

Development of Autism Spectrum Disorder Scale and its Psychometric Properties

Original
Article

Tasmia Ijaz¹, Dr. Zaqia Bano¹

¹Department of Psychology University of Gujrat.

²Department of Psychology National University of Medical Sciences (NUMS) Rawalpindi, Pakistan

* Correspondence: Tasmia Ijaz (tasmiaijaz@gmail.com)

Citation | Ijaz. T, Bano. Z, “Development of Autism Spectrum Disorder Scale and its Psychometric Properties”. Int. J. Innov. Sci. Technol., Special Issue., pp. 9-24, 2022.

Received | July 17, 2022; **Revised** | Aug 23, 2022; **Accepted** | Aug 25, 2022; **Published** | 01 September, 2022.

Autism spectrum disorder scale was developed for the use of diagnoses purpose of autism. This scale is consisting of 15 items in Pakistan’s indigenous language Urdu. Most autism assessment tools are available in English and were developed by Western cultures; however, when those tools are used in different cultures, biased results can be evident. So, a culture-friendly tool was dire need to be developed. A scale was developed and administered to individuals (N=143) with autism using standard procedures from item pooling to standardization of scale. The sample was selected from different cities in Pakistan through a convenient sampling technique. Rotated component matrix analysis, factors loading, sample adequacy KMO and CFI tests were performed using SPSS and AMOS. The convergent validity test demonstrated that there is a significant correlation ($r=0.81$, $p=.00$) at the 0.01 alpha level with CARS on the sample of $n=50$. The indigenous scale also confirmed good test-retest reliability ($r=0.950$, $p=.000$) at a 0.01 alpha level, which indicated that the scale is a valid and reliable measure for diagnosing individuals with an autism spectrum disorder. This scale can be used by researchers, psychologists, and psychiatrists for the general population to measure the prevalence and for diagnosis.

Keywords: Autism Spectrum Disorder; Scale Development; Autistic Individuals And Childhood Autism Rating Scale.

Acknowledgment.

My dear supervisor Dr. Zaqia Bano has my deepest gratitude for her perseverance, inspiration, enthusiasm, and sincere guidance and assistance in getting this project done.

My respected teachers and other employees of special children's schools and institutes have my sincere gratitude for their invaluable assistance in gathering data for this study.

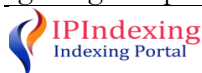
Project details. Nil

Author’s Contribution.

Each author contributed a significant part to the study.

Conflict of interest:

The authors of this paper declare no conflict of interest.



Introduction

Autism spectrum disorder is a neurodevelopmental disorder that is depicted by insistent impairment of social communication and reciprocity over numerous settings just as a limited monotonous and stereotypic sample of behavior, activities and interests. According to the DSM 4th edition [1], delays or aberrant functioning in one of the supporting regions before the age of 3 years indicate autism. Appearances of autism must be experienced in the early developmental periods of life (<30-36 months of age) although they probably would not be completely developed until later when the social requirements far surpass the child's capacities. Meanwhile they should direct clinically significant deficiencies in occupational, communal, and further vital functioning regions of life. The assessment may be complicated as the child gets an adult because the individual figures out how to conceal some basic demonstrative signs [2], [3]. Autism has numerous specifiers that make every child exceptional and requires individualization of determination and a management plan. The DSM-V likewise announces the degree of intensity extending from one to three. The severity level depends on the social communication impairments and restrictive and repetitive behavior patterns. One shows that a child “requires support” and severity level three demonstrates that the subject “requires very substantial support” [1]. A few people having autism face incapacitating social issues while others might have the option to work all the more freely. In short, autism can cause numerous worries and can significantly affect a people functioning in various aspects of life.

Since the 1700s, children displaying behaviors that are characteristic of the current origination of autism have been observed. Eughen Bleuler, a Swiss psychiatrist coined the term "autism" in 1911, to assign loss of contact with the real world that can ground trouble with the inadequacy of communication [4]. He used this term to depict schizophrenics who experienced issues concerning individuals and who had all the earmarks of being turned internal or towards themselves [5]. The word ‘spectrum’ alludes to the wide assortment of indications and severities within autism.

What difficulties have to face by one having autism were explained through many theories, but one of the most popular and well-described theory is the theory of mind in accordance with autism. Premark and Woodruff in 1978, presented a theory of mind according to that person determined to have autism or assumed to occurrence trouble in understanding the viewpoints of other people. Theory of Mind refers to the ability to get the next person’s perspective. At the age of a few months, the child usually can notice the individual facial expression of other people and within the next two months can get a sense of these outward appearances. When children grow enough to understand the other’s facial expressions, they start to utilize this information to change or adjust their conduct. For example, once a little child sees his mom's face for prompts about whether or not it is protected to move toward a new individual. This understanding of others may feel and think distinctively as compared to one’s own is an instance of a child’s use of the “theory of mind” evidence [6].

The insufficient use of this type of theory of mind’ information is thought to contribute to some of the social difficulties and lack of empathy that are typically present in autistic people. Joint attention and its relationship to the theory of mind have been studied about autistic children [7]. The person’s ability to comprehend another person’s point of view is impacted by joint attention deficiencies in ASD. Joint attention has been suggested as a sign of the development of the theory of mind. The research was directed to kids younger than 5 years determined to have ASD to examine the utilization of highlighting to find out the significance of the sign and its connection to joint attention [8]. The connection between cognitive, affective, and emotional factors of the theory of mind [9] is given below in fig 1.

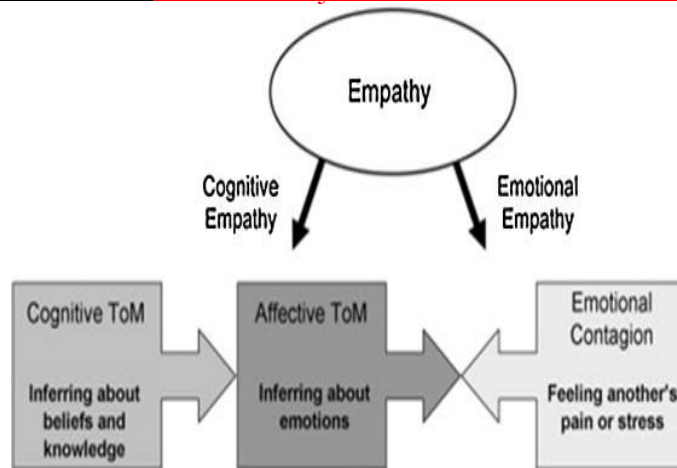


Figure 1. Model on Theory of Mind [9].

It's debatable if ASD can be detected in a child's period of early life. Assessments can be exceptionally useful in recognizing the particular challenges that every individual experiences and in choosing effective methods and interventions to discourse these shortcomings. Evasion of building up eye-to-eye connection is a typical trait of people determined to have autism. Newborn children with autism show eye stares that will in general, be merely fleeting and from the corner of their eyes. Quirks in the audible range also are available in most cases. Even though they may not respond to their names and appear to be sensitive to strange or unusual changes in the ambient sound. They are rarely perceived as having hearing loss. Autistic babies do not play games with their parents and do not share activities with others. Neither show interest nor take part in playing baby's games [10].

A multidisciplinary team of experts directs the evaluation of autism at this early age, usually in a child development unit. There would be a clinical psychologist, a pediatrician, a child psychiatrist, a speech therapist, a nursing specialist, a play therapist, and a social worker in this unit. The parent is questioned during multidisciplinary group evaluations about the family history, the pregnancy's timeline and the development of the child. To identify any underlying conditions that might be causing variations from expected developmental growth as well as delays a physical examination is necessary. The assessment of play, language, sensory perception, emotional, social development, both fine and gross motor skills are all included in these developmental evaluations. One of the main focuses of the evaluation process is the type of improvement. When an autism diagnosis is made based on the diagnostic assessment, suggestions are offered for early intervention programs that can provide both social and educational experiences [11].

In school, the evaluation should be integrated with contributions from speech-language therapists, teachers, and occupational therapists. The specific domains known to indicate the difficulties faced by autistic people such as social skills, communication, (verbal, nonverbal, and pragmatics) environmental impacts and behavioral variability should be the focus of autism assessment [12].

Assessment measures for diagnosing the autism of a child depend intensely on observation, interviews with parents, consultation with teachers and behavior rating scales. Observation ought to be finished over various settings while surveying for autism. Observation recording must reflect what extent the conduct is shown and the recurrence with which it happens. The observer needs to understand that a person's social and intellectual abilities are what enable them to interact and have fun with others. Children with autism have a less independent play and lower levels of group play participation [13].

These days every society is experiencing an alarming increase in psychological problems. Assessment tools are necessary to identify and address these problems. As Psychological issues are heavily influenced by cultural and social factors. There is a dire need to develop culture-friendly tools for measuring these issues. There aren't many assessment methods available for neuro-developmental disorders particularly for autism spectrum disorder as available for other psychiatric problems. The indigenous scale of autism spectrum disorder is established to diminish the deficiency of reliable and culture-friendly scales in Pakistan for autism. However, various English scales based on western cultures are available to diagnose autism for example, the autism screening instrument for education planned (ASIEP-3) [14], autism behavior checklist (ABC) [15], childhood autism rating scale (CARS) [16], vineland adaptive behavior scales (VABS) [17], autism diagnostic interview-revised (ADI-R) [18] and the Gilliam autism rating scale (GARS) [19] are thought to be useful in the autism diagnostic procedure. In addition, the revised modified checklist for autism in toddlers (M-CHAT-R) was translated into Urdu.

Therefore, it was necessary to create a measure of the most apparent issue of autism spectrum disorder (ASD) that can be used in Pakistani settings because there aren't enough scales in the language of the source. But English is the language of the accessible western assessment instruments and is highly focused on their cultures. When they are used in other cultures, the biased result will occur [20]. Therefore, cultural differences are largely ignored in this framework when a test is administered to a population for which it was not originally developed [21]. Due to this lack of standardized measurements a culturally reliable tool in the local tongue was required for easy understanding of the concerned population. Furthermore, cultural differences may skew the responses to various items producing unreliable results. Hence, there is a scope for the development of a scale for diagnosing autism, especially in the setting of Pakistan. The objective of the present study was to create a tool to distinguish autism based on early developmental and behavioral patterns in children later diagnosed with ASD. Then established the psychometric properties of indigenously developed scale of autism spectrum disorder.

Methodology

This study was conducted in the Psychology department, Al-Farabi block, Hafiz Hayat Campus, University of Gujrat. The duration of this study was a whole year from 5th July 2019 to 24th April 2020. There is no community involvement in this study. There were two Phases of this investigation. In phase-1 scale was developed by following 5 steps; item pool generation, expert evaluation, pilot study, final administration and factor analysis. In phase 2 evaluation of the psychometric properties of the scale was presented. And the detail of this study and each phase are provided as follows in figure 2.

Phase I- Scale Development

There were 5 steps of scale development in this phase.

Generation of item pool:

According to Hinkin, Tracey, and Enz 1997, the First step of scale development is item pool generation [22]. For item pool generation information from all aspects was collected about Autism such as face-to-face interviews with psychologists, autistic child's parents and teachers. Previously developed scales on autism and literature review were investigated. Moreover, symptoms of autism discussed in DSM-5 were also considered. So, 153 items were finalized as the initial item pool. The Urdu language was used according to cultural perspectives.

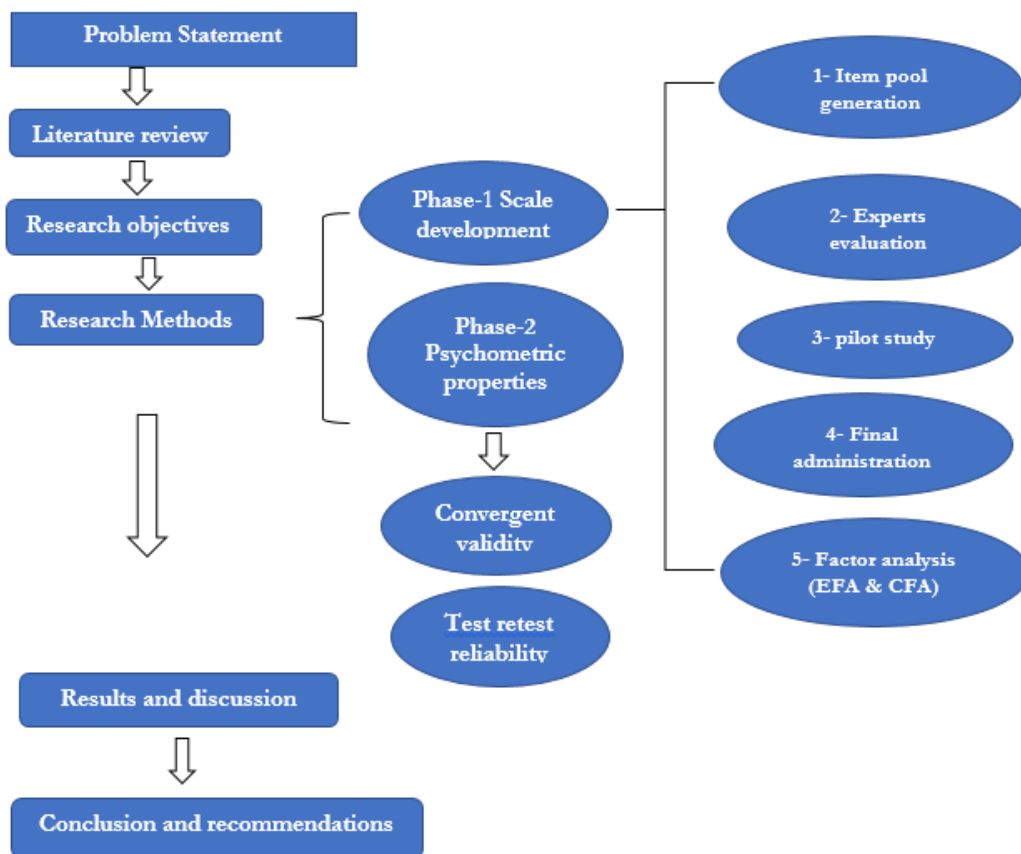


Figure 2. Flow chart of the methodology

Expert's evaluation of items:

The following step involved a methodical process of content validation by professionals. A panel of experts should evaluate the produced item pool for content validity [23]. It was preferred to hire experts with knowledge of scale development and relevant subjects. We asked 3 Ph.D. scholars and 5 MPhil scholars in clinical and applied psychology to evaluate each item's suitability for the scale. The relevancy to the construct, clarity, comprehension, fairness, signifying, content and understanding of the items were other criteria that experts were asked to judge. In addition the item's ambiguity, suitability and content were evaluated. The recommendations led to either changes or eliminations of the items. Options for responses were confirmed as well. That was made using a likert scale with a maximum score of 5, with 1 denoting strong agreement, 2 mostly agreement, 3 agree, 4 mostly disagreement and 5 strongly disagreements. Five items were eliminated and some were improved after evaluation only 148 items persisted.

Pilot study:

After the experts evaluated the autism spectrum disorder scale, the data were collected from 40 diagnosed autistic individuals from Islamabad, Lalamusa, and Kharian using the convenient sampling technique to check the appropriateness of the items. The items having 0.4 or above item-total correlation were held and the others discarded as shown in table 1 only 75 items retained. It also helps to clarify any vagueness in the comprehension of instructions of tests and item statements.

Table 1. Table describing Pearson product-moment correlation coefficient (n=40)

Sr. No.	Items	R	Sr. No.	Items	R	Sr. No.	Items	R
1	2	.525**	26	51	.515**	51	86	.602**
2	3	.608**	27	52	.411**	52	87	.421**
3	4	.561**	28	54	.521**	53	88	.405**
4	5	.500**	29	55	.566**	54	89	.439**
5	6	.445**	30	56	.648**	55	90	.413**
6	9	.448**	31	57	.604**	56	92	.503**
7	11	.544**	32	58	.531**	57	94	.429**
8	12	.429**	33	61	.672**	58	96	.405**
9	13	.421**	34	63	.563**	59	100	.472**
10	15	.447**	35	65	.448**	60	101	.458**
11	27	.501**	36	68	.488**	61	102	.777**
12	28	.504**	37	69	.487**	62	104	.499**
13	29	.470**	38	71	.529**	63	108	.436**
14	30	.520**	39	72	.512**	64	112	.481**
15	37	.548**	40	73	.431**	65	113	.411**
16	39	.621**	41	76	.452**	66	116	-.459**
17	41	.452**	42	77	.653**	67	120	.452**
18	42	.568**	43	78	.647**	68	121	.400**
19	43	.533**	44	79	.584**	69	122	.474**
20	44	.634**	45	80	.531**	70	126	.413**
21	45	.572**	46	81	.626**	71	127	.408**
22	46	.406**	47	82	.620**	72	131	.454**
23	48	.626**	48	83	.545**	73	136	.445**
24	49	.521**	49	84	.567**	74	142	.425**
25	50	.729**	50	85	.401**	75	144	.482**

Note: There is a significant Correlation coefficient level of 0.01 (2-tailed).

Final Administration

Procedure:

Each participant signed off on their informed consent. People were made aware of the goals and importance of the research. Whether they want to fill the scale or not is entirely up to them. They were instructed to read the items clearly and give honest responses. Participants were given the necessary explanation if they are not getting it. Participants were ultimately thanked for their cooperation. In this way data was collected from 143 respondents for factor analysis.

The demographic form was used to obtain information about participants that included name, religion, gender, race, age, class, occupation, no of siblings, birth order, family system, parent alive, parent’s status, education, employment and income of parents , earning members, family monthly income and medical psychological issues given in table 2 below.

Table 2. The table describes the demographic characteristics of the sample (N=143)

Characteristics	Frequencies (f)	Percentage (%)	
Religion	Muslim	142	99.3
	non-Muslim	1	.7
gender	male	112	78.3
	female	31	21.7
Race	Punjabi	142	99.3
	others	1	.7

age	4 years	2	1.4
	5 years	2	1.4
	6 years	14	9.8
	7 years	7	4.9
	8 years	12	8.4
	9 years	14	9.8
	10 years	2	1.4
	11 years	9	6.3
	12 years	13	9.1
	13 years	18	12.6
	14 years	8	5.6
	15 years	9	6.3
	16 years	8	5.6
	17 years	10	6.7
	18 years	4	2.8
	19 years	2	1.4
	22 years	7	4.9
	24 years	1	.7
	28 years	1	.7
	siblings	1	53
2		43	30.1
3		21	14.7
4		13	9.1
5		5	3.5
6		5	3.5
7		3	2.1
birth order	1 st	66	46.2
	2 nd	51	35.7
	3 rd	14	9.8
	4 th	5	3.5
	5 th	1	.7
	6 th	6	4.2
Family system	nuclear	115	80.4
	joint	28	19.6
parent alive	yes	126	88.1
	no	17	11.9
parent live together	yes	120	83.9
	no	23	16.1
father education	middle	5	3.5
	matric	43	30.1
	inter	22	15.4
	graduate	41	28.7
	master	25	17.5
	MPhil	1	.7
	PhD	6	4.2
father occupation	none	5	3.5
	job	81	56.6
	personal business	57	39.9
mother education	middle	23	16.1

	matric	31	21.7
	inter	52	36.4
	graduate	10	7.0
	master	25	17.5
	MPhil	2	1.4
mother	housewife	138	96.5
occupation	job	5	3.5
earning member	1	110	76.9
	2	26	18.2
	3	6	4.2
	4	1	7
family monthly income	14000-30000	47	32.9
	above 30000	96	67.1

Sample and sampling technique:

A sample of 143 (N=143) diagnosed autistic individuals were taken and 75 items scales were administered using convenient sampling techniques from different private and Govt. special education schools, institutes and centers of autism from different areas of Province Punjab Pakistan that were conveniently available. Only diagnosed autistic individuals with no other psychological disorder, physical disability or comorbidity with the age of 2 years and above were selected.

Statistical analysis

Exploratory factor analysis (EFA):

Following steps for final administration,, Exploratory factor analysis was done to minimize the volume of data. This is used for inductive purposes and to break down a large set of variables into smaller ones. Statistical significance and the relationships between the factors are used in confirmatory analysis to assess the quality of the factors [24]. Principal component analysis and varimax rotations were used to run EFA on 75 items in table 3 to determine the factor validity and importance of the scale’s items. The significance and correlation of these items were determined by the Bartlett test of sphere city in Table 4 with the 59 items, a KMO value of 0.6 and higher is required to claim sample adequacy [25].

Table 3. Factor loading of 75 items after varimax rotation (N=143)

Serial no.	Item no.	Components		
		1	2	3
1	2	.702		
2	29	.540		
3	42	.538		
4	43	.751		
5	48	.578		
6	49	.631		
7	50	.616		
8	54	.608		
9	55	.443		
10	56	.511		
11	57	.706		
12	61	.620		
13	63	.652		
14	65	.466		
15	68	.596		
16	71	.421		

17	77	.643	
18	79	.619	
19	81	.572	
20	83	.514	
21	84	.491	
22	102	.688	
23	104	.428	
24	113	.425	
25	131	.451	
26	142	.442	
27	144	.644	
28	3		.553
29	5		.701
30	27		.569
31	28		.789
32	30		.535
33	39		.409
34	41		.693
35	44		.543
36	45		.554
37	46		.425
38	51		.452
39	52		.667
40	78		.595
41	80		.436
42	82		.567
43	86		.530
44	127		.424
45	4		.548
46	6		.687
47	9		.648
48	11		.730
49	12		.469
50	13		.624
51	15		.402
52	72		.434
53	73		.482
54	87		.528
55	88		.448
56	100		.527
57	101		.479
58	120		.508
59	136		.429

Note: Extraction method: a component analysis. Rotation method: varimax with Kaiser normalization. Rotation converged in 20 iterations.

Table 4. Kaiser-meyer-olkin measure of sampling adequacy (KMO) and Bartlett’s test of sphericity

	Bartlett’s Test Sphericity			
	KMO	Chi-Square	df	Sig.
ASD scale	.830	7682.81	2775	.000

Note: ASD means autism spectrum disorder. KMO value is significant at $P < .001$

Confirmatory factor analysis (CFA):

An analysis of confirmatory factors has supported 15 items as shown in figure 3. The CFI value which ranges from 0.90 to 0.95 is good [26]. Consequently, the CFI value of this scale at .942 confirmed the scale's usefulness. The significance of the model was demonstrated by the value of $p = .00$ in table 5.

Table 5. Model fit indices of confirmatory factor analysis with 59 items (N= 143)

P Value	CMIN/DF	GFI	CFI	RMSEA	PGFI	PCLOSE	RMR
.000	1.449	.900	.942	.056	.635	.307	.039

Note: CFI=Comparative Fit Index, GFI=Goodness of a Fit Index, PCLOSE=P value of close fit, RMSEA=Root Mean Squared Error of Approximation, CMIN=Chi-Square value, RMR=Root Mean Square Residual.

This 15-item indigenous scale of autism spectrum disorder has also cut off scores to identify the severity level of autism as shown in table 6. To find the cut off scores of the Scale tool Khurshheed Ahmed’s formula was used [27]. To measure the test-retest reliability and convergent validity of the ASDS scale sample of (N=50) diagnosed autistic individuals above age 2 years were selected from different institutes, clinics and special education schools in different areas of Province Punjab Pakistan using a convenient sampling technique. Measures: to access the test-retest reliability and convergent validity of the autism spectrum disorder scale (ASDS), Childhood Autism Rating Scale [28] was used. The scale consisted of 15 items with 7 liker scales having score ranges; 1, 1.5, 2, 2.5, 3, 3.5, and 4. The Autism Spectrum Disorder Scale (ASDS) and Childhood Autism Rating Scale (CARS) were predicted to correlate positively.

Table 6. Cut off Score Ranges for Autism Spectrum Disorder Scale (ASDS) in Urdu spectrum disorder with 3 sub-scales images taken from Amos Phase II- Determining Psychometric Properties of Autism Spectrum Disorder Scale

Score Range	Description
0-30	No Autism
31-45	Mild level of Autism
46-60	Moderate level of Autism
61-75	Sever level of Autism

Test-retest reliability:

To evaluate the test-retest reliability final 15-item scale of autism spectrum disorder (ASDS) was administered on the sample of (n=50) and after two weeks again administer the indigenous scale on the same individuals. The responses were collected and analyzed the test-retest reliability which is shown in table 7.

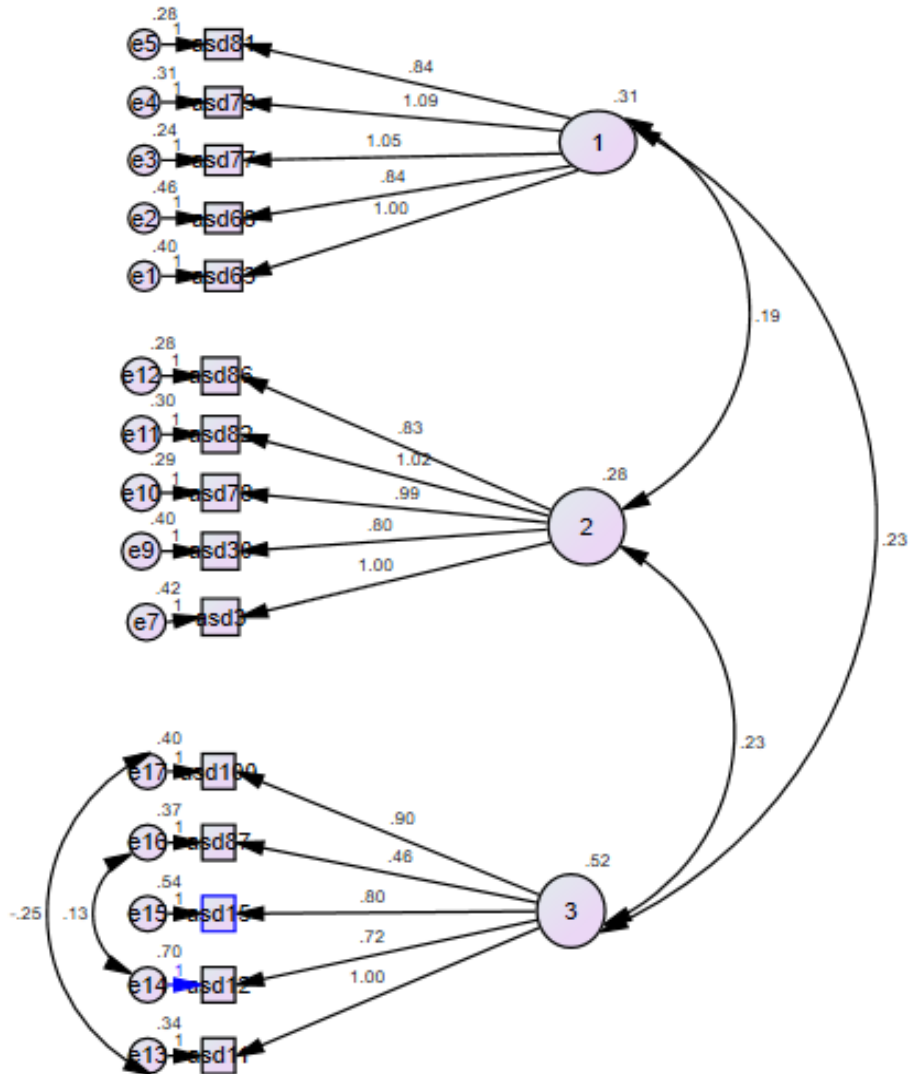


Figure 3. CFA model confirming the factor structure of the domains of the scale of autism
Table 7. Test-retest reliability analysis of autism spectrum disorder scale in Urdu (n=50)

Scale	Cronbach's Alpha	Sig
Autism spectrum disorder scale	.950	0.01

Cronbach Alpha helps to quantify the test re-test reliability of the scale. The value of Cronbach Alpha of the autism spectrum disorder scale was significant at 0.01 levels. The value of Cronbach's alpha (.950) of 15 items of scale shows high internal consistency as mentioned [29] the reliability value of .7 and above is considered appropriate.

Convergent validity:

The ASDS and CARS scales were administered simultaneously to the respondents (n=50) to evaluate the convergent validity. Following the respondents' verbal and written approval, the data were gathered by two raters. They were instructed to carefully read each statement on both scales and reply by their circumstances. With the aid of SPSS software, the responses were gathered and the interrater reliability of CARS was first examined, followed by the convergent validity of the ASDS. That is given below in table 8.

Table 8. Correlation between autism spectrum disorder scale and childhood autism rating scale scores of the participants (n=50)

Variables	ASDS	CARS
ASDS	-	
CARS	.810**	-

Note: Correlation is significant at the 0.01 level (2-tailed). ASD=Autism spectrum disorder, CARS=Childhood Autism Rating Scale.

The results showed there is a highly positive correlation exists between the indigenous scale ASDS and CARS at the alpha level 0.01 on 2-tailed with sample size N = 50 ($r=.810, p=.00$) confirming the good convergent validity. The correlation value must fall between 0.50 and 0.70 to be considered appropriate and recommend for convergent validity [30].

Reliability of indigenous scale ASDS:

To check the variant reliabilities of the newly developed autism spectrum disorder scale in the Urdu language, a final 15item scale was administered on the sample of autistic individuals then analyzed the data and results of reliability of the scale, factor reliability of the scale, split-half reliability of the scale, and interclass correlation coefficient analysis of ASD scale in Urdu are given in table 9, 10,11,12 respectively.

Table 9. Reliability analysis of autism spectrum disorder scale in Urdu (n=143)

Scale	Cronbach's Alpha	Total Item
ASDS	.865**	15

Note: Analysis indicated that reliability is significant at alpha $p<.01$

Table 10. Factors reliability analysis of autism spectrum disorder scale in Urdu (n=143)

Subscale	Total Items	Cronbach's Alpha
Factor 1	05	.808**
Factor 2	05	.776**
Factor 3	05	.744**

Note: correlation is significant at 0.01 level (2-tailed).

Table 11. Split-half reliability of autism spectrum disorder scale (ASDS) in Urdu (n=143)

Cronbach's Alpha	Part a	8	.755	Sig
	Part b	7		
Correlation Between Forms			.791	0.01
Spearman-Brown Coefficient			.884	0.01
Guttman Split-Half Coefficient			.878	0.01

Note: Split half reliability is significant at 0.01 level (2-tailed).

Table 12. Intraclass correlation coefficient analysis of ASDS scale in Urdu

	Interclass Coefficient	95% CI		F Test with True Value 0			
		LB	UB	Value	df ₁	df ₂	Sig.
Average measure	.865	.830	.895	7.404	142	1988	.000

A good degree of reliability was found on ASD Scale. The average measure ICC was .865 with a 95% confidence interval from .830 to .895 [$F(142, 1988) = 7.404, p<.001$]. As mentioned by Koo and Li the ICC value in the range of 0.75 - 0.9 demonstrated good [31].

Discussion

Autism spectrum disorder was developed by following all statistical procedures properly. This scale is intended for use in autism spectrum disorder diagnosis. Additionally, a person with less training and expertise can use it. This tool offers finer criteria for their interpretation within the context of Pakistani culture and can thoroughly identify autistic symptoms that are just briefly covered in DSM 5. It can therefore be used more extensively

in Pakistani healthcare facilities. The construct validity of this scale is very high which made this scale very reliable measuring tool.

To find the items analysis Pearson product-moment correlation was run. This removed the items having below 0.4 correlation values [32]. Now with the 75 items data reduction procedure, EFA was run. To see the factor validation and items significance principal component analysis and varimax rotation were carried out. Which shows only 59 items fit in 3 component factor. Factor loading value should be above 0.4 to fit in the components [33]. Bartlett's test of sphericity ($KMO=.830$) identified the significance of items and the correlation of items. Showing a KMO value above 0.6 declared the sample adequacy [34] on 59 items. Which satisfies the exploratory factor analysis.

Analysis of a Moment Structure (AMOS) was used to conduct a confirmatory factor analysis (version 21). After removing items, the 59 items on three factors advanced to CFA, which supported the structure suggested by exploratory factor analysis. A good model fit was provided by confirmatory factor analysis, which also provided highly recommended values for GFI, RMSEA, TLI, RMR, CFI, and a significant P value. The CFI value of .50 has been witnessed in model fit on the first run which was not within the acceptable limit of .900 and above [35]. To handle this issue, the modification indices were considered. The covariance and regression weights identified repetition in the item. These repeated items were deleted to enhance the value of CFI. 44 items were deleted and the following covariance has been executed, these items 11 to 100 and 12 to 87. After all these changes CFA runs again.

The CFI value on the final run was .942 in the accepted limit. The remaining scale after deleting items became 15. The following were the other indices: CMIN/DF, GFI, RMSEA, and PCLOSE. The CMIN/DF ratio is under 2, and Byrne [36] suggested that the ratio shouldn't rise above 3 for the model to be accepted. GFI values of 0.90 or higher are regarded as acceptable [37]. The values in the current study are identical to the standard value. If the CFI cutoff value falls between 0.90 and 0.95 that is ideal. With a CFI value of 0.942, the scale's efficacy was verified. The value of RMSEA is good, according to the literature, if it is less than 0.05 [38]. The RMSEA value in this study is roughly equivalent to the suggested value. In the case of PGFI, the value is .635. The acceptable value of PGFI was within 0.5 value [39] whereas, the study value is greater than .50 value. The standard value of RMR is difficult to interpret [40] but with reference to literature good models have a small RMR value [41]. In the current study, this value is small $RMR=.03$.

Pearson product-moment correlation was run using spss-21 to analyze the test re-test reliability. Analysis indicated high alpha reliability with value $r=.950$ at alpha 0.01. As mentioned by Mendi and Mendi 2005 [42]. A statistical test was run to evaluate the convergent validity by administering CARS along with the ASDS scale and the results exhibited a very good positive correlation among them at the alpha level of 0.01 on 2-tailed [$N=50$ ($r=.81$, $p=.00$)]. Further reliability analysis was also confirmed on ($r=.865$), factor reliability with [$F1(r=.808)$, $F2(r=.776)$, $F3(r=.744)$ $p<0.01$], split-half reliability and intraclass correlation coefficient analysis of ASDS were also confirmed at significant level $p<0.00$. Which surely an indicator of the autism spectrum disorder (ASDS) scale's significance.

Conclusion

Finally indigenous 15-item scale of ASDS, highly reliable and valid is worth using as an instrument to diagnose autism spectrum disorder. This scale can be used by researchers, psychologists and psychiatrists for the general population to measure the prevalence and diagnose autism and identify its severity level.

Recommendations

The study does have certain restrictions. Because of the limited sample size, conclusions from this study may not be generalizable. The participants' age range was not uniformly distributed. The sample size and distribution of the target population may be improved via outreach recruitment of participants in special education facilities and healthcare services. The samples were only drawn from one province of Pakistan, which is another drawback. Thus, the follow-up studies should increase the sample size. And also, the recommendation for future studies is to choose more demographic features in their study to seek the correct severity level through cut-off scores of this scale.

References

- [1] S. B. GUZE, "Diagnostic and Statistical Manual of Mental Disorders, 4th ed. (DSM-IV)," <https://doi.org/10.1176/ajp.152.8.1228>, vol. 152, no. 8, pp. 1228–1228, Apr. 2006, doi: 10.1176/AJP.152.8.1228.
- [2] American Psychiatric Association, "Diagnostic and Statistical Manual of Mental Disorders, 5th Edition: DSM-5," *Diagnostic Stat. Man. Ment. Disord. 5th Ed.*, p. 280, 2013, Accessed: Aug. 21, 2022. [Online]. Available: <http://dsm.psychiatryonline.org//content.aspx?bookid=556§ionid=41101754>
- [3] M. Sandbank *et al.*, "Project AIM: Autism intervention meta-analysis for studies of young children," *Psychol. Bull.*, vol. 146, no. 1, pp. 1–29, Jan. 2020, doi: 10.1037/BUL0000215.
- [4] "autism | Definition, Symptoms, Neuropathology, & Diagnosis | Britannica." <https://www.britannica.com/science/autism> (accessed Aug. 21, 2022).
- [5] "Autism History." <https://www.news-medical.net/health/Autism-History.aspx> (accessed Aug. 21, 2022).
- [6] S. Simpraga *et al.*, "Adults with autism spectrum disorder show atypical patterns of thoughts and feelings during rest," *Autism*, vol. 25, no. 5, pp. 1433–1443, Jul. 2021, doi: 10.1177/1362361321990928.
- [7] M. Sano, T. Hirose, M. Kikuchi, C. Hasegawa, S. Tanaka, and Y. Yoshimura, "Relation between acquisition of lexical concept and joint attention in children with autism spectrum disorder without severe intellectual disability," *PLoS One*, vol. 17, no. 4 April, pp. 1–8, 2022, doi: 10.1371/journal.pone.0266953.
- [8] S. Srinivasan and A. Bhat, "Differences in caregiver behaviors of infants at-risk for autism and typically developing infants from 9 to 15 months of age," *Infant Behav. Dev.*, vol. 59, May 2020, doi: 10.1016/J.INFBEH.2020.101445.
- [9] L. Tsoi and K. McAuliffe, "Individual Differences in Theory of Mind Predict Inequity Aversion in Children," *Personal. Soc. Psychol. Bull.*, vol. 46, no. 4, pp. 559–571, Apr. 2020, doi: 10.1177/0146167219867957.
- [10] G. Atherton and L. Cross, "The Use of Analog and Digital Games for Autism Interventions," *Front. Psychol.*, vol. 12, p. 3049, Aug. 2021, doi: 10.3389/FPSYG.2021.669734/BIBTEX.
- [11] R. Grzadzinski *et al.*, "Pre-symptomatic intervention for autism spectrum disorder (ASD): defining a research agenda," *J. Neurodev. Disord.* 2021 131, vol. 13, no. 1, pp. 1–23, Oct. 2021, doi: 10.1186/S11689-021-09393-Y.
- [12] M. B. McClain, T. L. Otero, C. R. Haverkamp, and F. Molsberry, "Autism spectrum disorder assessment and evaluation research in 10 school psychology journals from 2007 to 2017," *Psychol. Sch.*, vol. 55, no. 6, pp. 661–679, Jul. 2018, doi: 10.1002/PITS.22133.
- [13] J. L. Gibson, E. Pritchard, and C. de Lemos, "Play-based interventions to support social and communication development in autistic children aged 2–8 years: A scoping review.," <https://doi.org/10.1177/23969415211015840>, vol. 6, Jun. 2021, doi: 10.1177/23969415211015840.
- [14] L. Cordeiro, M. Braden, E. Coan, N. Welnick, T. Tanda, and N. Tartaglia, "Evaluating social interactions using the autism screening instrument for education planning-3rd

- edition (ASIEP-3): Interaction assessment in children and adults with fragile X syndrome,” *Brain Sci.*, vol. 10, no. 4, 2020, doi: 10.3390/brainsci10040248.
- [15] M. B. Usta *et al.*, “Use of machine learning methods in prediction of short-term outcome in autism spectrum disorders,” *Psychiatry Clin. Psychopharmacol.*, vol. 29, no. 3, pp. 320–325, 2019, doi: 10.1080/24750573.2018.1545334.
- [16] S. J. Moon *et al.*, “Accuracy of the Childhood Autism Rating Scale: a systematic review and meta-analysis,” *Dev. Med. Child Neurol.*, vol. 61, no. 9, pp. 1030–1038, Sep. 2019, doi: 10.1111/DMCN.14246.
- [17] “Vineland Adaptive Behavior Scales | Third Edition.”
<https://www.pearsonassessments.com/store/usassessments/en/Store/Professional-Assessments/Behavior/Adaptive/Vineland-Adaptive-Behavior-Scales-%7C-Third-Edition/p/100001622.html> (accessed Aug. 21, 2022).
- [18] M. Oh *et al.*, “Validating the autism diagnostic interview-revised in the Korean population,” *Psychiatry Investig.*, vol. 18, no. 3, pp. 196–204, 2021, doi: 10.30773/pi.2020.0337.
- [19] S. A. Samadi, C. A. Biçak, H. Noori, B. Abdalla, A. Abdullah, and L. Ahmed, “Autism Spectrum Disorder Diagnostic Criteria Changes and Impacts on the Diagnostic Scales-Utility of the 2nd and 3rd Versions of the Gilliam Autism Rating Scale (GARS),” *Brain Sci.*, vol. 12, no. 5, May 2022, doi: 10.3390/BRAINSCI12050537.
- [20] A. Farooq and S. Ahmed, “Screening for Autism Spectrum Disorder in Children up to Age 2.5 years in a Tertiary Care Hospital,” *Life Sci.*, vol. 1, no. 1, p. 5, 2020, doi: 10.37185/lins.1.1.74.
- [21] F. J. R. van de Vijver and Y. H. Poortinga, “Dealing with Methodological Pitfalls in Cross-Cultural Studies of Stress,” *Handb. Stress und Kult.*, pp. 1–19, 2020, doi: 10.1007/978-3-658-27825-0_2-1.
- [22] F. F. R. Morgado, J. F. F. Meireles, C. M. Neves, A. C. S. Amaral, and M. E. C. Ferreira, “Scale development: ten main limitations and recommendations to improve future research practices,” *Psicol. Reflexão e Crítica 2017 301*, vol. 30, no. 1, pp. 1–20, Jan. 2017, doi: 10.1186/S41155-016-0057-1.
- [23] G. O. Boateng, T. B. Neilands, E. A. Frongillo, H. R. Melgar-Quiñonez, and S. L. Young, “Best Practices for Developing and Validating Scales for Health, Social, and Behavioral Research: A Primer,” *Front. Public Heal.*, vol. 6, p. 149, Jun. 2018, doi: 10.3389/FPUBH.2018.00149/BIBTEX.
- [24] G. J. Bean and N. K. Bowen, “Item Response Theory and Confirmatory Factor Analysis: Complementary Approaches for Scale Development,” *J. Evid. Based. Soc. Work.*, vol. 18, no. 6, pp. 597–618, Jul. 2021, doi: 10.1080/26408066.2021.1906813.
- [25] B. K. Nkansah, “On the Kaiser-Meier-Olkin’s Measure of Sampling Adequacy,” *Math. Theory Model.*, vol. 8, no. 7, pp. 52–76, 2018, Accessed: Aug. 21, 2022. [Online]. Available: <https://iiste.org/Journals/index.php/MTM/article/view/44386>
- [26] W. H. Finch, “Using Fit Statistic Differences to Determine the Optimal Number of Factors to Retain in an Exploratory Factor Analysis:”
<https://doi.org/10.1177/0013164419865769>, vol. 80, no. 2, pp. 217–241, Jul. 2019, doi: 10.1177/0013164419865769.
- [27] “How we can find the Cut off score of the Scale tool?”
<https://www.researchgate.net/post/How-we-can-find-the-Cut-off-score-of-the-Scale-tool> (accessed Aug. 21, 2022).
- [28] M. Grissom, “Childhood Autism Rating Scales,” *Encycl. Clin. Neuropsychol.*, pp. 553–554, 2011, doi: 10.1007/978-0-387-79948-3_1530.
- [29] K. S. Taber, “The Use of Cronbach’s Alpha When Developing and Reporting Research Instruments in Science Education,” *Res. Sci. Educ.*, vol. 48, no. 6, pp. 1273–1296, Dec. 2018, doi: 10.1007/S11165-016-9602-2/TABLES/1.
- [30] “¿Wich are the recommended thresholds for convergent and discriminant validity

- analysis?”
https://www.researchgate.net/post/Wich_are_the_recommended_thresholds_for_convergent_and_discriminant_validity_analysis (accessed Aug. 21, 2022).
- [31] C. A. Bobak, P. J. Barr, and A. J. O'Malley, “Estimation of an inter-rater intra-class correlation coefficient that overcomes common assumption violations in the assessment of health measurement scales,” *BMC Med. Res. Methodol.*, vol. 18, no. 1, pp. 1–11, Sep. 2018, doi: 10.1186/S12874-018-0550-6/FIGURES/6.
- [32] “How to Interpret correlation coefficient (r)? – STATS-U.”
<https://sites.education.miami.edu/statsu/2020/09/22/how-to-interpret-correlation-coefficient-r/> (accessed Aug. 21, 2022).
- [33] “Factor Analysis: A Short Introduction, Part 5-Dropping unimportant variables from your analysis - The Analysis Factor.” <https://www.theanalysisfactor.com/factor-analysis-5/> (accessed Aug. 21, 2022).
- [34] J. Pallant, “SPSS Survival Manual : A Step by Step Guide to Data Analysis Using IBM SPSS,” Jul. 2020, doi: 10.4324/9781003117452.
- [35] L. T. Hu and P. M. Bentler, “Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives,”
<https://doi.org/10.1080/10705519909540118>, vol. 6, no. 1, pp. 1–55, 2009, doi: 10.1080/10705519909540118.
- [36] D. Hooper, J. Coughlan, and M. R. Mullen, “Structural equation modelling: Guidelines for determining model fit,” *Electron. J. Bus. Res. Methods*, vol. 6, no. 1, pp. 53–60, 2008.
- [37] L. R. Fabrigar, R. C. MacCallum, D. T. Wegener, and E. J. Strahan, “Evaluating the use of exploratory factor analysis in psychological research,” *Psychol. Methods*, vol. 4, no. 3, pp. 272–299, Sep. 1999, doi: 10.1037/1082-989X.4.3.272.
- [38] B. M. Byrne, “Structural equation modeling with EQS : basic concepts, applications, and programming,” p. 440, 2006.
- [39] S. A. Mulaik, L. R. James, J. Van Alstine, N. Bennett, S. Lind, and C. D. Stilwell, “Evaluation of Goodness-of-Fit Indices for Structural Equation Models,” *Psychol. Bull.*, vol. 105, no. 3, pp. 430–445, 1989, doi: 10.1037/0033-2909.105.3.430.
- [40] R. B. Kline, “Principles and Practice of Structural Equation Modeling, Fourth Edition - Rex B. Kline - Google Books,” p. 9, 2011, Accessed: Aug. 21, 2022. [Online]. Available: https://books.google.de/books?hl=de&lr=&id=Q61ECgAAQBAJ&oi=fnd&pg=PP1&dq=kline+2015+sem&ots=jFjg0uwanh&sig=IGqNsLCD7-r6SJpeh2MxR_Ppt84#v=onepage&q=kline+2015+sem&f=false
- [41] B. G. Tabachnick and L. S. Fidell, “Using Multivariate Statistics 5th Edition,” *Using Multivar. Stat.*, p. 1008, 2001, Accessed: Aug. 21, 2022. [Online]. Available: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Cleaning+up+your+act:+Screening+Data+Prior+to+Analysis#0>
- [42] B. MENDI and O. MENDI, “Evaluation of Validity and Reliability of the Turkish Version of the E-lifestyle Instrument,” *J. Yaşar Univ.*, vol. 10, no. 40, p. 6624, 2015, doi: 10.19168/jyu.37431.



Copyright © by authors and 50Sea. This work is licensed under Creative Commons Attribution 4.0 International License.