

Development and Validation of the Forman Autism Spectrum Disorder Scale (FASDS) in Pakistan

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The present study aimed to develop an indigenous scale in the Urdu language for the assessment of autism spectrum disorder in Pakistan. There is a lack of availability of indigenous tools for the assessment of autism in Pakistan. An 18-items parent/caregiver rating scale, the Forman Autism Spectrum Disorder Scale was established following a 5-steps mixed-method model of scale development and validation analysis. The scale was administered on a sample of parents/caregivers ($n = 216$) of the children (both boys and girls) already diagnosed with autism of the age of 2 years or older ($M = 6.75$ years, $SD = 3.60$). The sample was collected through an online Google form from the different cities of Pakistan. Data analysis was done on SPSS version 23. Exploratory factor analysis suggested a 3-factors solution and these factors were named as Restricted Behaviors, Socialization, and Sensitivity. The psychometric properties of the scale were established. The Cronbach's alpha of the scale was high ($\alpha = .85$). The scale was found to have good reliability and validity as well. The total score on the Forman Autism Spectrum Disorder Scale (FASDS) can range from 18 to 90 with scores indicating levels of severity of symptoms associated with autism spectrum disorders. This scale is a culture-specific screening measure appropriate for use in Pakistan. The implications and further suggestions related to the scale are discussed.

Keywords. Scale development, autism spectrum disorder, indigenous scale, exploratory factor analysis, reliability, validity

Autism spectrum disorder is one of the neurodevelopmental disorders that is characterized by deficiencies in social interaction and communication skills and the presence of specific and inflexible behaviors, patterns, or routines in an individual (Zwaigenbaum et al.,

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2015). According to the Diagnostic Statistical Manual-V (DSM-V; 2022), in autism spectrum disorder, the deficiencies occur in two major domains of an individual. These characteristics include persistent deficits in social communication and social interaction across multiple contexts (use of visual gestures; difficulties with verbal and nonverbal social communication; deficits in sharing, taking turns and coordinating joint attention; fails to initiate or maintain conversations, topics, or mood; lacks reciprocity and may seem to be cross or unfriendly, and fails to understand tone of voice or nuances of language in speech and written communication; difficulties adapting to changes in routine or situations and to sensing and responding to the emotions of others). In addition, there are restricted, repetitive patterns of behavior, interests, or activities (stereotyped or repetitive motor movements; insistence on sameness or routine for physical or ritualistic reasons; highly restricted, repetitive, or obsessive interests; hyper- or hypo-reactivity to sensory input or unusual use of sensory output). Autism Spectrum Disorder (ASD) is a lifelong condition. Early identification and intervention are key to optimum developmental outcomes (Zwaigenbaum et al., 2015).

Autism spectrum disorder (ASD) has become a global public health concern. Recent prevalence estimates suggest that 1 in 36 (2.8%) eight years old children have ASD, with varying rates reported by geographic region, among different demographic groups, and over time. While many view the increasing prevalence with concern, the trend may also be a result of improvements in awareness, broadened diagnostic criteria, and expanded and more effective screening practices. There is now general agreement that early identification of ASD is key to potentially achieving better developmental outcomes through timely and effective interventions (Lord et al., 2020).

In Pakistan, it was reported in a study that most of the individuals were gone undiagnosed from their childhood to adulthood, with autism and attention deficit hyperactivity disorder. It was found that when these individuals later came for the assessment in a hospital, they were diagnosed with autism and attention deficit hyperactivity disorder. The reason for not being able to diagnose early was low education and minimal awareness about these disorders. Most of the adult patients coming for the assessment in the hospital were diagnosed with these two disorders. There is a need to create awareness among the people of Pakistan about these disorders so that management and intervention can be given to the individuals at the early stages. Low education was found to be the factor associated with these individuals who were undiagnosed in early childhood. Therefore, it is a basic need to create more and more awareness about these disorders in Pakistan (Khan et al., 2019, Rauf et al. 2014).

In Pakistan, despite growing research on Autism Spectrum Disorder (ASD), there are many challenges associated with early identification and diagnosis of the condition. Due to lack of awareness, stigma attached to having a child with autism, and the absence of culturally and linguistically relevant assessment tools and measures, caregivers and parents often do not have adequate knowledge about early signs and symptoms of autism, and as a result, they miss the critical period for early help seeking. This is further compounded by the dearth of trained professionals in the field, and the lack of diagnostic facilities in various parts of the country (Samadi & McConkey, 2018; Tara & Rauf, 2024).

The latest prevalence estimate in the United States is 1 in 54 (1 in 31 among boys, 1 in 89 among girls) among 8 years old children based on 2016 data. The previous prevalence estimate based on 2012 data was 1 in 68 (1 in 42 among boys, 1 in 150 among girls). Autism prevalence in Pakistan is unclear, due to many reasons including poor resources for individuals with autism and other disabilities, lack of diagnostic facilities and no systematic data collection and monitoring from national or provincial level. There is also a lack of indigenous standardized tools for assessing autism in Pakistan (Azeem & Imran, 2016).

Screening and diagnosis of individuals with Autism Spectrum Disorder (ASD) typically employs a variety of standardized assessment tools. In the West, commonly used instruments for measuring traits of autism spectrum disorders include the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2; Lord et al., 2012), the Childhood Autism Rating Scale-Second Edition (CARS-2; Schopler et al., 2010), and the Social Communication Questionnaire (SCQ; Rutter et al., 2003). However, these standardized instruments have primarily been validated in predominantly White populations from Western countries. Their applicability in non-Western cultures, therefore, remains uncertain. Administration of these tests further require specialized training and significant resources, making them often impractical for low and middle resource countries like Pakistan.

Cultural influences shape how individuals and families experience and express developmental behaviors and assign meaning to behaviors that might be diagnosed as Autism Spectrum Disorder (ASD) in individualistic cultures such as the West. In collectivistic cultures such as Pakistan, expectations for social interaction and communication differ, and how children's behaviors are identified as having ASD symptoms may differ accordingly. Previous qualitative studies with Pakistani caregivers and adolescents with ASD and their relatives have illustrated how typical symptoms of ASD are given different meanings

and interpreted within the context of limited awareness about ASD. The studies demonstrate the need for cultural-specific assessments, understanding typical development within the child's home culture, and development of culturally grounded diagnostic criteria and screening instruments for use with Pakistani children.

Therefore, there was a need to develop an indigenous tool for the assessment of autism in Pakistan. Although there are many tools available for the assessment of autism, they are all based on western culture or western representation of the symptoms of autism, and they are mostly in the English language. Therefore, in this study, the tool for the assessment of autism was established in the Urdu language.

Rationale for the Present Study

The development of an indigenous ASD scale for Pakistan is not just an academic exercise; it has direct and profound clinical and public health implications. Currently available research-based scales for ASD have certain limitations which make their direct application to Pakistani samples challenging. Firstly, many of these scales are available only in the English language that is spoken by approximately 8% of the Pakistani population ([Rahman et al., 2003](#)). Secondly, although the scales have good psychometric properties, the populations on which the scales have been tested are mostly Western or non-South Asian. Furthermore, administration of most of these scales also requires specialized training and facilities that are lacking in most of the clinical settings in Pakistan. What is equally, if not more, important is that none of the currently available scales have been developed using a bottom-up approach by investigating how caregivers and clinicians in Pakistan conceptualize, perceive, and label features of ASD.

Although several high quality studies have been published regarding the use of existing standardized tools like ADOS-2, CARS-2, SCQ and others for the assessment of Autism Spectrum Disorders (ASD) in Pakistan (e.g., [Azeem & Imran, 2016](#); [Khan et al., 2019](#)), the data can only represent the construct of ASD based on Western conceptualizations and may not be universally relevant. An indigenous scale using Urdu language will have its own merits. Firstly, it will be readable for the caregivers belonging to different levels of education. Secondly, it will be based on qualitative data collected from Pakistani professionals as well as families. The scale will serve as a useful screening tool as it is affordable and can easily be administered in under-resourced settings. Moreover, it will help in establishing norms within the Pakistani population.

In addition, the FASDS is more than a simple translation and adaptation of an existing screening tool for autism spectrum disorders, because it was constructed from indigenous qualitative data rather than having to retain the framework of an already existing instrument. The items and symptom domains emerged naturally from the data collected within the Pakistani socio-cultural context, thus emerging as being naturally meaningful within that context. The current study aims to address a significant gap in autism research and practice in Pakistan, which is the absence of a screening instrument, with consequences of delayed diagnosis, misdirected interventions and lack of research in the field.

The aims of the present study were threefold: to develop a locally relevant Urdu-language scale for the assessment of ASD in Pakistan; to establish the initial psychometric properties of the new scale, such as internal consistency, test-retest reliability, split-half reliability, and discriminant validity; and to investigate the factor structure of the scale using a clinical sample of children with ASD in Pakistan.

Method

Research Design

The mixed-method research design was used in the present study. In the first part of the study, a qualitative method was used in which semi-structured interviews of the professionals (psychologists and psychiatrists) working in the field of autism and the parents or caregivers of children with autism were conducted. In the second part of this study, the quantitative method was used in which the tools were administered to the research participants and psychometric properties of the newly developed scale were established.

Framework for Scale Development

The basic framework which was used in developing this scale was a mixed-method model of scale development and validation analysis (MADVA), comprised of 5 steps procedure. In this framework of scale development, the scale construction, and the validation of the scale, are unified with each other (Zhou, 2019). This framework of scale development follows the exploratory instrument design of Creswell and Clark (2011) in which five steps were followed of this mixed-method framework that are 1) qualitative investigation of the scale construct, 2) generating the scale items from the qualitative investigation, 3) content validation of the scale items, 4) administration of the scale on the target population, and 5) construct validation of the scale items.

Step 1: Qualitative Investigation of the Construct

The first step of scale development is the qualitative investigation of the scale construct. In this step, a central phenomenon or construct is first defined and then the information related to that construct is obtained by investigating the phenomenon or construct qualitatively. This qualitative investigation involves conducting interviews with the people related to the construct and asking different questions from the people about the construct. So, in the first step when the interviews are conducted after defining a specific construct then this step of scale development covers both the qualitative investigation of the construct and qualitative validation as well because the scale items are generated through the qualitative findings ([Zhou, 2019](#)).

Participants and Procedure

In light of the present study, the construct/central phenomenon which was first defined in this study was to investigate the symptoms of autism in children. For this purpose, semi-structured interviews were conducted with 8 professionals working in the field of autism (6 child clinical psychologists and 2 child psychiatrists) and the parents or caregivers of children diagnosed with autism (12 mothers). The criteria for selecting the professionals and the parents for interviews was that the professionals should have been working in the field of autism for more than five years, and for the parents, their child should have been already diagnosed with autism.

A list of questions in the Urdu language for the interviews with professionals and parents was first made in collaboration and discussion with the research supervisor. These pre-made questions were then asked from the professionals and parents during the interviews. The interviews were conducted in the Urdu language as the aim of this research was to construct an indigenous assessment tool for autism in the Urdu language. The professionals and parents were approached through different institutions or centers for autism spectrum disorder in Pakistan. The professionals were already working in these institutions and the parents were coming to these institutions for the treatment of their children. The permission to conduct interviews with the professionals and the parents was first taken from the respective heads or directors of the institutions after explaining the aim of the research and interviews.

The interviews with the different professionals and parents continued to be taken until the saturation in the responses from the interviews occurred, then the interviews were stopped. The saturation

in responses from the professionals came after 8 interviews and from the parents, after 12 interviews. Six out of eight interviews with professionals and two out of the twelve interviews with parents were conducted in person while the remaining interviews with professionals and parents were taken over a phone call due to the lockdown in Pakistan because of COVID-19. The responses to the interviews were audio-recorded after taking verbal consent from the participants and explaining the purpose of the interviews and research in detail. They were informed about confidentiality and their rights as well.

Step 2: Generating the Scale Items from Qualitative Investigation

The next step in scale development is to convert all the gathered information or responses of the participants from the interviews to generate a list of items of the scale (Zhou, 2019).

Procedure

When the interviews in the first step were stopped after the saturation came in the responses of the participants, all the audio-recorded responses from the interviews were utilized carefully to create a list of items for the scale. In the first step, the interviews were conducted with two different participants i.e., the professionals and the parents. Therefore, two different lists of responses were generated after listening to the audio recordings and listing down all the responses of the participants. After listening to all the recordings of the interviews with professionals, the first list of items generated contained 18 items and the second list of items from the recordings of responses from the parents contained 19 items.

A final list of items was generated after listing down all the responses from both lists (the list of professionals and the parents) into a single list of items. In this list several items were the same and repeating, those items were removed from the final list of items. After carefully looking for the same or repeated items and removing them, a final list of 26- items was then generated for empirical validation.

Step 3: Content Validation of the Scale Items

The third step in scale development is the content validation of the items of the scale. In this step, the final list of items generated from the qualitative data of the interviews goes through both the qualitative and quantitative approaches to review the list of items. The main focus in this step is the content-based validation of the items i.e., to check if the

items are measuring the construct which was defined in the first step of this procedure or not. To do so, both the qualitative and quantitative approaches are used in this step. The qualitative approaches include panel review, debriefing, and reflection. The quantitative approaches include the calculation and sorting of the items (Zhou, 2019).

Procedure

The final list of 26 items generated in the previous step went through the review process to check the content validation of items. First, the qualitative approach of items review was used in which the subject experts panel review was done on all 26 items. In the panel review, the list of 26 items was given to five subject matter experts (4 child clinical psychologists and 1 child psychiatrist) working in the field of autism for more than 5 years. Every professional rated each item of the list on a scale of 1 to 5 (1 = *poor* and 5 = *excellent*). After getting the ratings on all items of the list from all the professionals, the researcher looked for the items which were rated 3 or below 3 and these items were discussed with the professionals and with the research supervisor. Items were revised according to the feedback provided by all the professionals. Then, the quantitative approach for item review was used in which the sorting of all the items was done. In sorting, the items were arranged and grouped according to the feedback provided by the professionals after reviewing all the items (Zhou, 2019). After all these steps, a final list of the items was again made at the end to move on to the next step of this procedure.

Tryout was carried out to make sure that all the items were easily understandable to the participants and to rule out any difficulty in the structure or comprehension of the items. The five participants were approached for the tryout. The participants were requested to point out any difficulty or problem in understanding the items of the questionnaire. The participants did not report any kind of difficulty in completing the questionnaire and understanding the items.

Step 4: Administration of the Scale on Target Population

The next step after getting the final list of items is to administer the scale to the target population (Zhou, 2019). A final list of 26 items was then administered to the target population.

Sample

In this study, both purposive and snowball sampling was used. Purposive sampling was used because the sample was highly selective

and specified as the children already diagnosed with autism at the age of 2 years or above were targeted as a sample. Furthermore, the snowball sampling strategy was used in this research for collecting the data from the participants through an online Google form.

The sample was comprised of parents or caregivers ($N = 216$) of the children (both boys and girls) already diagnosed with autism of the age of 2 years or older ($M = 6.75$ years, $SD = 3.60$). Recommended guidelines for factor analysis suggest a minimum of 100 to 200 participants for a reliable factor solution (Spector, 1992). The sample size for this study was deemed adequate.

Inclusion and Exclusion Criteria of the Participants

The parents or caregivers who had a child already diagnosed with autism were included. Moreover, the parents or caregivers who had a child (both male and female) with the age of 2 years or older were included in the study. Those parents or caregivers were not included in the study who had a child without a prior diagnosis of autism. Furthermore, the parents who had a child younger than the age of 2 years were excluded from the study.

Measures

One scale was used in the present study along with a demographic sheet. The scale used in the present study was the Forman Autism Spectrum Disorder Scale (FASDS).

Demographic Sheet

A demographic sheet was used in this study to gather the personal information of the children from their parents or caregivers. Different questions were asked in this demographic sheet such as the age, gender, and age of the onset of the disorder.

Forman Autism Spectrum Disorder Scale (FASDS)

Forman Autism Spectrum Disorder Scale (FASDS) is an 18-items parent/caregiver rating scale used for the screening/diagnosing of autism in children of age 2 years or above. The responses are scored on a 5-point Likert scale (1 = *never* and 5 = *always*). This scale has 3 subscales: Restricted Behaviors has 6 items, Socialization has 7 items and Sensitivity has 5 items. The FASDS yields a total score that ranges from 18 to 90, with higher scores indicating more severe levels of autism-related symptoms. In addition, the three subscales (Restricted

Behaviors (6-30), Socialization (7-35), and Sensitivity (5-25) each have higher scores that indicate more impairment. The scale consists of all positive items, and there are no reverse scored items.

Procedure

The permission to carry out this study was taken from the Institutional Review Board (IRB). The permission to collect data from the research participants was taken from the heads and directors of the different special institutions or centers of autism spectrum disorder in different cities of Pakistan. The permission from some of the heads or directors of the special institutions was taken in writing, however, the permission from the other institutions was taken verbally on a phone call due to the lockdown in Pakistan because of COVID-19. The data from the research participants was collected through a Google online form due to the lockdown because of COVID-19. The consent of the research participants was taken by using a consent form through Google online form. The participants were informed about the confidentiality of their information and that their information will only be used for diagnostic, educational, and research purposes. This online form was shared with the different professionals working in special institutions or centers and they were requested to share this online form with their clients (parents who were seeking treatment for their children diagnosed with autism from the respective institutions). This Google online form was shared in different groups specifically related to autism spectrum disorder on different social media applications such as Facebook and WhatsApp. The Google online form was shared in these groups after taking permission from the admins of these groups and explaining the purpose of the research in detail. In these groups, parents, or caregivers of children with autism were already added.

The Google online form was shared with different professionals on Facebook and WhatsApp such as Clinical Psychologists, Psychiatrists, Therapists, and Speech Therapists. First, the purpose of the research was described in detail to the participants and the professionals, and then they were requested to fill out this form and forward it to other people and other groups related to autism spectrum disorder. A total of 235 forms were collected from the participants and 19 forms were discarded because they did not meet the inclusion criteria of the research participants. The data collection was completed in one month.

Step 5: Construct Validation of the Scale Items

The fifth and final step of scale development is the construct validation of the items of the scale. In this step, all the items of the

scale go through a series of different statistical analysis to check the construct-based validation of the scale. In this step, the responses to the items of the scale are analyzed and finally, the psychometric properties of the scale are developed. After getting the results from this step, the poor items should be deleted or revised by sending them back to step 3 (content validation of the scale items) of this procedure (Zhou, 2019).

Results

After completing the data collection, the final 216 valid forms were entered into the Statistical Package for Social Sciences-Version 23 (SPSS-23) to run the statistical analysis on the data and to develop the psychometric properties of the newly developed scale. Different statistical analysis was run on the data such as Cronbach's alpha of the scale was find out and exploratory factor analysis was run on the data to find out the possible number of factors for the scale. The initial 26-items scale was reduced to the final 18-items scale after the exploratory factor analysis. Furthermore, the reliability and validity of the constructed scale were found.

Demographic Characteristics of the Sample

Table 1: *Demographic Characteristics including Mean Scores and Standard Deviations of Age and Age of Diagnosis of Children (N = 216)*

Demographic Characteristics	<i>M</i>	<i>SD</i>	Minimum	Maximum
Age of the Child in Years	6.75	3.60	2.0	22
Age of Diagnosis of Child in Years	3.02	1.32	0.60	10
	<i>n</i>		<i>%</i>	
Gender of the Child				
Males	175		81.0	
Females	41		19.0	
Family's Monthly Income (PKR)				
Below 30,000	23		10.6	
31,000 – 50,000	46		21.3	
51,000 – 75,000	40		18.5	
76,000 – 100,000	35		16.2	
Above 100,000	72		33.3	

The above table shows that the minimum and maximum age of the children was between 2 – 22 years ($M = 6.75$ years, $SD = 3.60$). Furthermore, the age of diagnosis of the children was between 0.60 – 10 years ($M = 3.02$ years, $SD = 1.32$).

Corrected Item-Total Correlation

The corrected item-total correlation was carried out of all the items of the FASDS and any item with a corrected correlation of less than .30 was excluded from the scale. To do the factor analysis on the scale, all the items should have a corrected correlation of at least .30 (Tabachnick & Fidell, 2007).

Table 2: *Item Number and Total Item Correlation of Forman Autism Spectrum Disorder Scale (FASDS)*

Item No.	Item Total Correlation	Item No.	Item Total Correlation
1	-.12	14	.42
2	.31	15	.57
3	.09	16	.60
4	.18	17	.53
5	.49	18	.42
6	.31	19	.28
7	.45	20	.01
8	.52	21	.37
9	.54	22	.38
10	.41	23	.32
11	.49	24	.31
12	.62	25	.43
13	.35	26	.46

Note. Items with below .30 Item-Total Correlation are boldface.

Table 2 shows the total-item correlation of all 26 items of FASDS and it can be seen that 5 items have an item-total correlation of less than .30. These 5 items i.e., items number 1, 3, 4, 19, and 20 were eliminated before moving on to the factor analysis because these items are not inconsistent with the internal consistency of the scale (Spector, 1992).

Factor Analysis and Psychometric Properties of the Forman Autism Spectrum Disorder Scale (FASDS)

The factor analysis was then carried out on the remaining 21 items of FASDS through SPSS Version 23. The exploratory factor analysis with the principal component was done on the data to find out the internal structure or underlying factors of this scale. The factor analysis was done in 3 steps i.e., 1) to find out the suitability of the data to run factor analysis, 2) the extraction of the factors, and 3) rotation and interpretation of the factors.

Step I: To find out the Suitability of the Data to run Factor Analysis

First, the assessment of the data was done to find if the data was enough and suitable to run the factor analysis. To find out the suitability of the data, the examination of the correlation matrix, Bartlett's test of sphericity, and Kaiser-Meyer-Olkin (KMO) measure of sample adequacy were done first. The examination of the correlation matrix showed that there were many correlation coefficients above 0.3 in the table. Bartlett's test of sphericity should be significant i.e., $p < 0.05$, and the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy should be 0.6 or more (Pallant, 2007). In this case, Bartlett's test of sphericity was significant ($p = 0.00$) and the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy value was .84. The sample size is another important factor to be considered while doing the factor analysis. Some researchers suggest that a sample size of 100 to 200 participants is sufficient (Spector, 1992). In this study, the sample was 216 participants. Therefore, it was concluded that the data of this research was suitable to run the factor analysis on it.

Step II: The Extraction of the Factors

The second step was the extraction of the underlying factors of FASDS. Factor extraction is used to find out the minimum number of underlying factors that can be representative of the relation among the variables (Pallant, 2007). The principal component analysis was utilized to extract the underlying factors. To extract the factors of this scale, three techniques were used i.e., Kaiser's Criterion or Eigenvalue Rule, Scree Test and Parallel Analysis.

Kaiser's Criterion or Eigenvalue Rule

Kaiser's criterion (Kaiser, 1960) or also known as the eigenvalue rule is the most frequently used method in the extraction of the factors. The basic idea behind this technique is to retain the factors which have an eigenvalue of greater than 1.0. The eigenvalue of a factor represents the total amount of variance explained by the factor. This rule of eigenvalue has been criticized in terms of retaining too many factors (Pallant, 2007).

Table 3: *Total Variance Explained*

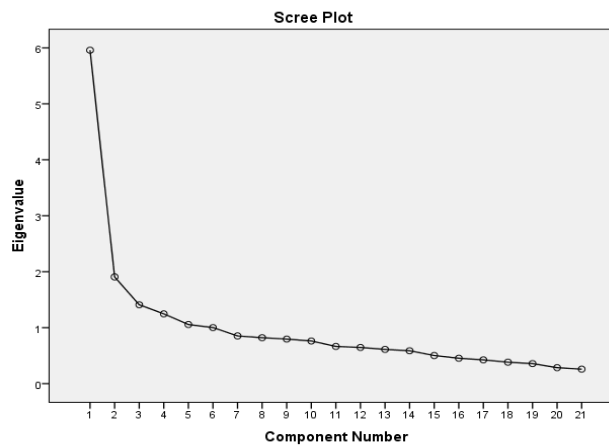
Factors	Eigenvalues	% of Variance	Cumulative %
1	5.95	28.37	28.73
2	1.90	9.08	37.45
3	1.41	6.71	44.17
4	1.24	5.94	50.11
5	1.05	5.03	55.14
6	1.00	4.77	59.91

Table 3 shows that 6 factors have eigenvalues of greater than 1.0 and these 6 factors explained a total variance of 59.91 %.

Scree Test

Another technique for determining the number of factors to keep is Catell's scree test. In this scree test, a scree plot is made of the variables against the eigenvalues. In this scree plot, the factors which are above the curve "the elbow" are retained because these factors usually contribute mostly to the explication of the variance in data (Pallant, 2007).

Figure 1: *Scree Plot Demonstrating the Extraction of Factors of the Forman Autism Spectrum Disorder Scale (FASDS)*



The above figure 1 of the scree plot suggests a 3-factor solution as there are 3 factors above the curve "the elbow" in the picture. However, this 3-factor solution is in a contrast to the 6-factor solution given by Kaiser's criterion or eigenvalue rule.

Parallel Analysis

Another technique that was used to find out the number of factors was Horn's parallel analysis. This method of factor extraction has proven to be the most efficient and promising as compared to Kaiser's criterion or scree test (Pallant, 2007). In this technique, the original eigenvalues from the Total Variance Explained table are compared with the eigenvalues generated through a random set of data by the Monte Carlo PCA for Parallel Analysis. Those factors are kept that have original eigenvalues greater than the eigenvalues of the random set of data.

Table 4: *Result of Monte Carlo PCA for Parallel Analysis*

Factors	Original Eigenvalues	Random Eigenvalues	Decision
1	5.95	1.60	Retained
2	1.90	1.48	Retained
3	1.41	1.40	Retained
4	1.24	1.33	Not Retained
5	1.05	1.27	Not Retained
6	1.00	1.22	Not Retained

Table 4 shows that there are only 3 factors (1, 2, and 3) that have original eigenvalues (5.95, 1.90, and 1.41) greater than the eigenvalues generated through a random set of data (1.60, 1.48, and 1.40) with 100 number of replicants. Finally, the parallel analysis suggests a 3-factor solution and therefore only 3 factors were retained for further analysis.

Step III: Rotation and Interpretation of the Factors

The third and final step of factor analysis is the rotation and interpretation of the factors. In the previous step, a 3-factor solution came out as the best fit for the FASDS. In the extraction step, several factors are extracted and in the rotation, the extracted factors are explained easily according to their latent variables. There are usually two ways of rotating the factors i.e., orthogonal rotation and oblique rotation. The orthogonal rotation is used when the underlying variables are considered to be uncorrelated with each other and the oblique rotation is used when the underlying variables are considered to be correlated with each other (DeVellis, 2012). Usually, it is suggested that the oblique rotation should be used first to get an idea about the correlation between the factors, and then the orthogonal rotation should be used after that because both rotations often provide similar results (Pallant, 2007).

First, the oblique rotation (Direct Oblimin) was carried out. The Component Correlation Matrix showed the correlation between the 3 factors as, between factors 1 and 2 as -.34, between factors 1 and 3 as .31, and between factors 2 and 3 to be -.24. If the correlation between the factors comes out to be low (lower than .30) then the orthogonal rotation should be used (Pallant, 2007). Therefore, the orthogonal rotation (Varimax) was used as a final rotation method.

Table 5: *The Structure of the Factors of Forman Autism Spectrum Disorder Scale (FASDS) with Varimax Rotation*

Sr. No.	Item No.	F1	F2	F3
1	16	.76	.15	.19
2	12	.73	.24	.19
3	17	.69	.13	.14
4	13	.62	.10	-.11
5	15	.60	.16	.35
6	22	.52	.00	.20
7	18	.47	.15	.19
8	5	.41	.35	.17
9	8	.33	.68	-.03
10	10	.20	.67	-.01
11	6	-.04	.67	.05
12	7	.18	.65	.04
13	9	.39	.54	.11
14	11	.25	.50	.26
15	2	-.05	.44	.30
16	25	.22	.00	.75
17	26	.14	.16	.74
18	24	.15	-.12	.71
19	23	.07	.21	.38
20	14	.31	.26	.35
21	21	.23	.23	.27

Note. Items with .40 or above loadings are in boldface.

Table 5 shows the structure of the factors of FASDS with varimax rotation. It can be seen that only 18 items out of 21 items loaded significantly on the factors i.e., 0.4 or greater than 0.4 on each factor. The items loaded on each factor significantly are boldface. The items which did not load on any factor were items no. 23, 14, and 21. The items which loaded significantly on factor 1 were 8, items that loaded significantly on factor 2 were 7, and items that loaded significantly on factor 3 were 3 in number. Items no. 23, 14, and 21, which did not load on any factor were eliminated from the scale and only 18 items were retained in the scale. Furthermore, after doing the varimax rotation, all the items were carefully looked if they were correctly loaded on their

relevant factors. As a result, after using clinical judgment it was found that items no. 22 and 18 did not fit into the items of factor 1, therefore these items were moved from factor 1 to factor 3. Finally, factor 1 comprised 6 items, factor 2 comprised 7 items, and factor 3 comprised 5 items.

Factors Description

A total of 3 factors were extracted from FASDS through factor analysis and there were given names according to the items they were loaded significantly.

Factor 1: Restricted Behaviors

The first factor extracted from the factor analysis was given the name Restricted Behaviors. Factor 1 consists of 6 items. These items measure the daily behaviors, routines, and interests of children. Individuals with autism usually have constricted and constant patterns of behaviors, routines, and interests.

Factor 2: Socialization

The second factor extracted from the factor analysis was given the name Socialization. This second factor has 7 items in it. These items measure the social communication and interaction patterns of children as individuals with autism have a deficit in their social communication and interaction patterns with other people.

Factor 3: Sensitivity

The third and last factor from the factor analysis was given the name Sensitivity. This factor consists of 5 items that measure the sensitivity of children related to different textures, smells, sounds, and lights. Individuals with autism disorder are usually either hyper or hypo sensitive towards the different textures or surfaces, smells, sounds, and lights.

Higher scores on the Likert scale indicate greater severity of autism-related symptoms.

Table 6: Means, Standard Deviations and Inter Factor Correlation of the Three Factors of Forman Autism Spectrum Disorder Scale ($N = 216$)

Factors	Items	α	F1	F2	F3	M	SD
F1	06	.80	-			18.18	5.52
F2	07	.76	.52**	-		23.46	5.09
F3	05	.69	.51**	.32**	-	11.84	4.10
FASDS Total	18	.85	.87**	.78**	.72**	53.48	11.8

** $p < 0.01$.

Table 6 shows that factor 1 correlates significantly with factors 2 and 3. Furthermore, factor 2 correlates significantly with factors 1 and 3, however, the correlation between factors 2 and 3 is a weak one. Table 6 also shows the Cronbach's alpha of FASDS and its 3 factors. The Cronbach's alpha of total FASDS was .85. The Cronbach's alpha of factors 1, 2, and 3 was .80, .76, and .69, respectively. Cronbach's alpha of above .70 is usually considered to be a good one. Therefore, Cronbach's alpha of FASDS and its 3 factors is above .70, which shows its good internal consistency.

Test Re-Test Reliability

The test re-test reliability of FASDS was found. The test was administered to $n = 35$ participants after a gap of one month. The test re-test reliability of FASDS was found to be $r = .74$ ($p < 0.001$).

Split Half Reliability

The split-half reliability of FASDS was calculated by using the odd and even method and it came out to be .88. The Cronbach's alpha for the two splits of FASDS was .76 and .72, respectively.

Discriminant Validity

The discriminant validity of FASDS was found as well. The FASDS was administered on a sample of $n = 35$ normally developed children of the age of 2 years or elder. A non-significant negative correlation came out between the scores of FASDS of children with autism and normally developed children.

Discussion

The present research aimed to develop an indigenous scale in the Urdu language for the assessment of autism children in Pakistan. There

is a lack of indigenous assessment tools in Pakistan for the assessment of autism (Azeem & Imran, 2016). Furthermore, there is a language barrier as well when it comes to the availability of tools for the assessment of autism in Pakistan. Mostly all the assessment tools in Pakistan are available in the English language and standardized on the Western populations. Commonly used assessment tools such as the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2020), Autism Spectrum Rating Scale (ASRS; Goldstein & Naglieri, 2009), and Childhood Autism Rating Scale, Second Edition (CARS-2; Schopler et al., 2010) have been developed within Western contexts. The use of these tools in Pakistan may limit the accuracy and cultural relevance of assessment, thereby affecting the validity of diagnostic outcomes. The assessment tool developed in this present study was established in the Urdu language which is the national and official language of Pakistan and everyone in Pakistan speaks and understands it. In a study in Pakistan, it was observed that numerous individuals were not diagnosed with autism in their childhood, and when they came again for the assessment in a hospital in their adulthood, the same individuals were diagnosed with autism spectrum disorder. They missed their diagnosis in their childhood because of their minimal education and lack of awareness (Khan et al., 2019; Rauf et al., 2014).

The findings in this study align with current knowledge on autism spectrum disorder, which is now typically defined by levels of deficits in social communication and restricted, repetitive behaviors and interests. (American Psychiatric Association, 2022; Lord et al., 2020)

Another aim of the present research was to figure out any differences in the manifestation of the symptoms of autism spectrum disorder related to cultural or ecological aspects in Pakistan. All the assessment tools which are available in Pakistan are based on western culture and western representation of the symptoms of autism spectrum disorder, so the researcher wanted to find out any differences in the representation and the manifestation of the symptoms of this disorder in Pakistan as the culture and environment of Pakistan is very different and unique as compared to the western culture. After conducting the interviews of different professionals working in the field of autism in Pakistan and the interviews with parents or caregivers of children with autism revealed that there was not any dissimilarity in the manifestation of the symptoms of autism in children in Pakistan in the context of the culture or ecology. All the symptoms reported by the professionals and parents or caregivers of children having autism were consistent with the previous literature and the Diagnostic and Statistical Manual of Mental Disorders – V (DSM-V) (American Psychiatric Association, 2013).

Although the factor structure was theoretically consistent with expectations, qualitative findings provided insight into culturally specific ways in which autism manifested in Pakistan. Parents and family members described how children with autism were rigid in their daily routines of play, were less likely to engage in social interaction with family members, and were more sensitive to auditory and visual stimuli than their typical peers. The findings support the development of culturally and linguistically relevant measures to screen and assess individuals with autism spectrum disorders in Pakistan.

The indigenous scale for the assessment of autism in children in Pakistan was established in this present study and it was given the name of the Forman Autism Spectrum Disorder Scale (FASDS). Whereas instruments such as the ADOS-2 and CARS-2 require training to administer and scoring to complete, the FASDS is a caregiver-reported developmental screening measure that is more appropriate for use in low-resource clinical settings where only brief developmental assessment is possible without extensive training.

Furthermore, the psychometric properties of this scale were established in this present study. After doing the factor analysis on the data, a final scale of a total of 18 items and 3 factors was constructed as a result of factor analysis. These three factors of the scale were given the names Restricted Behaviors, Socialization, and Sensitivity according to their items which were loaded on these factors in the factor analysis. These three factors are consistent with the previous literature and the domains reported in the DSM-V (American Psychiatric Association, 2013).

The first factor which was extracted as a result of factor analysis was named Restricted Behaviors. This factor has 6 items in it and all these items measure the restricted, repetitive, and constant behaviors, routines, body movements, and interests in children having autism. Individuals with autism have a certain type of constricted and constant behaviors or routines. These individuals have a peculiar type of motor movement in different parts of the body. These types of bodily movements are called stereotypical body movements. These individuals usually find it difficult to change their normal routine or routine work. They have a specific and selected type of behavior or routine that they normally follow and when a certain change occurs in their routine, they find it difficult to go with that change and as a result, they experience intense stress due to that change (American Psychiatric Association, 2013).

The second factor was named Socialization and this factor has 7 items. This factor measures the socialization and interaction patterns of

children having autism with other people. Children with autism, usually have impaired socialization and interaction with other people. They cannot initiate and maintain normal conversations with other people. They have diminished facial expressions and they cannot maintain proper eye contact with others while talking to them. These individuals have a reduced sense of emotional understanding as they have difficulties in recognizing the emotions of others and in expressing their own emotions to others as well. Furthermore, they have difficulties in understanding the non-verbal gestures of other people. Moreover, they have difficulties in making friendships and social relationships with other people as they prefer to remain in their world (American Psychiatric Association, 2013).

The third and last factor which was extracted through factor analysis was named Sensitivity. This factor has 5 items and it measures the sensitivity of children having autism spectrum disorder towards the light, sound, smell, and different textures. Children with autism spectrum disorder have hypo or hypersensitivity towards different sensations present in their environments for example lights, sounds, textures, temperature, and pain (American Psychiatric Association, 2013). Sensory sensitivity factor was introduced in addition to other features and reflects current research which highlights sensory processing differences as a major feature of ASD ([Ben-Sasson et al., 2019](#)).

Limitations and Suggestions

In this study, the data was collected through an online Google form so the people who did not have any access to the internet or who did not know how to fill the form online, may have been missed in the data collection. Although the data of 216 participants was enough to run the factor analysis, a larger sample could have produced more generalized results for the study. The data was collected from the Pakistani population only and validated on the Pakistani population so the scale cannot be generalized to other countries or populations. This scale should be translated into English so that it can be used for other populations as well for research purposes and assessment of autism spectrum disorder.

Implications of the Present Study

This scale can be used by different professionals and researchers in their research specifically those who want to do indigenous research on autism in Pakistan. This tool will be very helpful for the professionals in the diagnosing/screening of autism in children in Pakistan as this

scale is in the Urdu language and it will be very easily understandable for the parents or caregivers of children coming for the assessment of their children to different professionals.

Conclusion

In conclusion, this study endeavored to establish a reliable and valid indigenous measure for the identification of autism in Pakistan. The final scale had a three-factor structure, that was theoretically consistent with commonly accepted domains of diagnosis of autism and promised to be a culturally appropriate screening tool to aid assessment and early identification of individuals with autism spectrum disorder in Pakistan.

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