The Psychometric Properties of Turkish Version of Autism Spectrum Screening Questionnaire in Children aged 6-18 years

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SUMMARY

Objective: The objective of this study is to determine the psychometric properties of the Turkish version of the Autism Spectrum Screening Questionnaire (ASSQ-TR) and to find the best cutoff score for Pervasive Developmental Disorder (PDD) cases.

Method: Children between 6 to 18 years old with diagnoses of PDD, Obsessive Compulsive Disorder (OCD), and Attention Deficit Hyperactivity Disorder (ADHD) were included. The healthy control (HC) group was recruited from children who did not have any psychiatric complaints or history. Furthermore, parents of 268 children filled the ASSQ-TR. Of the children, 51 were PDD, 67 were ADHD, 50 were OCD, and 100 were HC. In order to show the reliability of the ASSQ-TR, Cronbach's alpha values and test-retest were evaluated. ROC analyses was carried out to show concurrent validity and to determine the cutoff score.

Results: The Cronbach's alpha of ASSQ-TR is 0.86, while the test-retest reliability is r: 0.98. Total ASSQ-TR scores of children with PDD (27.96±9.5) were significantly higher than other groups (p<0.001). ROC analysis of ASSQ-TR showed the area under curve to be 0.97 with a cutoff of 16, having the maximum sensitivity (94.1%), specificity (89.0%), and 90.7% diagnostic accuracy of PDD versus HC scores.

Conclusions: Our pilot data showed that ASSQ-TR is a reliable instrument that successfully differentiates clinically diagnosed PDD from HC. This instrument might therefore be useful for the screening of PDD in school-aged children in Turkish populations.

Keywords: Pervasive developmental disorders, Autism Spectrum Screening Questionnaire, reliability, validity

INTRODUCTION

Autism is a neurodevelopmental disorder, which is characterized by persistent impairment in reciprocal social communication and social interaction, as well as restricted, repetitive patterns of behavior, interests, or activities, with increasing prevalence in recent years (American Psychiatric Association 2013). Behavior and findings of children with autism are being seen in a wide range from mild to progressively severe developmental disorders. The current term of "Autism Spectrum Disorder" is in the DSM-5 due to the quantitative differences in symptoms (American Psychiatric Association 2013). This term includes the diagnoses of Autistic Disorder, Asperger Disorder, and Pervasive Developmental Disorder-Not Otherwise Specified which were classified under the Pervasive Developmental Disorders (PDD) in DSM-IV-TR. The prevalence ratio was stated to be 0.07% to 2.6%. The increase in prevalence has been attributed to multiple factors, such as increased awareness of autism in public and clinical settings, broadening of ASD diagnostic criteria, early diagnosis, and diagnostic shifts (Fombonne et al. 2008, Kim et al. 2001).

Although the increase in PDD prevalence in Turkey has anecdotally and widely been reported, there has not yet been any study of autism prevalence in Turkey. Since early diagnosis and treatment are important in terms of prognosis, appropriate screening tools for early detection of the disorder in the population are crucial. Procedures in epidemiological

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studies initially require screening for representative subjects of the population and then detailed diagnostic evaluation of the sample (Kim et al. 2011). Although screening tools are gradually increasing in Turkey, the number of available validated scales for both psychiatric settings and total population are also still limited. The translated and standardized scales are The Childhood Autism Rating Scale (CARS) (Sucuoglu et al. 1996, Incekac et al. 2009), Autism Behavior Checklist (Yilmaz Irmak et al. 2007), Checklist for Autism in Toddlers-CHAT (Kabil 2005), Modified Checklist for Autism in Toddlers- M-CHAT (Yikgec 2005), and Social Communication Questionnaire- SCQ (Öner et al. 2012, Avcil et al. 2015). CHAT and M-CHAT is used for preschoolers, while CARS and ABC is used to screen PDD for both preschool and school-aged. SCQ is also standardized for both preschoolers and school-aged children, but it has commercial rights and payment is required in order to use SCQ. These questionnaires include more questions about low functioning subjects.

Autism Spectrum Screening Questionnaire (ASSQ) is a 27-item questionnaire that was developed in Sweden (Ehlers and Gilberg 1993, Ehlers et al. 1999). Initially, it was utilized for screening Asperger Syndrome (AS) in school-aged children (Ehlers ve Gilberg 1993). In addition to AS, it was then used for the subgroup of PDD aged 6-17 year-old children with normal intelligence or mild mental retardation (total IQ>50) (Ehlers et al. 1999) and the scale has been renamed as "Autism Spectrum Screening Questionnaire". ASSQ items were originally designated for evaluating social interactions, communication problems, restricted and repetitive behaviors as well motor clumsiness and other associated problems such as motor and/or vocal tics (Ehlers et al. 1999). Its validity and reliability in clinical settings as well as effectiveness of sensitivity and specificity were reported for screening high functioning subjects (Ehlers et al. 1999). The scale was translated into English (Ehlers et al. 1999), Lithuanian (Lesinskiene 2000, Matilla et al. 2012), Norwegian (Posserud et al. 2006, Posserud et al. 2008, Posserud et al. 2009), Finnish (Matilla et al. 2009, Matilla et al. 2012), and Mandarin Chinese (Guo et al. 2011).

In spite of the increase in PDD prevalence stated in the aforementioned epidemiological studies, epidemiologic data regarding Turkey has not been collected. The limited availability of instruments in Turkish that are designated as a screening tool for high functioning PDD among school-aged children warrants development or the adaptation of a questionnaire that would serve screening purposes. The main goals of this study are, (a) testing psychometric properties and reliability and concurrent validity of Turkish version of ASSQ (ASSQ-TR), and (b) finding the best cutoff score for ASD cases. The significance of the study was that the translated scale (ASSQ-TR) is aiming to determine the high functioning PDD cases whose diagnosis was relatively difficult and may be delayed until adolescence or even early adulthood. Although, the scale was developed for screening school-aged children with AS, it was used in the subgroup of PDD with normal intelligence or mild retardation (total IQ< 50) in subsequent research and its application was shown (Ehlers et al. 1999, Matilla et al. 2009, Matilla et al. 2012, Posserud et al. 2009). The scale enables screening in the population attending formal education with its current property and may be preferred in epidemiological research in primary screening units, such as schools.

METHOD

Translation procedure of the ASSQ

The ASSQ was translated into Turkish by discussing each item of the scale with the authors of the study who have an advanced level of professional English and clinical experience in PDD for 15 years. The Turkish translation of the scale was then back-translated into English with blind control method by two psychologists who speak advanced English. Then, the Turkish version was rearranged after the original English version and back-translated English version were reviewed. Finally, the Turkish version of the questionnaire was drafted by the authors of the study after the re-evaluation of both Turkish translations.

Participants and Procedure

Cases aged 6 to 18 years old and those having been followed at Ege University Medical Faculty Child and Adolescent Psychiatry Department with one of any diagnoses of Pervasive Developmental Disorder (PDD) (n:51), Obsessive Compulsive Disorder (OCD) (n:50), and Attention Deficit Hyperactivity Disorder (ADHD) (n:67) according to the DSM-IV-TR (American Psychiatric Association 2000) were included to the study. The healthy control (HC) group (n: 100) was recruited from children who were admitted to the Ege University Pediatrics Department for physical symptoms, but not possessing any psychiatric complaint or history as well as hospital staffs' children who have met the aforementioned criteria. These children were evaluated through a semi-structured interview, and the ones who did not have behavioral and emotional problems were included to the study. Patients were verbally informed and assented to the study. Written informed consent was obtained from parents. In addition, ethical permission was obtained from Ege University Clinical Researches Ethical Committee.

Psychiatric examinations with K-SADS (Kaufman et al. 1997, Gökler et al. 2004) were performed during routine clinical visits of ADHD and OCD cases for this study and their diagnoses were confirmed.

Turkish adaptations of golden standard instruments such as the Autism Diagnostic Interview-Revised-ADI-R (Lord et al 1994) and the Autism Diagnostic Observation Schedule-ADOS (Lord et al 2000) for autism diagnosis are not yet available. Therefore, diagnostic evaluation and interview of the PDD cases were done according to a form that was developed based on DSM-IV-TR, and their diagnoses were confirmed via two-stage evaluation.

The autism cases that we aimed to reach and include in the study were those in which they have the good clinical functioning level to continue primary school, in other words the cases attending primary school. In the first stage, cases presenting with these features were invited to the study during their routine policlinic examination. The diagnoses of Autistic Disorder (AD), Pervasive developmental disorder- not otherwise specified (PDD-NOS), and Asperger Syndrome (AS) were made based on DSM-IV-TR criteria. Furthermore, diagnostic criteria of DSM-IV-TR were strictly applied. In the second stage, diagnoses of the cases were re-evaluated by the academic members of child and adolescent psychiatry who were experienced in the field of PDD. Furthermore, diagnoses of AD, PDD-NOS, and AS were confirmed by the consensus. According to DSM-IV-TR, the requirement of lack of delay or deficiency/impairment in cognitive development exists in the criteria for AS. WISC-R (Wechsler Intelligence of Scale for Children-Revised) was applied in order to confirm the required diagnostic criteria of AS and to detect the level of intelligence of PDD cases included in the study (Weschler 1974, Savasir and Sahin 1995). Total IQ score was detected to be 95.7±15.1 (min:71 - max:128) in AS cases. Individuals with autism lacking intellectual disability (IQ score ≥70) were defined as "high functioning autism" in literature (Ghaziuddin and Gerstein 1996). Total IQ score of the AD cases was 96.6±9.7 (min: 88 - max: 113). While the PDD-NOS cases were requiring the clinically sufficient functioning level to attend to primary school, the mean score of WISC-R was 65.62±11.96 (min: 51 - max: 85). Six cases were not be able to perform WISC-R; furthermore social, motor, cognitive and communication development of those cases were evaluated with Ankara Developmental Screening Inventory-ADSI (Savasir et al. 1998). Investigators identified the cases whose total IQ≥50 as "higher functioning" (Matilla et al. 2009, Matilla et al. 2012). These cases were not excluded from the study due to the application of ASSQ in PDD cases aged 6 to 17 years old with normal intelligence or mild mental retardation (TIQ≥50) (Ehlers et al. 1999, Mattila et al. 2009, Posserud et al. 2009, Mattila et al. 2012).

One of the authors made a brief semi-structured interview with the HC subjects and their parents, screening the main current and lifetime psychiatric symptoms (depressive mood, irritability, anxiety, sleep problems, hyperactivity, conduct problems, academic-school-peer related problems and functioning), as well as kids who showed any of the symptoms that were excluded from the study. During this stage, 27 parents did not approve joining the study and we found that 6 children had psychiatric treatment (ADHD and Anxiety Disorders) and did not enroll in the study. The study was completed with a total of 100 HC subjects.

A total of 268 parents filled the ASSQ-TR that includes 27 items scale and of which 51 were from the PDD group (24 AS, 5 Autism, 22 PDD-NOS), of which 67 were ADHD group, of which 50 were OCD group, and of which the remaining 100 were belonging to HC. Internal consistency and test-retest reliability were evaluated in order to show reliability of Turkish ASSQ version. Fifty parents of the control group completed the questionnaire 4 weeks later for test-retest reliability.

Materials

Sociodemographic Data Form: This form was created by the authors and consists of age, gender, education data, medical history, and family background.

DSM-IV-TR based Pervasive Developmental Disorder evaluating form: This form was also created by the authors of the study and deeply screening for A, B, and C criteria of DSM-IV-TR.

Autism Spectrum Screening Questionnaire (ASSQ): The ASSQ was developed in Sweden and comprised of 27-items (Ehlers and Gilberg 1993, Ehlers et al. 1999). ASSQ requires that the responder answer for all items "whether the child has particularly notable aspects in comparison to his/her peers". It is a 3-point Likert-type scale and can be rated in 10 minutes: "No" (0 point=normal), "Somewhat" (1 point=some abnormality) and "Yes" (2 point=definite abnormality). The total score is between 0 and 54. Recommended cut-off score to identify the higher-functioning children with PDD in clinical settings were 22 for teachers and 19 for parents (Ehlers et al. 1999).

ASSQ items were originally designated for 4 factors: social interaction (11 questions), communication problems (6 questions), restricted and repetitive behavior (5 questions) as well as 5 questions for motor clumsiness and associated problems, such as motor and/or vocal tics (Ehlers and Gilberg 1993, Ehlers et al. 1999). However, Hattori et al. (2006) and Guo et al. (2011) used 3 aspects of the questionnaire: restrictive and repetitive behaviors (2, 3, 9, 10, 18, 20, 21, 22, 23, 24, 27 numbered questions), social interactions (1, 12, 14, 15, 16, 17, 19, 25, 26 numbered questions), and communication problems (4, 5, 6, 7, 8, 11, 13 numbered questions). These authors stated that both the total and subscale scores differed PDD cases from ADHD, Schizophrenia patients, and healthy subjects (Hattori et al. 2006, Guo et al. 2011). Posserud et

al. (2008) proposed a 3 factor structure (social difficulties; tics/motor/ obsessive compulsive disorder; autistic style). Their study revealed the effectiveness of the 3 factor structure and internal consistency (for parents Cronbach alpha=0.86). Additionally ASSQ was revised and enlarged to cover the female phenotype (Kopp and Gilberg 2008). Cut-off points for Swedish (Ehlers et al. 1999), Norwegian (Posserud et al. 2009), Mandarin Chinese (Guo et al 2011), and Finnish (Matilla et al. 2012) versions have been established.

Schedule for Affective Disorders and Schizophrenia for School Aged Children, Present and Lifetime Version (K-SADS-PL): The K-SADS is a semi-structured interview to determine psychopathology in children and adolescents according to the DSM-IV-TR criteria (Kaufman et al. 1997). The Turkish adaptation study was conducted by Gokler et al. (2004). The presence and severity of symptoms are decided by combining answers and sights of child or adolescent, parents, and physician.

Wechsler Intelligence Scale for Children-Revised (WISC-R): The WISC-R is a standardized intelligence test developed by Wechsler (1974) for children which includes two parts, as verbal and performance subtests. Total IQ score is calculated by summing verbal and performance scores. The Turkish standardization was made by Savasir and Sahin (1995) in 6-16 years of age.

Ankara Development Screening Inventory (ADSI): It was developed for Turkish children by Savasir et al. (1998). The ADSI is a 154-item scale widely used in Turkey for the assessment and evaluation of social, motor, cognitive, and communicative levels in children aged between 0 and 6 years. The total development score reflects the general development level of the child and it is obtained from the total of the four subscales (language-cognitive development, fine motor development, gross motor development, social interaction subscales). Furthermore, the reliability and validity of the inventory was reported (Savasir 1998).

Statistical analysis

SPSS Windows 16.0 was used for the statistical evaluation of the data, and statistically significant p value was set at $p<0.05$. Cronbach's alpha coefficient was calculated to evaluate internal consistency of the total scale. Test-retest reliability of the questionnaire was measured by Pearson correlation analysis. A receiver operating characteristics (ROC) analysis was performed in order to determine the concurrent validity of the ASSQ as compared with healthy control and clinical diagnosis, and to find the best cutoff score for ASD, to measure its sensitivity, specificity, positive predictive value, and negative predictive value. Total ASSQ-TR scores of groups were compared by independent sample t test to ascertain content validity.

RESULTS

Demographic and clinical characteristics of cases

A total of 168 parents of which 51 are PDD (24 AS, 5 Autism, 22 PDD-NOS), 67 are ADHD, and 50 are OCD cases, and also 100 parents of healthy control volunteers fulfilled the ASSQ-TR. Mean age and gender distribution of all cases and mean of total IQ scores and ratio of special education attendance of PDD cases are all presented in Table 1.

The reliability measures of ASSQ-TR

The internal consistency reliability

Cronbach's Alpha value that represents internal consistency of the scale was 0.861.

Test-retest reliability

For the test-retest reliability evaluation, parents of 50 HC subjects re-filled the ASSQ-TR after 4 weeks, and the coefficient was found to be excellent ($r=0.98$, $p<0.001$).

Comparison of ASSQ-TR scores of the different clinical groups and healthy controls

Table1. Demographic and clinical characteristics of cases

	PDD (n:51)	AS (n:24)	Autism (n:5)	PDD- NOS (n:22)	ADHD (n:67)	OCD (n:50)	HC (n:100)
Age (mean±SD)	10.3±3.4	11.0±3.8	10.8±3.9	9.5±2.5	11.2±2.5	11.8±2.7	10.3±3.2
Gender							
Female(n)	7	3	0	4	15	25	58
Male(n)	44	21	5	18	52	25	41
Total IQ (mean±SD)		95.7±15.1	96.6±9.7	65.6±11.9			
Special Education							
yes(n)	45	20	4	21			
no(n)	6	4	1	1			

PDD: Pervasive developmental disorder, AS: Asperger syndrome, PDD-NOS: Pervasive developmental disorder-not otherwise specified, ADHD: Attention deficit hyperactivity disorder, OCD: Obsessive compulsive disorder, HC: Healthy control, SD: Standard deviation

Table 2. Comparison of ASSQ-TR scores of cases

Cases	ASSQ-TR total score			
	Mean	SD	Minimum	Maximum
PDD All (n:51)	27.96	9.5	12	47
AS (n:24)	28.29	9.4	12	47
Autism (n:5)	29.60	7.8	19	40
PDD-NOS (n:22)	27.23	10.2	13	46
ADHD (n:67)	16.39	10.5	1	42
OCD (n:50)	13.14	9.9	0	43
Healthy Control (n:100)	5.86	6.0	0	21
All Cases (n:268)	14.06	11.8	0	47

The comparison of ASSQ-TR total score with independent samples t test; PDD>ADHD=OCD>Healthy Control PDD: Pervasive developmental disorder, AS: Asperger syndrome, PDD-NOS: Pervasive developmental disorder-not otherwise specified, ADHD: Attention deficit hyperactivity disorder, OCD: Obsessive compulsive disorder, SD: Standard deviation

The mean ASSQ total score of all PDD cases was 27.96 (min:12, max:47; SD:9.5); AS was 28.29 (min: 12, max: 47; SD:9.4), AD was 29.6 (min:19, max:40; SD:7.8), and PDD-NOS was 27.23 (min:13, max:46; SD:10.2).

The ASSQ-TR total scores of PDD, ADHD, and OCD cases were significantly higher than HC group ($p<0.001$). The scores of PDD cases were statistically higher than the ADHD and OCD group ($p<0.001$). We did not find statistically significant differences between ADHD and OCD group scores (p:0.94) (Table 2).

ROC analysis and cutoff score of the ASSQ-TR versus healthy control and clinical diagnosis

ROC analysis was performed for determining the optimal cutoff score for ASSQ-TR. The reference line in ROC curves shows the differentiation between the two groups by chance (Öner et al. 2012). As the diagram displaying the true positive rate (sensitivity) against the false positive rate (1- specificity) approaches the left upper side, and the area under the ROC curve approaches 1.0, the scale can differentiate between the two groups well (Öner et al. 20012). The area under the ROC curve (AUC) (Bradley et al. 1998), one of the aspects of ROC, can also be used to analyze the relationship between a scale and a criterion measure, and it is an overall measure of the relationship between the scale and the clinical diagnosis. A score of 0.5 represents a chance relationship with no differentiation property, and 1.0 represents a perfect relationship meaning that the scale can definitely differentiate the targeted population from controls (Guo et al. 2011).

We found that total ASSQ-TR score can successfully distinguish ASD and the healthy control group (AUC is 0.97; CI: 0.959-0.994). Maximum diagnostic accuracy was found to be 90.7%. When we take the cutoff score of 16, the sensitivity score is 94.1% and specificity is 89.0%, while the positive predictive value (PPV) is 81.4%, negative predictive value (NPV) is 96.7%, and the overall diagnostic accuracy is 90.7%

Table 3. The impact of ASSQ-TR cutoff scores on sensitivity and specificity (PDD versus healthy control group)

ASSQ-TR score >=	Sensitivity %	Specificity %	Sensitivity+ Specificity	PPV	NPV	Overall Accuracy
11	100	78.0	1.780	69.9	100.0	85.4
12	100	80.0	1.800	71.8	100.0	86.8
13	98.0	83.0	1.810	74.6	98.8	88.1
14	96.1	85.0	1.811	76.6	97.7	88.7
15	94.1	88.0	1.821	80.0	96.7	90.1
16	94.1	89.0	1.831	81.4	96.7	90.7
17	88.2	91.0	1.792	83.3	93.8	90.1
18	86.3	92.0	1.783	84.6	92.9	90.1
19	80.4	95.0	1.754	89.1	90.5	90.1
20	76.5	98.0	1.745	95.1	89.1	90.7
21	70.6	99.0	1.696	97.3	86.8	89.4
22	66.7	100.0	1.667	100.0	85.5	88.7

Parent ASSQ-TR; Area Under The Curve: 0.97 (Confidential Interval:0.959-0.994) Overall accuracy: number of (true positives + true negatives)/number of total subjects, PDD: Pervasive developmental disorder, PPV: positive predictive value, NPV: negative predictive value

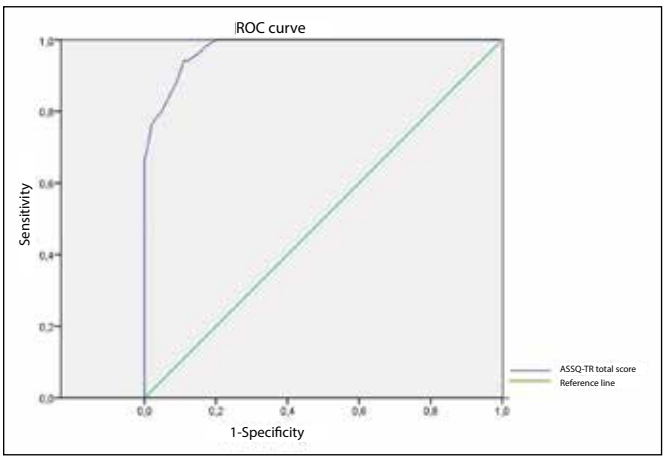

Fig 1. ROC analysis of the ASSQ-TR scores of PDD cases and healthy controls **ROC:** Receiver operating characteristic, **ASSQ-TR:** Autism Spectrum Screening Questionnaire-Turkish, **PDD:** Pervasive developmental disorders

Table 4. The impact of ASSQ-TR cutoff scores on sensitivity and specificity (PDD versus clinically diagnosed group)

ASSQ-TR score >=	Sensitivity %	Specificity %	Sensitivity+ Specificity	PPV	NPV	Overall Accuracy
16	94.1	53.0	1.471	46.6	95.4	65.5
17	88.2	55.6	1.438	46.4	91.5	65.5
18	86.3	59.0	1.452	47.8	90.8	67.3
19	80.4	62.4	1.428	48.2	88.0	67.9
20	76.5	69.2	1.457	52.0	87.1	71.4
21	70.6	72.6	1.432	52.9	85.0	72.0
22	66.7	73.5	1.402	52.3	83.5	71.4
23	64.7	76.9	1.416	55.0	83.3	73.2
24	64.7	79.5	1.442	57.9	83.8	75.0
25	62.7	82.1	1.448	60.4	83.5	76.2
26	62.7	83.8	1.465	62.7	83.8	77.4
27	51.0	84.6	1.356	59.1	79.8	74.4

Overall accuracy: number of (true positives + true negatives)/number of total subjects, PDD: Pervasive developmental disorder, PPV: positive predictive value, NPV: negative predictive value

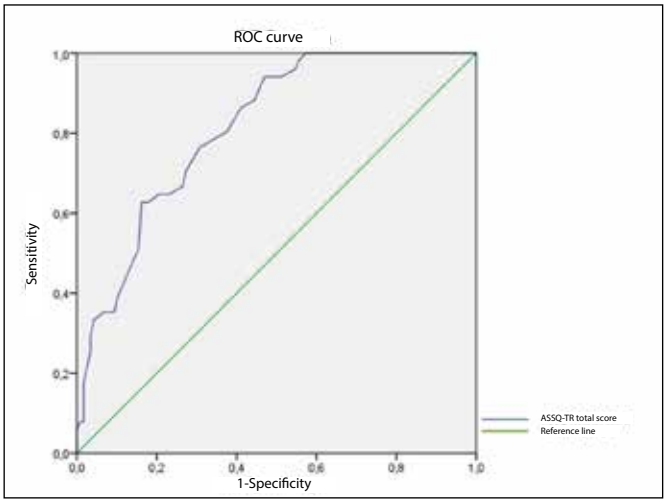

Fig 2. ROC analysis of the ASSQ-TR scores of diagnostic groups (ADHD and OCD) and PDD cases
ROC: Receiver operating characteristic, **ASSQ-TR:** Autism Spectrum Screening Questionnaire-Turkish, **ADHD:** Attention deficit hyperactivity disorder, **OCD:** Obsessive compulsive disorder, **PDD:** Pervasive developmental disorders

at this cutoff. When the cut off score was taken as 20, the overall diagnostic accuracy was also 90.7%, the sensitivity is 76.5%, specificity is 98.0%, PPV 95.1%, and NPV 89.1%. For scales aiming to screen PDD cases in the population, higher sensitivity is more important. In our study, this score was detected at 16-point with the highest overall diagnostic accuracy. Therefore we suggest taking 16 points as the cutoff score to distinguish PDD and HC cases. Table 3 shows the impact of ASSQ-TR cutoff scores on sensitivity and specificity of the instrument.

ROC analysis was performed to determine the cutoff score and qualification of the ASSQ in distinguishing PDD cases from other clinical groups (ADHD and OCD). When the cut off score was taken as 26, the overall diagnostic accuracy is 77.4%, the sensitivity is 62.7%, specificity is 83.8%, PPV 62.7%, and NPV 83.8%.

DISCUSSION

In spite of the increase in PDD prevalence stated in the aforementioned epidemiological studies, epidemiologic data regarding Turkey has not been collected. The limited availability of instruments in Turkish that are designated as a screening tool for high functioning PDD among school-aged children warrants the development or adaptation of a questionnaire that would serve screening purposes. The ASSQ has been widely used as a screening instrument in ASD studies (Kim et al. 2011, Ehlers and Gilberg 1993, Ehlers et al. 1999, Matilla et al. 2012, Posserud et al. 2006, Peterson et al. 2006). This study presents the psychometric properties of the Turkish translation of ASSQ.

It was determined that the internal consistency and test-retest reliability of Turkish translation of ASSQ (ASSQ-TR) was good. Thus ASSQ-TR is a reliable instrument. ASSQ-TR total score, which is completed by parents, is significantly higher in ASD cases than the ADHD, OCD, and healthy control group. ASSQ-TR can successfully distinguish the ASD group from healthy controls, ADHD, and OCD cases.

The internal consistency and test-retest reliability

By evaluating internal consistency, it was determined that the scale measures the desired measure. It was stated that the high internal consistency coefficient shows the items used for the measurement are indicators that they measure homogenous structure (Avcil et al 2015). The Cronbach's alpha coefficient of ASSQ was 0.86, while the internal consistency was found to be at good level. To our knowledge only Posserud et al. (2008) reported internal consistency of the instrument, and they also found good internal consistency for the ASSQ with Cronbach's alpha of 0.89 for teachers, and 0.86 for parents. Our result is consistent with the Posserud et al.'s (2008) study.

In the epidemiological study of Ehlers & Gillberg (1993) the test-retest reliability for teacher ASSQ total scores, over an 8-month period was Pearson r = 0.90. The second study of ASSQ which was conducted by Ehlers et al. (1999), the test-retest reliability for teacher ASSQ total scores, over a 2-week period in the main sample was r = .94; n = 65; $p < 0.0001$; for parent ASSQ total scores was r = 0.96; n = 86; $p < 0.0001$ (Ehlers et al. 1993). Our test-retest reliability for parent ASSQ-TR total score in the healthy control group is r = 0.98; n = 50; $p < 0.001$. Our result is consistent with these studies, but our slightly higher correlation coefficient can be due to the evaluation of the healthy control group's scores.

Comparisons of ASSQ-TR scores of groups

The mean ASSQ-TR total score of all PDD cases was 27.96±9.5 (min:12 - max:47). This result is similar to Swedish studies. Asperger Syndrome ASSQ parent mean score was found to be 26.2±10.3 in Ehlers and Gilberg's (1993) study, and 25.1±7.3 in Ehlers et al. (1999) study. The ASSQ parent mean score of Finnish study (24.3± 8.5), Chinese study (25.3±9.2), and Japanese study (21.7; mean rank: 60.8) is relatively lower than our results (Matilla et al. 2009, Guo et al. 2011, Hattori et al. 2006). This can be due to either the cultural differences or the awareness about the PDD symptoms of parents in our cases, because our PDD cases are from the patients who have been following at our clinic and they could have gained knowledge and awareness of the symptoms of PDD during this time.

The mean ASSQ total score of all ADHD cases was 16.39±10.5. This score is similar to the Japanese study (14.8; mean rank: 48.5), but higher than Chinese study (10.4±7.1)

[20, 29]. Control cases' mean ASSQ score is 5.86±6.0, which is similar to the Japanese (4.3) and Chinese study (5.2±6.6), but higher than the Finnish (2.0±3.5) study (Guo et al. 2011, Hattori et al. 2006, Matilla et al. 2009). We think that these differences might be due to the cultural differences. The mean score of total ASSQ in OCD cases was 13.14. This score was higher than the control, lower than PDD but not different from ADHD cases' score. We did not find a study including OCD cases.

Total ASSQ parent scores of children with PDD were significantly higher than in any other group ($p<0.001$). This result is consistent with other studies (Matilla et al. 2009, Guo et al. 2011, Hattori et al. 2006). Our study showed that ASSQ-TR can differentiates clinically diagnosed children with PDD from healthy control and other clinically diagnosis, specifically ADHD and OCD. Hattori et al. (2006) in Japan reported that the ASSQ scores of the PDD group and the ADHD group were significantly higher than the control group; furthermore the PDD group scored significantly higher than the ADHD group. Guo et al.'s (2011) study showed that CH-ASSQ can differentiate children with PDD from healthy control, ADHD, and childhood onset schizophrenia. These results are consistent with our study.

Cutoff score for ASSQ-TR

ROC curves are plots of true positives against false positives for all cut-off values. Sensitivity, specificity, and predictive values give clinically useful information on how an instrument works as a test. In clinical work, an excellent instrument provides high sensitivity (the proportion of subjects who have the disorder who test positive for it) and specificity (the proportion of subjects who do not have the disorder who test negative for it). In primary screening units, such as health-care centers and schools, the primary task is to identify possible ASD cases. That is for screening purposes in a population it is more important to have high sensitivity rather than high specificity (Matilla et al 2012). We found in our study that the optimal cutoff score for ASSQ-TR in clinically diagnosed PDD against healthy controls was 16. At this cutoff the overall accuracy (90.7%) and the specificity (89%) and sensitivity (94.1%) is found to be at the maximum level. Positive predictive value (PPV) is 81.4% while negative predictive value (NPV) is 96.7% at this cutoff. When the cut off score was taken as 20, the overall diagnostic accuracy was also 90.7%, the sensitivity is 76.5%, specificity is 98.0%, PPV 95.1%, and NPV 89.1%; sensitivity was therefore decreased. For screening purposes in a population to identify possible PDD cases, it is stated that to have high sensitivity is more important (Matilla et al 2012), and in our study this score was found at 16. Therefore we recommend 16 for the cutoff score to identify possible PDD cases against unaffected controls. Three of the 51 cases' scores are under 16 (one case is AS, 2 are PDD-NOS) in our study.

Ehlers et al. (1999) suggested the cut-off score of 19 (sensitivity of 62–82% and specificity of 90%) for ASSQ parent ratings in clinical settings. When the cutoff score of parent-rated ASSQ was set as 12 in a Chinese sample, PDD cases were distinguished from healthy ones (sensitivity 96% and specificity 83%) (Guo et al 2011).

For the Finnish version, Matilla et al. (2012) proposed the completion of ASSQ by both teacher and parent, and the sum of obtained scores. The suggested optimal cut-off score was 30 in clinical settings, and 28 total population screening using summed ASSQ scores of parents' and teachers' ratings, in order to distinguish PDD cases from healthy ones. In cases in which only the teacher's ASSQ rating is available, the cut-off score of 22 can be used as an indication for more careful examination in a clinical setting (Matilla et al. 2009, Matilla et al. 2012). A valid cut-off score for parents' single score could not have been estimated in the Finnish study (Matilla 2009). In the Bergen (Norwegian) Child Study, Posserud et al. (2009) suggested the optimal cut-off for ASSQ as 17 points (sensitivity of 91% and specificity of 86%) for both parent and teacher informants, in a total population sample. They also stated that whenever possible, both parents and teachers should complete the ASSQ, in this manner by combining teacher and parent information the best screening properties could be obtained (Posserud 2009).

Our PDD sample and our results are similar and are therefore more comparable with the clinical sample studies conducted in Sweden (Ehlers et al. 1999), in China (Guo et al. 2001) and in Finland (Matilla et al. 2012). Our cut-off score recommendation (≥16) is similar to Ehlers et al.'s (1999) study but higher than the Chinese. Furthermore, the Finnish study suggested to sum up scores of the teacher and parent. The different ASSQ cut-off scores could be explained by cultural differences or methodological differences, as well as different sample sizes of studies.

Matilla et al. (2012) stated that in child psychiatry, neurology and neuropsychiatry units, it is important to identify possible PDD cases, as well as to distinguish possible PDD from other types of behavioral problems with social impairment (e.g., ADHD, conduct disorder, social anxiety). In our study, ADHD and OCD cases were also included due to their shared symptoms with PDD. ADHD symptoms are frequent in ASD cases, and social impairment and cognition deficits are mostly seen in ADHD cases (Uekerman et al 2010). We found that ASSQ-TR scores of ADHD cases were significantly higher than the healthy control but still measured lower than PDD cases. ROC analysis was performed to identify whether ASSQ-TR distinguishes PDD cases from other diagnostic groups (ADHD, OCD) as well as to determine appropriate cutoff

score. Cutoff score was determined to be 26. At the maximum overall diagnostic accuracy (77.4%) and maximum summed sensitivity and specificity (the sensitivity is 62.7%, specificity is 83.8%) the cut off score was 26. This cut off score's sensitivity and specificity ratios are lower than our recommended score for the healthy control group. We should state that ASSQ is a screening tool, not a diagnostic assessment, so gold standard approach for PDD diagnosis is still a full parental interview including a past and current developmental and behavioral history, and structured observation of the child individually and in a peer-group setting. The optimal cutoff score was 16 for Mandarin Chinese ASSQ to differentiate ADHD and ASD cases, which yielded a sensitivity of 86.2%, a specificity of 84.8%, and an overall diagnostic accuracy of 85.3% (Guo et al. 2011). The cutoff scores of the Chinese translation are lower than other cultures. The authors explain these differences through cultural properties. OCD cases are similar to ADHD cases in ASSQ-TR scores. There is not a study to compare our results in literature, but we think that the aforementioned issues are eligible for OCD cases as well.

Limitations of the study

This study is designated to determine the reliability and concurrent validity of the ASSQ-TR and to find the best cutoff score for ASD cases. Factor analysis can be carried out to test the construct validity of the questionnaire by increasing the sample size in further studies. Another important point is that of informant issues. The researchers have stated that for the best screening method, getting information from multiple sources is important to improve case finding (Posserud et al. 2009, Matilla et al. 2009). A high functioning child with PDD may fail completely in the unstructured recesses in school while he or she may function very well in a one-to-one setting with adults (Posserud 2009). Furthermore, autistics traits that parents have often called as the broader autism phenotype (Bolton et al 1994, Kose et al 2003) may have an impact on the ability to identify the social impairment, whereas teachers may miss the passive and withdrawn child with ASD (Posserud et al. 2009). Because of these reasons, further studies including teacher reports are necessary.

CONCLUSION

We found that the internal consistency and test-retest reliability of the Turkish translation of ASSQ (ASSQ-TR) was good. Thus ASSQ-TR is a reliable instrument. ASSQ-TR parent total score is significantly higher in ASD cases than ADHD, OCD, and HC group, and so successfully differentiates clinically diagnosed ASD patients from HC, as well as from patients with ADHD and OCD. The recommended optimal cutoff score for ASSQ-TR in clinically diagnosed ASD against healthy controls was 16 (sensitivity is 94.1%, specificity is 89.0%, overall diagnostic accuracy is 90.7%). This instrument might therefore be useful in screening for ASD in Turkish populations with its psychometric properties as well as its practicality, concise nature, and lack of payment requirement.

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