Persian version of C-SHARP in children with ASD. The result showed that the Persian version of the instrument had excellent validity and reliability. The instrument also represented a highly accepted responsiveness to change.

In this study, the internal consistency was obtained by estimating Cronbach's alpha coefficient. These coefficients ranged from 0.87 (hostility) to 0.97 (physical aggression), indicating high internal consistency of the Persian version of C-SHARP. An exploratory study was conducted by Farmer and Aman among ASD children to develop an instrument for measuring aggression; it was shown that the Cronbach's alpha coefficient for verbal aggression was 0.92.[29] Farmer and Aman's study also showed that the C-SHARP total score for internal consistency was excellent, which was consistent with the result of the Persian version of C-SHARP.[29] Farmer and Aman, in another study, reported that the internal consistency of the instrument was high.[25]

Our study was the first one in the world which used the Composite Reliability technique to assess the C-SHARP. The result showed highly acceptable CR for all subscales of the Persian version of the instrument ranging from 0.91 to 0.98, which approved the robust consistency of the latent construct of C-SHARP. Farmer and Aman used an item-total correlation method for testing the internal consistency of C-SHARP; they reported that the value of correlation coefficients for all the original subscales of C-SHARP was acceptable and ranged from 0.60 to 0.75.[29]

The result of CFA revealed that all the items of the Persian version of C-SHARP had factor loadings greater than 0.40, which approved the construct of the instrument. Farmer and Aman in their exploratory factor analysis reported that the items of the original version of C-SHARP were loaded on five subscales with a mean factor loading for each subscale ranging from 0.47 to 0.57.[25] The result was consistent with that of our study. The RMSEA, SRMR, and CFI for the Persian version of C-SHARP were 0.065, 0.052, and 0.97, respectively, which confirmed that the five-factor model of C-SHARP had excellent and appropriate construct to measure the aggression in clinical settings. These results were confirmed by Farmer and Aman's explanatory study in which they

reported that the RMSEA for original version of C-SHARP was 0.071, which provided a best fit for the 5 factors model of the instrument.[25] Also, Farmer et al. carried out a study to confirm the factorial structure of C-SHARP using confirmatory factor analysis. The result of confirmatory study of Farmer showed that the average factor loading for each C-SHARP subscales was greater than RMSEA (0.053), SRMR (0.083), and CFI (0.79), which confirmed the five factors model of the instrument.[37] AVE was computed for assessing the convergent validity. All subscales of the Persian version of C-SHARP had AVE greater than 0.50, ranging from 0.54 to 0.85, which supported the idea that the latent variables of the Persian version of the instrument had high convergent validity.

Several methods have been developed to assess responsiveness, However, the Gamma correlation was used in this research. Gamma correlation coefficient was obtained 0.77 that indicates excellent responsiveness to change of the instrument. Optimistically, an instrument should identify slight clinically changes;[38] ideally, the study showed that C-SHARP had a highly acceptable responsiveness for detecting minimally important changes in aggression severity following a dietary intervention. As a result, it can help the therapists who need to recognize actual changes to describe the effects of therapeutic interventions and distinguish thev children whose aggressive severity was decreased or worsened.

The results of the present study showed that the rate of aggression after GF diet decreased in almost 66% of children, which indicates a relatively good effect of this diet. The results of study of Johnson et al. showed that the intervention group fed with the GF had a significant improvement in reduction of aggression.[39] Ghalichi et al. demonstrated that gluten-free diet was effective in improving the stereotyped and aggressive behaviors in the intervention group compared to the control group. They also attributed the reduction in gastrointestinal symptoms to mitigated aggressive behaviors.[40] However, the results of studies such as those of Piwowarczyk et al.[41] and Gonzalez et al.[42] were not in the same line with those of the present study, and no association was found between this diet and the improvement of autistic child behaviors. However, care should be taken when creating a GF diet for children with ASD, and adequate training programs and information should be provided to their families. It is recommended that their families should

be trained for at least 3 hours.[26]

The findings of this study are also useful and effective for future research and these findings can be considered as a base line for more detailed studies to solve the problems of autistic children in Iran because it is possible to measure the aggression of these children and find solutions to control and improve it in Iran.

*Limitations*

The study has some limitations that should be considered. First, only forty-four children fully participated in the assessment of the responsiveness to change of the Persian version of C-SHARP because free-gluten diet was a relatively costly intervention for families to follow, so for other research some more affordable interventions may increase the participation rates. Second, the participants of the study were only the children with ASD. Hence, for further studies, it is recommended that the research should include other developmental disabilities.

## Conclusion

In summary, this study showed that the Persian version of C-SHARP had excellent dimensionality and convergent validity, and high internal consistency and composite reliability. In addition, this translated version can be used in future research settings in Iran for measuring interventions to control hostility and aggression among ASD children.

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## Ethics Approval

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**Conflict of Interest:** None declared.

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