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Psychometric Validation and Age Extension of the Chinese Quality of Life for Children with Autism Spectrum Disorder Scale in Children Aged 0–12 Years: A Cross-Sectional Study

Junning Fang
Gannan Medical University
Yujie Zeng
Gannan Medical University
Long Yao
Gannan Medical University
Yuhan Xu
Gannan Medical University
Feng Zhang
Ganzhou Maternal and Child Health Hospital
Yihui Li
feizifen@gmu.edu.cn

Gannan Medical University

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Abstract

Background

The Quality of Life for Children with Autism Spectrum Disorder scale (QOLASD) is a parent-proxy measure specifically designed for children with autism spectrum disorder. However, evidence supporting the Chinese version of this scale has been primarily derived from children aged 0–7 years. This study aims to evaluate the reliability, construct validity, age-related measurement invariance, and convergent validity of the Chinese scale in children aged 0–12 years with autism spectrum disorder (ASD).

Methods

This cross-sectional study included 358 children with ASD aged 0–12 years (81.3% male). Parents completed the Chinese version of the Quality of Life for Children with Autism Spectrum Disorder scale (QOLASD-C), and 326 children aged 2–12 years with complete data on both the QOLASD-C and the Pediatric Quality of Life Inventory 4.0 (PedsQL 4.0) were included in the convergent validity analysis. Psychometric analyses included internal consistency, split-half reliability, construct validity, age-related measurement invariance, and convergent validity. Construct validity and measurement invariance were assessed using confirmatory factor analysis (CFA) and multigroup CFA with robust maximum likelihood estimation, respectively. Convergent validity was examined using Spearman correlations with the PedsQL 4.0.

Results

The total scale exhibited excellent internal consistency (Cronbach's α = 0.914), with good reliability across all three dimensions. Confirmatory factor analysis indicated acceptable fit for the modified three-factor model. Measurement invariance was confirmed across the 0–7 and 8–12 year age groups. The QOLASD-C correlated positively with all PedsQL 4.0 dimensions (r = 0.146–0.366, all P < 0.01).

Conclusions

The QOLASD-C shows satisfactory reliability and validity for measuring quality of life in children with ASD aged 0–12 years. The scale is appropriate for cross-sectional description and screening in clinical settings and for population-based research in both preschool and school-age populations. However, its use for individual-level clinical decision-making or tracking change over time should await further longitudinal and multi-informant validation.

Background

Autism spectrum disorder (ASD) is a neurodevelopmental condition characcterized by persistent difficulties in social communication and restricted or repetitive patterns of behaviors [1]. With global prevalence rates increasing—approximately 2.76% among 8-year-olds in the U.S., and demonstrating an upward trend in China [2–4]—there is growing recognition that clinical outcomes need to extend beyond mere symptom reduction to encompass quality of life (QoL) improvements [5, 6].

QoL reflects an individual's perception of well-being within their cultural context [7] and serves as a critical indicator of long-term adaptation and intervention success for individuals with autism spectrum disorder (ASD) [8]. Due to impairments in language, cognition, and social skills, children with ASD often struggle to provide reliable self-reports. As a result, parent-proxy reports are widely used to assess QoL in children with ASD, particularly when reliable self-report is difficult to obtain [9].

Most of instruments used to assess quality of life in children with autism spectrum disorder are generic measures, such as the Pediatric Quality of Life Inventory 4.0 [10], the Inventory for the Assessment of Quality of Life in Children and Adolescents [11], the KINDL-R [12], and the Child Health Questionnaire [13]. While these measures capture broad aspects of health-related quality of life, they may lack sensitivity to autism-specific experiences, such as atypical social motivation, restricted behavioral patterns, and variations in daily autonomy. For instance, the social functioning dimension of the Pediatric Quality of Life Inventory 4.0(PedsQL 4.0) primarily reflects general peer interactions. However, it may not fully capture ASD-specific aspects of social experience and functioning [14, 15]. These limitations highlight the value of ASD-specific Qol measures that complement, rather than replace, generic instruments.

To address this gap, the Quality of Life for Children with Autism Spectrum Disorder (QOLASD-C) scale was developed by Chezan et al. based on Schalock's QOL conceptual model [16]. This parent-proxy measure comprises 16 items across three domains: Interpersonal Relationships, Self-Determination, and Emotional Well-Being. The original scale demonstrated strong reliability (Cronbach's $\alpha = 0.90$) and fit the Rasch model well in a sample of US children with ASD aged 5–10 years [17, 18]. More recently, Fang and colleagues translated and culturally adapted the QOLASD-C into Chinese and evaluated its psychometric properties in children with ASD aged 0–7 years, reporting excellent internal consistency (Cronbach's $\alpha = 0.928$) and supporting a three-domain structure [19].

Nonetheless, extending the use of the Chinese QOLASD-C beyond the age range in which it was previously validated requires consideration of developmental changes. As children with ASD grow older, the contexts in which interpersonal relationships, self-determination, and emotional well-being are expressed become increasingly complex, particularly with school entry, expanding peer relationships, and increasing expectations for autonomy [20–23]. Moreover, some children with ASD, particularly those with less apparent support needs, may not receive a diagnosis until school age or later [24, 25]. Thus, there is a practical need to evaluate the QOLASD-C in older children. Importantly, extending a measure to a broader developmental range requires more than demonstrating acceptable reliability and factor structure. It is also necessary to establish whether the instrument measures the same underlying constructs equivalently across age groups. Without evidence of measurement invariance, observed age-group differences may reflect differences in measurement properties rather than true differences in QoL.

This study aimed to validate the psychometric properties of the Chinese QOLASD-C in a larger sample of children with ASD aged 0–12 years, with particular emphasis on its measurement comparability across age groups Specifically, we examined: (1) internal consistency and split-half reliability; (2) the three-factor structure using confirmatory factor analysis (CFA); (3) configural, metric, and scalar measurement invariance between the previously validated age range (0–7 years) and the extended age range (8–12 years); and (4) convergent validity using the PedsQL 4.0.

Study Design and Participants

This cross-sectional psychometric study involved the recruitment of children diagnosed with autism spectrum disorder (ASD) from child rehabilitation centers, maternal and child health hospitals, and psychiatric specialty hospitals located in Ganzhou and Yichun, Jiangxi Province, China, between April 2024 and September 2025.

Inclusion Criteria

Children were eligible if they: (1) had a clinical diagnosis of ASD based on DSM-5 criteria, made by a pediatrician or other qualified physician at attending-physician level or above, or had a formal ASD diagnosis issued by a tertiary Grade A hospital in China; (2) were aged 0–12 years; and (3) had received at least 3 months of professional ASD rehabilitation intervention during the previous year.

Primary caregivers were eligible if they : (1) were the child’s biological mother or father and primary caregiver; (2) cohabitated with the child for ≥ 6 hours daily within the past year and could comprehensively report the child's daily functioning, emotional, and behavioral status (3) had no severe cognitive or psychiatric disorders that would interfere with questionnaire completion, were fluent in Mandarin Chinese, and were able to complete the questionnaires independently or, when necessary, with procedural assistance from a trained researcher.

Children were excluded if:

1. ASD was only suspected and not confirmed.

(2) They had uncontrolled severe epilepsy, confirmed organic brain injury, or other neuropsychiatric conditions that could seriously affect quality-of-life assessment.

(3) They were participating in a drug or device trial that might interfere with the study results.

Primary caregivers were excluded if:

1. Severe mental or physical illness hindered their ability to cooperate.
2. They were not the primary caregiver.

Sample Size Requirements

In accordance with structural equation modeling guidelines, which suggest needing 10 to 20 times the number of observed variables [26], the confirmatory factor analysis (CFA) with 16 observed variables required a minimum sample size of 160–320 participants. Additionally, the multigroup CFA (MGCFA) required at least 100 participants per subgroup [27].

A total of 375 questionnaires were distributed. Questionnaires were excluded if they exhibited straight-lining (patterned responses), lacked essential information (e.g., age or diagnosis), reported an age outside the 0–12-year range, or contained more than 20% missing items on the QOLASD-C. After excluding 17 invalid questionnaires, 358 valid questionnaires were retained, yielding an effective response rate of 95.5%. These 358 participants constituted the main analytic sample for reliability analysis, CFA, and measurement invariance testing.

For the convergent validity analysis, only participants who had completed both the QOLASD-C and the PedsQL 4.0 and were aged 2 years or older were eligible. Of the 358 participants, 25 had not completed the PedsQL 4.0, and seven additional participants were younger than 2 years. After these exclusions, 326 children aged 2–12 years were included in the convergent validity analysis.

Measures

The QOLASD-C, initially developed by Chezan et al. [17], is a parent-reported tool designed to assess the QOL of children with ASD. The Chinese version was translated and culturally adapted by Fang et al. [19]. The scale comprises 16 items organized into three dimensions: interpersonal relationships (items 1–3), self-determination (items 7–12), and emotional well-being (items 4–6, 13–16). These dimensions assess children's willingness and performance in social interactions, their ability to express preferences and make choices, and their emotional states and experiences, respectively. All items are rated on a 4-point Likert scale (1 = strongly disagree, 4 = strongly agree), producing a total score ranging from 16 to 64, with higher scores indicating better QoL. Previous studies have demonstrated good internal consistency for the Chinese version in children with ASD aged 0–7 years (Cronbach's α = 0.928) [19].

The PedsQL 4.0, developed by Varni et al. [10], is a widely used generic QoL instrument for children and adolescents aged 2–18 years, with established validity for children with ASD [9, 28]. In this study, the parent-proxy version was used, comprising 23 items across four domains: physical, emotional, social, and school functioning. Items are rated on a 5-point scale and converted to a 0–100 scale after reverse scoring, with higher scores indicating better QoL (Cronbach's α = 0.90) [10]. Its social and emotional domains correspond conceptually to the interpersonal relationships and emotional well-being dimensions of the QOLASD-C, which supports examining the convergent validity of the QOLASD-C against an established generic QoL measure.

Statistical analysis

We conducted data analyses using IBM SPSS Statistics version 23.0 and R version 4.4.1. Since the data were derived from parent-reported measures, Harman's single-factor test was employed to assess

common method bias. All items from both scales were included in an exploratory factor analysis. Common method bias was considered unlikely to significantly affect the results if the first unrotated factor accounted for less than 40% of the total variance [29]. Normality of item distributions was evaluated using the Shapiro-Wilk test, supplemented by assessments of skewness, kurtosis, and Q-Q plots.

To assess reliability, the internal consistency of the total scale and its dimensions was calculated using Cronbach's α coefficients, split-half reliability, and item-total Spearman correlations. A Cronbach's α of 0.70 or higher was deemed acceptable [30], and item-total correlations of 0.20 or higher were retained [31].

Construct validity was examined using CFA based on the three-factor structure of the Chinese version for children aged 0–7 years. The Kaiser-Meyer-Olkin (KMO) statistic and Bartlett's test of sphericity were initially used to assess the appropriateness of factor analysis. Robust maximum likelihood (MLR) estimation was used to account for non-normal item distributions. Model fit was evaluated using CFI, TLI, RMSEA, and SRMR. Values greater than 0.90 for CFI and TLI and less than 0.08 for RMSEA and SRMR were considered acceptable [32]. If the fit was not optimal, a single round of model modification was conducted by releasing residual correlation paths with clear content overlap, guided by modification indices (MI > 3.84) and theoretical justification [33]. Only within-factor correlated residuals that were theoretically defensible were added.

Measurement invariance was tested using multi-group CFA across the 0-7-year and the 8-12-year groups. Configural, metric, and scalar invariance models were tested sequentially. Metric invariance was supported if ΔCFI > -0.010, ΔRMSEA < 0.015, and ΔSRMR < 0.030. Scalar invariance was supported when Delta CFI exceeded − 0.010, Delta RMSEA was less than 0.015, and Delta SRMR was below 0.010 [34]. Measurement invariance across sex, residence, and only-child status was also examined as supplementary evidence. Convergent validity was assessed using Spearman correlations between the QOLASD-C and the PedsQL 4.0. The significance level was set at alpha = 0.05 (two-tailed). Correlations of 0.10 to 0.29 were interpreted as weak, 0.30 to 0.49 as moderate, and 0.50 or higher as strong [35].

Results

Participant Characteristics

This study included 358 children diagnosed with ASD. The sample was predominantly male (n = 291, 81.3%), consistent with the known epidemiological sex distribution of ASD. The age distribution shows that 254 children (70.9%) were between 0 and 7 years old, while 104 children (29.1%) were aged 8 to 12 years. Additionally, 234 children (65.4%) resided in urban areas, whereas 124 children (34.6%) lived in rural areas. There were 57 only children (15.9%) in the sample, while 301 children (84.1%) had siblings. Table 1 presents detailed demographic characteristics of the participants.

Table 1
Sociodemographic Characteristics

Variable	N = 358	%
Male	291	81.3
Female	67	18.7
0–7 years	254	70.9
8–12 years	104	29.1
Urban residence	234	65.4
Rural residence	124	34.6
Only child	57	15.9
Not an only child	301	84.1

Common Method Bias and Item Distribution

All data were collected through parent-proxy reports; therefore, potential common method bias was evaluated using Harman's single-factor test. The unrotated solution revealed nine factors with eigenvalues exceeding one, together accounting for 67.04% of the cumulative variance. The first factor explained 24.24% of the total variance, which is below the 40% threshold, indicating that no single factor dominated the covariance among the items. The limitations of Harman's test were acknowledged in the interpretation due to its limited sensitivity.

To assess normality, we examined item distributions using Shapiro–Wilk tests, skewness and kurtosis, and Q–Q plots. All 16 items deviated significantly from normality (Shapiro–Wilk $P < 0.001$), although the deviations were mild in magnitude (absolute skewness 0.09–1.09; absolute kurtosis 0.07–1.16), and item-level Q–Q plots similarly showed departures from the reference line (Additional file 1: Table S1 and Additional file 2 : Fig. S1). Robust maximum likelihood (MLR) estimation was therefore used in both the confirmatory factor analysis and the multi-group confirmatory factor analysis to mitigate potential bias arising from non-normal distributions.

Additional file 1: Table S1. Item-level normality statistics for the 16 items of the Chinese QOLASD-C. (PDF) Shapiro–Wilk W and P values, skewness, and kurtosis are reported for each item; all items deviated significantly from normality (P < 0.001), although the deviations were mild in magnitude. n = 358.

Reliability

The total scale displayed excellent internal consistency, achieving a Cronbach's alpha of 0.914. All three dimensions showed good reliability, and the split-half reliability for the total scale was recorded at 0.851. Item-total Spearman correlations ranged from 0.51 to 0.77 (P < 0.001), indicating that all items showed

adequate associations with the overall score. These findings were consistent with those of the original scale as well as the Chinese version for children aged 0–7 years [17, 19]. Table 2 presents detailed reliability coefficients. The complete correlation matrix among the 16 items and the total score is presented in Additional file 3: Fig. S2.

Table 2
Reliability Coefficients

Dimension	Cronbach's alpha	Split-half reliability
Total scale	0.914	0.851
Interpersonal relationships	0.878	0.722
Self-determination	0.888	0.898
Emotional well-being	0.814	0.770

Construct validity

Before conducting CFA, we assessed the suitability of the data for factor analysis using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. The KMO statistic was 0.913, with Bartlett's test showing statistical significance ($\chi^2 = 3001.484$, df = 120, $P < 0.001$), indicating that the data were adequate for further analysis.

The initial three-factor CFA model showed marginal fit, with RMSEA = 0.086 (90% CI [0.075, 0.096]), CFI = 0.909, TLI = 0.892. Since the TLI fell below the commonly accepted threshold of 0.90, we proceeded with model modification. Modification indices identified residual correlations between two pairs of items: items 13 and 14 (pertaining to positive emotional states in a family context) and items 1 and 2 (pertaining to willingness to engage socially). Both pairs exhibited clear content overlap and strong theoretical justification. These residual correlations were freely estimated in a single modification step.

The modified model demonstrated improved fit indices, with all indicators now meeting widely accepted standards: RMSEA = 0.075 (90% CI [0.064, 0.086]), CFI = 0.932, TLI = 0.917. Notably, all standardized factor loadings were statistically significant ($P < 0.001$). The residual correlations were 0.35 (items 13 and 14) and 0.48 (items 1 and 2). Detailed results are provided in Table 3 and illustrated in Fig. 1.

Table 3
Confirmatory Factor Analysis Fit

Model	chi-square	df	RMSEA [90% CI]	CFI	TLI	SRMR
Before modification	318.59	101	0.086 [0.075, 0.096]	0.909	0.892	0.061
After modification	262.03	99	0.075 [0.064, 0.086]	0.932	0.917	0.056

Measurement Invariance

Measurement invariance across age groups (0–7 years vs. 8–12 years) was assessed using multigroup confirmatory factor analysis. The configural invariance model demonstrated an acceptable fit, with the following statistics: CFI = 0.936, TLI = 0.923, RMSEA = 0.065, and SRMR = 0.059. These findings indicate that both age groups share an identical three-factor structure with consistent item assignments. When comparing the configural model to the metric invariance model, the comparison revealed ΔCFI = − 0.001 (greater than − 0.010), ΔRMSEA = − 0.001 (less than 0.015), and ΔSRMR = 0.006 (less than 0.030). These results meet all the criteria for metric invariance, confirming equivalent factor loadings between the groups. Additionally, the comparison of the metric model to the scalar invariance model revealed ΔCFI = − 0.005 (greater than − 0.010), ΔRMSEA = 0.001 (less than 0.015), and ΔSRMR = 0.001 (less than 0.010). Together, these results fulfill all requirements for scalar invariance, ensuring that the intercepts remain equivalent across the age groups (see Table 4).

Table 4
Age-Group Measurement Invariance

Model	CFI	TLI	RMSEA [90% CI]	SRMR	Δ CFI	Δ RMSEA	Δ SRMR
Configural	0.936	0.923	0.065 [0.055, 0.076]	0.059	NA	NA	NA
Metric	0.935	0.926	0.064 [0.053, 0.074]	0.065	-0.001	-0.001	0.006
Scalar	0.930	0.925	0.064 [0.054, 0.074]	0.066	-0.005	0.001	0.001

Supplementary multi-group analyses considering sex, residence, and only-child status showed acceptable or nearly acceptable fit for all configural models. The incremental changes in CFI, RMSEA, and SRMR across the metric and scalar invariance comparisons met the recommended thresholds proposed by Chen (2007), reinforcing measurement invariance across these groups. Further analyses indicated highly consistent factor covariance structures across the subgroups, with standardized factor loading differences under 0.1 and intercept differences below 0.2. This suggests comparable measurement dimensions, item difficulty, and construct associations among the groups. As the TLI values for all three configural models fell slightly below 0.90, these subgroup findings should be viewed as supportive but less definitive than the primary age-group invariance results (detailed fit indices can be found in Table 5).

Table 5
Subgroup measurement invariance

Group	Model	TLI	CFI	RMSEA [90% CI]	SRMR	Δ TLI	Δ CFI	Δ RMSEA	Δ SRMR
Sex	Configural	0.878	0.900	0.084 [0.074, 0.093]	0.058	NA	NA	NA	NA
Sex	Metric	0.887	0.901	0.081 [0.071, 0.090]	0.063	0.009	0.001	-0.003	0.004
Sex	Scalar	0.891	0.898	0.079 [0.070, 0.089]	0.064	0.004	-0.003	-0.001	0.001
Residence	Configural	0.889	0.908	0.079 [0.069, 0.088]	0.067	NA	NA	NA	NA
Residence	Metric	0.896	0.909	0.076 [0.067, 0.086]	0.070	0.007	0.000	-0.003	0.003
Residence	Scalar	0.899	0.906	0.075 [0.065, 0.084]	0.072	0.003	-0.003	-0.001	0.002
Only-child status	Configural	0.880	0.901	0.083 [0.074, 0.093]	0.061	NA	NA	NA	NA
Only-child status	Metric	0.886	0.900	0.081 [0.072, 0.091]	0.065	0.006	-0.002	-0.002	0.004
Only-child status	Scalar	0.892	0.899	0.079 [0.070, 0.088]	0.066	0.006	-0.001	-0.002	0.001

Convergent validity

As shown in Fig. 2, the Chinese QOLASD-C demonstrated significant positive correlations with the PedsQL 4.0 across all dimensions and total scores (n = 326; r = 0.146–0.366, all P < 0.01); individual scatter plots with loess smoothing are presented in Additional file 4: Fig. S3.The strongest dimension-level cross-instrument correlation was found between the interpersonal relationship dimension of the QOLASD-C and the social functioning domain of the PedsQL 4.0 (r = 0.343), a moderate correlation. Cross-instrument dimension-level correlations ranged from 0.146 to 0.343, considered weak to moderate. The total-score correlations between the two instruments was 0.366, also classified as moderate. This pattern of significant yet low-to-moderate correlations aligns with the expected relationship between a disease-specific and a generic pediatric quality of life measure, confirming that the QOLASD-C captures variance in quality of life specific to Autism Spectrum Disorder that is not addressed by generic tools.

Discussion

This study systematically validated the Chinese version of the QOLASD-C among children with ASD aged 0–12 years in China. Our findings confirm its reliability, construct validity, age-related measurement invariance, and convergent validity (the latter in children aged 2–12 years). The results broaden the evidence base for the scale, extending its applicability from preschoolers to school-age populations, thereby strengthening its utility in the assessment of childhood ASD.

The QOLASD-C exhibited excellent internal consistency overall and demonstrated good consistency across its three dimensions. Item-total correlation analyses indicated that all items meaningfully contributed to the overall construct. Our findings align closely with those from the original scale and earlier Chinese validation involving children aged 0–7 years [17, 19], reinforcing that interpersonal relationships, self-determination, and emotional well-being are consistent quality-of-life dimensions for Chinese children with ASD through both early and middle childhood.

As predicted, the three-factor structure of the QOLASD-C showed an acceptable fit for children aged 0–12 years after a single, theoretically driven modification. Our results support the stability of social interaction, self-determination, and emotional well-being as core domains of QoL for children with ASD. This three-domain framework is consistent with Schalock's conceptual QoL model [16] and aligns with prior research that emphasizes social engagement, autonomy, and emotional functioning as central constructs in assessing quality of life for individuals with ASD [17, 18].

The improved model fit moving from the initial to the modified version stems from two main factors. First, the inclusion of free residual correlations for two pairs of items (items 13 and 14 in the emotional well-being dimension, and items 1 and 2 in the social interaction dimension) reflects a clear conceptual overlap. Accounting for this shared variance enhances the model's ability to capture systematic covariation among items. Second, our sample size of 358 children is sufficiently large to mitigate instability in estimation commonly seen in smaller samples ($N < 200$), and not so large that the chi-square test becomes overly sensitive to minor deviations [26]. Notably, the residual correlation of 0.48 between items 1 and 2 indicates a substantial overlap in caregiver perceptions; specifically, item 1 assesses the willingness to play with other children, while item 2 focuses on enjoyment in group activities. These closely related social participation behaviors may be viewed as highly similar by caregivers, suggesting potential item redundancy that could be addressed in future revisions of the scale.

A significant psychometric finding from this study is the measurement invariance across age groups. Multigroup confirmatory factor analysis (MGCFA) confirmed configural, metric, and scalar invariance of the Chinese QOLASD-C between the 0–7-year and 8–12-year cohorts, with all change indices meeting the stringent criteria proposed by Chen (2007) [34]. Configural invariance signifies that the same three-factor structure underlies the scale across both age groups. Metric invariance indicates that the strength of item-factor association is comparable for preschool and school-aged children, while scalar invariance confirms equal item intercepts across groups, allowing for direct comparison of raw scale scores

between both age ranges. These findings provide statistical support for expanding the applicable age range of the Chinese QOLASD-C from 0–7 years to 0–12 years.

The observed pattern of age-related measurement invariance is theoretically grounded in the persistence of core ASD impairments across development. Social communication deficits, a fundamental diagnostic feature of ASD [1], remain evident throughout various developmental stages, although their behavioral expressions evolve. In children aged 0–7 years, these deficits manifest primarily as challenges in foundational social behaviors such as eye contact and joint attention [36]. In contrast, children aged 8–12 years face difficulties in more complex social situations, including building peer relationships and integrating into groups [24, 25]. Similarly, self-determination, a basic human psychological need [37], also exhibits cross-age stability: early childhood focuses on developing abilities, while school-aged children showcase greater autonomy in decision-making [38]. Positive emotional well-being is not limited to a specific developmental stage; it functions as a vital developmental resource throughout the lifespan [39]. Collectively, these observations indicate that the QOLASD-C effectively captures stable quality of life constructs while accommodating age-related differences in their expression across developmental stages.

Measurement invariance was also established across demographic factors such as gender, residential location, and only-child status, indicating the scale's stable measurement properties across diverse subgroups and supporting its broader applicability.

The Chinese QOLASD-C showed significant, albeit weak-to-moderate, positive correlations with the PedsQL 4.0 across all domains and total scores. This finding is unsurprising. As a generic pediatric QOL instrument, the PedsQL 4.0 encompasses health-related domains relevant to all children, including physical and school functioning. In contrast, the QOLASD-C focuses on QOL domains specifically linked to ASD's core impairments, such as limited self-determination [40] and emotional regulation challenges [41].

Three key differences underline the differences between the two instruments. (1) Measurement perspective: the PedsQL 4.0 operates within a disease/health framework, while the QOLASD-C centers on ASD-specific lived experiences. (2) Item content: the social functioning dimension of the PedsQL 4.0 emphasizes general peer interactions, whereas the QOLASD-C addresses the unique social motivations and behaviors of children with ASD. (3) Construct level: the PedsQL 4.0 captures the "basic needs" tier of children's QOL, while the QOLASD-C measures the "disease-specific deeper manifestations" tier [17, 19].

The small-to-moderate correlations suggest that the QOLASD-C and PedsQL 4.0 assess related but noninterchangeable aspects of quality of life., which is consistent with their autism-specific and generic measurement perspectives, respectively. This finding is consistent with the systematic review by Ikeda et al. [9], which highlighted systematic differences in QOL domains and outcomes examined by generic versus ASD-specific tools., emphasizing the necessity for developing and utilizing disease-specific assessment measures.

This study has several strengths. (1) It represents the first validation of the psychometric properties of the Chinese QOLASD-C among children with ASD aged 0–12 years within the Chinese cultural context, providing preliminary psychometric evidence for its use in a sample that included children aged 8–12 years (2) The application of MGCFA rigorously tested measurement invariance across age and gender groups, providing preliminary support for age-group comparisons within the present cross-sectional sample (3) All analyses utilized robust maximum likelihood (MLR) estimation to effectively address non-normal data, ensuring rigorous statistical methodology.

However, this study also has limitations. (1) The sample was recruited from two cities in Jiangxi Province, which may limit the generalizability of the scale to other regions in China. (2) The gender distribution of the sample (81.3% male vs. 18.7% female) aligns with the epidemiological characteristics of ASD [42], but may limit the scale's generalizability for girls with ASD. (3) Sample sizes between the 0–7 years group (n = 254) and the 8–12 years group (n = 104) were uneven, potentially reducing the precision of subgroup invariance testing in MGCFA analyses. (4) This study relied solely on parent proxy reports, omitting teacher reports or self-reports from children capable of sharing their experiences, which may introduce rating biases [43]. (5) As a generic measure, the PedsQL 4.0 is not applicable to children younger than 2 years, so convergent validity was evaluated only in children aged 2–12 years (n = 326) rather than the full sample (N = 358); convergent validity for children under 2 years thus remains unestablished. future research should incorporate autism-specific external criteria, such as the Vineland Adaptive Behavior Scales [44] and the Social Responsiveness Scale [45]. (6) The cross-sectional design restricts the evaluation of longitudinal measurement invariance or test-retest reliability. (7) The modified CFA model represents an exploratory finding; its robustness necessitates cross-validation in independent samples.

Future research should aim to recruit larger, more balanced samples that include more girls with ASD and children aged 8–12 years, while incorporating teacher ratings and self-report data from high-functioning children to provide multi-informant validation evidence. A longitudinal follow-up design should be implemented to examine longitudinal measurement invariance and test-retest reliability of the scale, facilitating its utility in tracking QoL changes over time and evaluating intervention outcomes. The modified three-factor model should be validated in independent samples, and measurement invariance across subgroups—including different severity levels of ASD and the presence or absence of intellectual disabilities—should be further assessed.

Conclusions

The Chinese version of the QOLASD-C demonstrated high internal consistency and provided preliminary evidence of structural and convergent validity in this sample of Chinese children with ASD aged 0–12 years (convergent validity: 2–12 years). The modified three-factor model exhibited configural, metric, and scalar invariance between the 0–7-year and 8–12-year groups, providing preliminary support for comparisons of the latent constructs across the two age groups studied. These findings extend the available psychometric evidence for the QOLASD-C to a sample including children aged 8–12 years and support its continued use in research as a parent-proxy measure of quality of life. Independent cross-

validation, test–retest assessment, longitudinal measurement-invariance testing, and evaluation in larger, multisite, and multi-informant samples are needed before the scale can be recommended for clinical decision-making or monitoring changes over time.

Abbreviations

ASD: Autism Spectrum Disorder. CFI: Comparative Fit Index. DSM-5: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. KMO: Kaiser-Meyer-Olkin. MGCFA: Multi-Group Confirmatory Factor Analysis. PedsQL 4.0: Pediatric Quality of Life Inventory 4.0. QOLASD-C: Quality of Life for Children with Autism Spectrum Disorder scale. RMSEA: Root Mean Square Error of Approximation. SRMR: Standardized Root Mean Square Residual. TLI: Tucker-Lewis Index.

Declarations

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used Doubao (developed by ByteDance) and OpenAI's ChatGPT tool to assist with language translation, text polishing and readability improvement of the manuscript. The tools used were language assistance and academic writing support tools. After using these tools/services, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Ethics approval and consent to participate

Written informed consent was obtained from the parents or legal guardians of all participating children prior to participation. The study protocol, informed consent materials, and related research procedures were subsequently reviewed and approved by the Ethics Committee of Gannan Medical University (approval no. 2025071). All procedures were conducted in accordance with applicable institutional requirements and ethical principles for research involving human participants.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analysed during the current study are not publicly available due to participant privacy considerations but are available from the corresponding author upon reasonable request, subject to applicable ethical and data protection requirements.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

CRediT authorship contribution statement

Author initials: JF, Junning Fang; YZ, Yujie Zeng; YL, Yao Long; YX, Yuhan Xu; FZ, Feng Zhang; YL*, Yihui Li, .

JF: Methodology (study design), Formal analysis, Writing – original draft. YZ: Data curation, Formal analysis, Methodology, Project administration. YL: Methodology, Formal analysis, Writing – original draft. YX: Data curation, Project administration. FZ: Resources, Investigation. YL*: Funding acquisition, Conceptualization, Writing – review & editing.

All authors approved the final version of the manuscript for publication.

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Figures

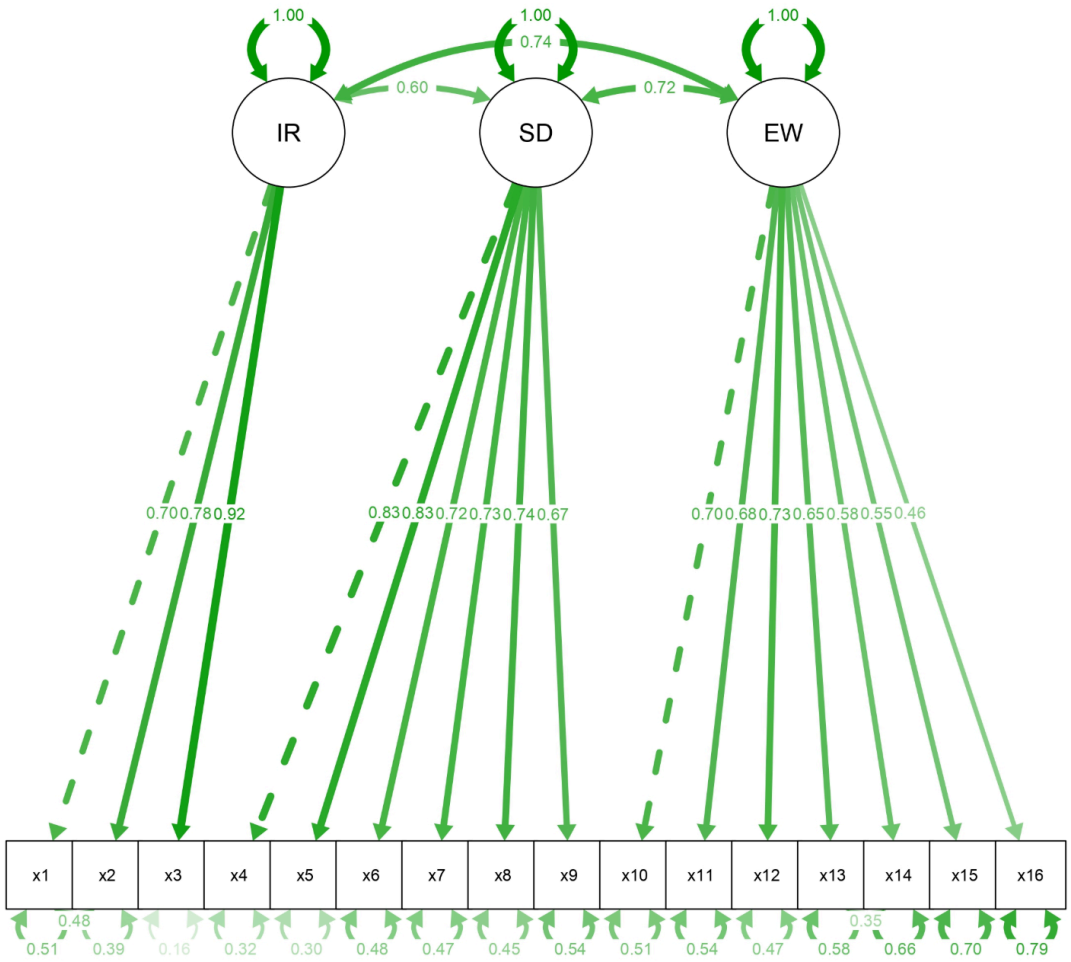


Figure 1

Structural Diagram of Factor Analysis**,**Three latent factors (IR: interpersonal relationships; SD: self-determination; EW: emotional well-being) are represented by circles, and 16 observed items are represented by rectangles (x1–x16). Standardized factor loadings are presented on the paths from latent factors to items. Inter-factor correlation coefficients are shown on the bidirectional paths between latent factors. Error variances for each item are displayed below the corresponding rectangles. All standardized factor loadings were statistically significant (P < 0.001).

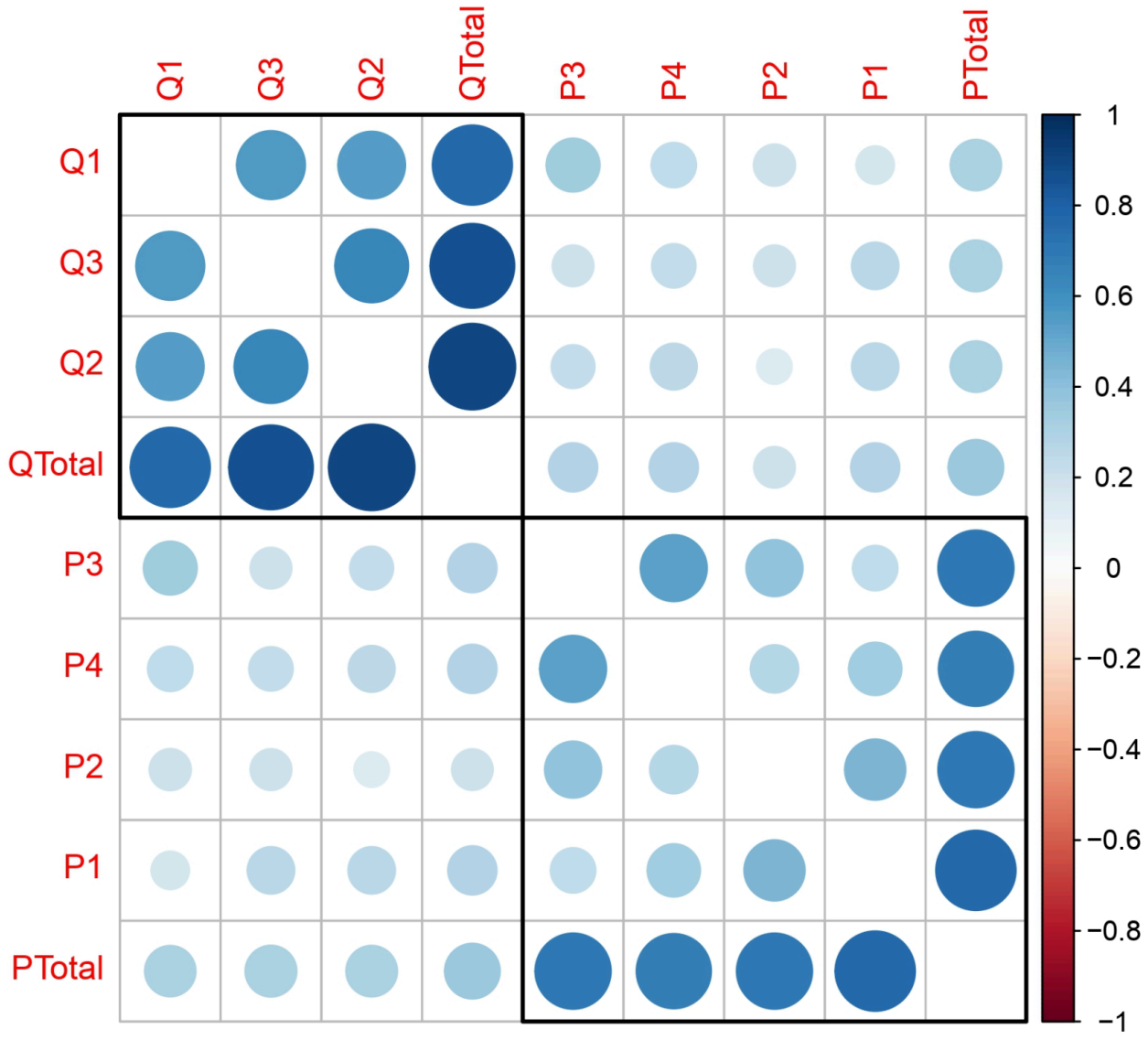


Figure 2

Heatmap of Spearman Correlations Between Dimensions and Total Scores of the QOLASD-C and PedsQL 4.0. Each cell presents the Spearman's rank correlation between a pair of variables; bubble size and color intensity represent the magnitude and direction of the coefficient. The upper-left block displays correlations within the QOLASD-C (Q1, interpersonal relationships; Q2, self-determination; Q3, emotional well-being; QTotal, QOLASD-C total score), the lower-right block correlations within the PedsQL 4.0 (P1, physical functioning; P2, emotional functioning; P3, social functioning; P4, school functioning; PTotal, PedsQL 4.0 total score), and the remaining cells cross-correlations between the two instruments. n = 326.

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