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ORIGINAL ARTICLE

Reliability and Validity Studies of the Adapted Autism Behaviour Checklist in Turkey

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Abstract

The present study aims to develop an assessment instrument for children with Autism Spectrum Disorders (ASD) in Turkey based on the Autism Behavior Checklist (ABC). Validity and reliability studies of Adapted ABC (AABC) were conducted on 969 children with ASD and 164 children with intellectual disability from 21 cities in Turkey. Exploratory and confirmatory factor analyses revealed a two-factor structure. The correlation of the AABC with the Gilliam Autism Rating Scale-2-Turkish Version supported criterion-referenced validity. Reliability analyses demonstrated that test–retest, internal consistency, and item discrimination reliability levels met the required conditions. Finally, the score equivalents of the percentiles required to use the instrument in accordance with the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM V), were determined.

Keywords Autism spectrum disorders · Screening and diagnostic instruments · Validity and reliability analysis · Turkey

Autism spectrum disorders (ASD) manifest as conditions appearing at birth or early childhood that negatively affect social interactions, sharing of ideas and feelings, imagination, and interpersonal relationships (National Research Council 2001) and cause repetitive–limited behaviors. A recent significant change within the framework of ASD involves assessment of the condition. The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM 5) was published by the American

This study is originated from first author's doctoral dissertation.

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Psychiatric Association (APA) in 2013 and provides major guidelines for diagnosing ASD. Social communication and interaction impairments in different environments and repetitive–limited patterns of behavior, interests, or activities are referred to in the DSM 5. According to the ASD definition described by the manual, symptoms appear at early developmental periods and cause significant clinical deteriorations in social, occupational, and other important life areas. Support services to compensate for the condition have been classified as "requiring support," "requiring substantial support," and "requiring very substantial support" (APA 2013).

Understanding the importance of early intervention to ASD has resulted in the development of evaluations for first-level screening procedures. Implementation of screening systems effectively facilitates early detection of children with ASD (Kamio et al. 2014; Nygren et al. 2012; Tohum Autism Turkey Early Diagnosis and Educational Foundation 2008). Dumont-Mathieu and Fein (2005) discussed the characteristics of two types of screening implementations, the first of which is called surveillance. According to the American Pediatric Academy, surveillance includes monitoring of the developmental conditions of all children at health centers (Johnson et al. 2007). The second type of screening implementation involves implementation of screening instruments focusing on ASD on all children checking into health centers at developmentally critical periods (e.g., 18–24 months). An important advantage of this implementation over the former method is its increased likelihood of detecting ASD. Despite their merits, however, both approaches suffer from the disadvantages of health professionals' ignoring/forgetting to apply these instruments because of their heavy workloads, parents' feelings of panic and anxiety because of the application of these instruments, and the unconfirmed validity of screening instruments for children younger than 18 months (Dumont-Mathieu and Fein 2005).

Second-level assessment is the process of diagnosing children whose conditions were considered at risk as a result of first-level screening and revealing their needs. (Filipek et al. 1999). Second-level assessment can determine; whether an individual displays the disorder and, if yes, the level of severity of the disorder, and identification of services the individual would need. ASD assessment is a comprehensive process involving various implementations. Using standardized diagnostic instruments, interviewing family members, reviewing a child's history, and observing the individual in different settings are considered ideal implementations in ASD assessment (Filipek et al. 2000). The instruments used to diagnosis ASD in a more detailed manner are called second-level instruments and are particularly beneficial for workers without considerable experience in the clinical appearance of ASD or those who wish to conduct assessment on a more systematic basis (Matson et al. 2007).

Various diagnostic instruments for ASD have been developed over the last three decades, and these instruments display different qualities. Some of these instruments are based on specialist observations of the child [e.g., Autism Diagnostic Observation Schedule Generic (ADOS-G), Lord et al. 2000; Autism Observation Scale for Infants (AOSI), Bryson et al. 2008] while others are based on interviews with parents [e.g., Gilliam Autism Rating Scale-2 Turkish Version (GARS-2 TV), Diken et al. 2012; Social Responsiveness Scale 2 (SRS 2), Constantino et al. 2003]. Likert scales (e.g., GARS-2 TV, AOSI) or yes/no type items [e.g., Autism Behavior Checklist (ABC), Krug et al. 2008] can be used to answer these scales. Some of these instruments include a large number of items under various titles [e.g., Autism Diagnostic Interview Revised

(ADI-R), Lord et al. 1994] and some include relatively fewer items [e.g., Childhood Autism Rating Scale (CARS), Schopler et al. 1980]. Identification of which variables affect diagnosis positively is a fairly controversial issue. An instrument including a detailed interview may provide more information; however, evaluation of how useful this extra information is for diagnosis or whether the time and effort exerted to obtain this information should be taken into consideration (Matson et al. 2007). Institutions and specialists are often encouraged to use instruments that meet their own needs. The statistical quality of the instrument is also an important factor influencing its usability. Steiner et al. (2012) opined that instruments that could be used for ASD diagnosis should include those for which standardization studies had been completed and of which validity and reliability levels had been determined.

A number of validity and reliability studies for some screening and diagnosis instruments of ASD have been carried out in Turkey. Sucuoğlu et al. (1996), for example, adapted the Behavior Observation Scale for Autistic Spectrum (BOS) for Turkish use and conducted a study involving 36 autistic, 30 intellectually disabled, and 23 normally developing children. Average scores and the standard deviations of the scores were then calculated and used to determine the condition of the children through discriminant analysis. The researchers reported that the instrument can discriminate the three conditions with an accuracy rate of 63%. In addition, 22 items that did not exist in the original version of the instrument were included in the instrument modified by the researchers, and these items were observed to increase the validity of the instrument (Kaner et al. 2013).

Yıkgeç (2005) conducted a Turkish validity study of the Modified Checklist for Autism in Toddlers (M-CHAT) with 83 children, and the checklist was observed to provide accurate evaluations in 77% of the participants. The checklist could also scan children with autism disorders correctly at a high level; unfortunately, it also tended to identify children with Down syndrome as false-positives considering that they may present ASD in some situations (Yıkgeç 2005).

A Turkish validity study of the Checklist for Autism in Toddlers (CHAT) was performed by Tetik-Kabil (2005); this study was conducted with a total of 80 children who were normally developing, with Down's syndrome, diagnosed with ASD, and at the risk of ASD. The instrument was observed to detect autism at a rate of 86%, and the criterion-related validity of the checklist in comparison with the M-CHAT was .75 (Hergüner and Özbaran 2010).

Turkish adaptation studies of the CARS were conducted by Sucuoğlu et al. (1996) and İncekaş (2009). Sucuoğlu et al. (1996) conducted their study with 20 male children and found out that all of the items except for the 14th one showed moderate-to-high correlations according to point-biserial correlation analysis. İncekaş (2009) studied 48 children who were diagnosed with pervasive developmental disorders and 48 children with intellectual disability. Findings revealed that the adapted version of the CARS showed high validity and reliability, and it was able to distinguish pervasive developmental disorders from other groups.

A Turkish standardization study of the GARS-2 was conducted by Diken et al. (2012) with 1191 children who were diagnosed with autistic disorder. Internal reliability and test–retest coefficients were generally high, and scores taken from the GARS-2 by various groups (e.g., autism, intellectual disability, hearing impairment, or normal development) showed significant differentiation. The results of exploratory and confirmatory factor analyses showed that the instrument was compatible with the three basic structures of ASD.

Yılmaz-Irmak et al. (2007) conducted validity and reliability studies on the Turkish version of the 1993 ABC with 208 children with autistic disorder; 97 children with intellectual disability, and 174 normally developing children. Analyses revealed high Cronbach alpha internal consistency and Spearman–Brown split-half reliability coefficients. A 2 × 2 chi square analysis was carried out to evaluate content validity, and all 57 items included in the test were found to be distinctive at significant levels. Excluding normally developing children, 53 out of 57 items were found to be successful at discriminating autistic disorder and intellectual disability. The researchers thus concluded that a sensitivity of .82 and specificity of .74, as revealed by ROC analyses, were ideal for a cut-off score of 39.

The common theme among the studies described above, except that of Diken et al. (2012), was their being conducted with a limited sample size. Thus, to enable their application to countries such as Turkey, which possesses distinct cultural and socio-economic structures, more participants are necessary for validity and reliability analysis. Development of an instrument reflecting the DSM 5 criteria would be an important step in following contemporary ASD practices in Turkey. Thus, this study aimed to develop an assessment instrument that reflects current developments in ASD studies considering Turkey conditions, and conduct validity and reliability studies on it. With respect to this aim, a checklist based on the ABC (Krug et al. 2008) which is used in the United States was developed and its validity and reliability were determined.

Method

Development of the Instrument

The instrument developed in the current study was based on the ABC, which published in the United States in 2008. The first version of the ABC was published by Krug et al. in 2008 and updated first in 1993 and then in 2008. The ABC's clear and concise structure enables its use in both first- and second-level assessments. Except for 10 items that were eliminated by the researchers, the 2008 version of ABC included the same number of items (i.e., 47 items) as its previous versions. The checklist is rather practical in implementation; if the situation stated in an item is observed in a child, the item is endorsed. Then, the raw score, which refers to the total number of endorsed items, is turned into a standard score. A child's autism state was finally evaluated considering this standard score.

A new version of the ABC, hereinafter referred to as the Adapted Autism Behavior Checklist (AABC), was developed by the researchers in the current study. During the development process, specialist opinions, examination of diagnostic criteria of DSM 4-TR (APA 2000), DSM 5 (APA 2013), International Statistical Classification of Diseases and Related Health Problems (ICD-10) (World Health Organization 1992) and another assessment instrument (GARS-2 TV) were taken into consideration.

Development of the AABC was initiated with linguistic equivalence studies. Initially, the checklist was translated into Turkish. The translation process and evaluation of the translated checklist were carried out through the linguistic equivalence criteria described by Şekercioğlu (2009). Six English-proficient specialists produced translations of the ABC, and the most convenient translation of each item among the translations obtained was selected by a group of five academicians. During the first evaluation, the academicians could not reach a consensus on six items; thus, these items were reevaluated and agreed upon in a second meeting. Moreover, considering cultural differences, three items were retranslated in accordance with their applicability to Turkish culture. The 3rd and 41st items evaluating two different conditions in the original form were also transformed into four items evaluating a single condition. Thus, the number of total items in the instruments was 49.

In the original form, conditions related to ASD were itemized by brief behavior definitions. This quality makes the instrument simple and plain. However, during the discussions, some items were found to be difficult to comprehend. Thus, although they did not exist in original ABC form, explanations were added below each item to increase their comprehensibility. These explanations included examples and definitions of some terms used in the item. The explanations were obtained by reviewing the literature on ASD and finalized by three academicians who specialized in ASD.

The next step in the development of the instrument was the implementation and evaluation of the first draft by specialists in the field and parents of children with ASD. For the specialist group, two group meetings were held in two different special-education institutions. The participant specialists held bachelor and master's degrees in the fields of special education, psychology, or preschool teaching, and were asked to answer the items relative to the children with ASD they were working with. The items were then read one by one, and each specialist was asked to determine whether they were comprehensible and suitable for evaluating ASD. The specialists were also asked for their opinions on the checklist as a whole. For the parent group, eight mothers whose children were affected by ASD answered the items in the checklist. Each mother provided their opinion on the comprehensibility of the items and the checklist as a whole. After completion of this development step, some of the item explanations in the checklist were revised to enable better understanding.

As some specialists noted that several conditions related to ASD were not present in the original form, behaviors that were seen in individuals with ASD but not included in the original form were noted. In addition, other resources that were used to diagnose ASD and formulate ABC items were compared on an item basis. A matrix was developed to compare the items of the a) DSM 4-TR criteria, b) DSM 5 criteria, c) ICD-10 - criteria and d) the original ABC form. The conditions that were absent from the checklist but were considered to be related to ASD and present in the DSM 4-TR, DSM 5, and ICD 10 were translated into items and included in the checklist. These items were as follows:

- Insists on eating similar meals
- Spends a lot of time watching light sources or rotating objects that attract his/her attention
- Does not identify the object or situation that attracts him/her to others
- Does not display any reaction when he/she is called
- Does not play imaginary games
- Has difficulty touching certain surfaces with his/her hands or feet

- Cannot speak appropriately for his/her age
- Does not start a conversation with others spontaneously

These items were also evaluated by three academicians who specialized in ASD and agreed to be included in the checklist.

Another alteration of the original form adapted for the AABC was related to the order of the items. Since some of individuals with ASD do not reveal any behavior of speech for communication, items related to speech behaviors were gathered in one group and applied only to those individuals who revealed speech behaviors. The aim of this organization is to take speech behaviors (such as echolalia) seen in ASD into account only for those individuals exhibiting speech behaviors. The final form of the checklist consisted of 50 items for all children and 7 items for children with speech; thus, the checklist included a total of 57 items. After its development, the instrument was used in a pilot study to determine its validity and reliability based on various criteria. The results of this pilot study revealed that the AABC was appropriate for the main study (Özdemir et al. 2013).

Sample and Data Collection Procedure

The study sample included children aged between 3 and 15 years and diagnosed with ASD. The sample was selected via purposive sampling, and various institutions providing education for children with special needs contacted. Especially those institutions that were previously called "autistic children education centers" but had been converted into general special-education centers with regulations enacted in 2012, were selected. Besides these centers, private special-education centers providing support education for children diagnosed ASD were also contacted. Each institution was informed about the study and then sent separate AABC forms for specialists/teachers and primary caregivers as well as implementation guidelines by post. Besides the children with ASD, another group including 164 children with intellectual disability was formed through special-education centers for validity analysis. Data collection was performed between January and June 2014, and the study sample constituted forms received from 21 cities in Turkey.

A total of 872 out of 1837 forms that were sent to specialists/teachers to complete for their students were returned, and 97 of the received forms were excluded from the study because they were either imprecisely completed or irrelevant to the target age group. In addition, to avoid repetition, five forms for the same children who were evaluated in different institutions (i.e., public and private support centers) were excluded from the analysis. Thus, a total of 775 forms were included in the study. Specialists from various branches of special education distributed according to Table 1 evaluated their students.

A total of 1895 forms were sent to primary caregivers, and 665 were answered and returned. 83 of these forms were excluded from the study because of various reasons, including incomplete information and unsuitability for the age group of the children. Finally, 582 were included in the study. Most of the forms (73.7%) were completed by the mothers of the children.

To achieve the maximum number in the dataset, the forms of specialists/teachers and primary caregivers were combined. As stated in the data analysis and findings sections of this study, score correlations between primary caregivers and specialists and total

Table 1 Branch distributions of specialists

Branch	Number of forms	Percentage
Special-education teacher	415	53.5
Preschool teacher	121	15.6
Psychologist- School counselor	213	27.5
Not stated	26	3.4
Total	775	100

scores were compared, and a high level of correlation was observed between the two groups. Based on this finding, forms that had been filled by specialists/teachers ($n = 387$) were added to the forms completed by primary caregivers ($n = 582$) so that a sample including 969 children was achieved. The sample indicated that males were affected by ASD at a much higher rate (80.9%) than girls (19.1%). The average age of the children was 9 years (standard deviation, 3.43 years). The age distribution of the children who participated in this study is given in Table 2.

Diagnoses of the participating children were identified as "autism" (autism, autistic disorder, and pervasive developmental disorder) or "atypical autism" (pervasive developmental disorder–not otherwise specified and atypical autism) according to their education and health reports. Diagnosis distributions based on these reports are shown in Table 3.

Data Analysis

Data were analyzed using SPSS 20, FACTOR 9.2, LISREL 9.1, and MedCalc 14.8 statistical software. The analyses conducted within the scope of the study aimed to identify various validity and reliability types. Statistical calculations were made at the

Table 2 Age distribution of participants

Age	Frequency	Percentage
3,00	74	7.6
4,00	55	5.7
5,00	57	5.9
6,00	65	6.7
7,00	76	7.8
8,00	85	8.8
9,00	90	9.3
10,00	121	12.5
11,00	89	9.2
12,00	77	7.9
13,00	76	7.8
14,00	58	6
15,00	46	4.7
Total	969	100

Table 3 Diagnosis distributions of sample

Diagnosis	Frequency	Percentage
Atypical Autism	103	89.4
Autism	866	10.6
Total	969	100

.05 significance level. For correlation analyses, a correlation coefficient between 0 and .35 was considered low, one between .36 and .67 was considered average, and one .68 and 1.0 was considered high (Taylor 1990). Parametric analyses were used for the data set demonstrating a normal distribution and met other criteria, while nonparametric analyses were used for data sets that did not show a normal distribution. The main analyses were conducted using items applicable to all children.

Findings

Evaluation of Data Sets

The skewness for the main data was −.03, and the kurtosis was −.76. Because these values are between −1 and + 1, the distribution of the data set appeared to be close to normal; however, because the p value was set to the <.01 level during Shapiro–Wilk analysis, the data set was not considered to be a normally distributed one.

Comparison of the Forms of Primary Caregivers and Specialists/Teachers

The total average scores for the first 50 items in the AABC were $\overline{x} = 21.27$ for the primary caregiver group and $\overline{x} = 21.83$ for the specialist/teacher group. The difference between these two groups was found to be statistically insignificant according to the Mann–Whitney U test (U = 72,821, Z = .79, $p = .43$). The relationship between total scores between groups was found to be high ($r = .67$) according to Spearman's correlation coefficient. Considering these findings, the two data sets were combined, and the combined data set was used for the rest of the analyses in the study.

Construct Validity Analyses

Kaiser–Meyer–Olkin statistics, which tests the appropriateness of the construct of the data set for factor analysis, was first applied, and a value of .93, which is well above the identified minimum level of .60 (Worthington and Whittaker 2006), was obtained. After factor analysis conducted with the first 50 items, 42 items belonging to two factors were determined to meet the required load values and overlapping conditions and kept in the scale. Eight items (i.e., Items 2, 8, 19, 20, 21, 23, 26, and 30) were dropped from the checklist because they could not meet the necessary conditions. To conduct exploratory factor analysis of the remaining 42 items, unweighted least-squares analysis with the direct oblimin rotation method (assuming that factors are interrelated) was used. The load values of two factors were found to explain 40.8% of the variance observed, and the correlation between the two factors was $r = .46$. Following identification of these two factors through exploratory factor analysis, confirmatory factor analysis was applied to confirm their structure. A goodness of fit index of 0.95, root mean square error of approximation of 0.055, comparative fit index of 0.98, and root mean square residual of 0.014 were obtained. These findings showed that the AABC was compatible with a two-factored construct, namely, "social limitations" and "problematic/repetitive behaviors."

Discriminant Validity Analyses

The score averages (first 42 items) of various groups from the AABC were calculated. The average score for the autism group was $\overline{x} = 21.29$, that for the atypical autism group was $\overline{x} = 13.34$, and that for the intellectual disability group was $\overline{x} = 7.82$. To determine whether the differences among these scores was significant, the scores of the autism ($n = 866$), atypical autism ($n = 103$), and intellectual disability ($n = 164$) groups were compared through Kruskall–Wallis H analysis, the results of which are shown in Table 4.

According to the results demonstrated in Table 4, differences among the groups were significant [$\chi^2(2) = 283.92$, $\eta^2 = .25$, $p < .01$].ROC analysis was conducted to determine the cut-off score with optimum sensitivity and specificity for distinguishing the ASD and intellectual disability groups. A score of 13 points was found to be the cut-off score. The following values were observed at a cut-off score of 13: sensitivity, 86.59; specificity, 81.71; area under the ROC curve, .90; and Youden Index (J), .68. These values imply that the checklist is able to distinguish ASD and intellectual disability with high levels of sensitivity and specificity.

Criterion-Referenced Validity Analyses

A group of 50 children who were diagnosed with ASD were evaluated by both the AABC and the GARS-2 TV, and correlations between their scores were analyzed. Since the groups were normally distributed, Pearson's coefficient was used in the analysis and a high level of correlation was seen between the two instruments ($r = .73$, $p < .01$).

Reliability Analyses

To calculate the internal consistency coefficient of the AABC, the Kuder–Richardson 21 (KR-21) technique was used. The KR-21 coefficient for the first 42 items was found to be

Table 4 Intergroup Kruskall–Wallis H analysis results

	Diagnosis	N	Mean Rank
Total Score	Autism	866	655.07
	Atypical Autism	103	386.92
	İntellectual disability	164	215.04
	Total	1333	

.89. In terms of sub-factors, KR-21 coefficients of .86 for the first sub-factor, "social limitations," and .81 for the second sub-factor, "problematic/repetitive behaviors," were obtained. The KR-21 coefficient for items related to speech (last 8 items) was found to be .68. The results of point-biserial correlation analysis revealed that all of the items showed significant correlations with the total score ($p < .05$). Test–retest reliability analysis was conducted with 50 forms filled in within a 2-week interval, and scores were analyzed through Pearson's coefficient. In this analysis, $r = .82$, ($p < .01$).

Comparison of AABC Scores in Terms of Other Variables

Mann–Whitney U tests were used to compare the scores of the sample group in terms of gender. No significant difference between the scores of girls ($\overline{x} = 20.39$) and boys ($\overline{x} = 20.62$) was observed (U = 71,513, Z = −.29, $p = .77$). No significant difference between subscales was also found. Although the average score of girls for the social limitations sub-factor ($\overline{x} = 13.12$) seemed to be slightly higher than that of boys ($\overline{x} = 13.32$), this difference was not statistically significant (U = 67,132, Z = −1.58, $p = .12$). No significant difference between the scores of girls ($\overline{x} = 8.07$) and boys ($\overline{x} = 7.5$) in terms of the problematic/repetitive behaviors sub-factor (U = 66,842, Z = −1.66, $p = .97$) was found.

Spearman' correlation coefficients were used to evaluate whether AABC scores changed in relation to the age groups. Findings revealed no significant relationship between the age groups and AABC scores ($r = .023$, $p = .47$). The AABC scores (first 42 items) of the children who participated in the study were also compared in terms of behaviors related to their ability or inability to speak. The results of Mann–Whitney U tests showed that children who were unable to speak ($\overline{x} = 23.53$) presented significantly higher scores than those who were able to speak ($\overline{x} = 15.43$) (U = 54,878, Z = −13.22, $r = .42$, $p < .01$). Finally, Mann–Whitney U tests were similarly used to compare the AABC scores of participants who were diagnosed with intellectual disability and those who were not. Children with ASD who were also diagnosed with intellectual disability showed significantly higher scores ($\overline{x} = 23.10$) than those who were not ($\overline{x} = 18.88$) (U = 62,955, Z = −6.33, $r = .21$, p < .01).

Determination of Cut-Off Scores

To determine the required support level, the cut-off scores of the AABC were obtained. This procedure was done by "Mean ± 2SD method"; identifying the portion of the normal distribution that was equivalent to two standard deviations below the average (Sharma and Jain 2014), and then determining the 33rd, 66th percentiles. So, the scores and required support equivalences compatible with the DSM 5 criteria were identified. Cut-off scores for children who were unable to speak ($n = 599$) are shown in Table 5, and cut-off scores for children who were able to speak are shown in Table 6.

Discussion

The most remarkable finding of this study is the factor structure of the AABC. Exploratory factor analysis helped identify a construct of two factors in the portion

Table 5 Cut-off scores obtained for children who were unable to speak

Score intervals	DSM 5 support need level
0–7	Very low probability of ASD
8–21	Require Mild Support
22–28	Require Moderate Support
29–42	Require Severe Support

of the checklist that did not include items related to speech. This structure corresponds to recent diagnostic criteria of ASD, and the two factors identified explained 40.8% of the variance observed in the checklist. This rate is higher than the rate found in similar studies (Köse et al. 2010; Sipes 2013) in the literature.

The first factor included social limitations and related situations in general. The 42nd item ("S/he is usually unaware of what happens around him/her"), which yielded the highest factor value, defines a situation frequently observed in ASD wherein the individual appears to live in his/her own inner world. In addition, situations related to *social communication* (e.g., Item 47: S/he does not show any reaction when called), incompetency in terms of clues related to *social interaction* (e.g., Item 13: S/he does not show any reaction to the facial expressions of others based on their feelings), and *limited interaction with peers* (e.g., Item 29: S/he does not make friends with other children) were categorized under this factor. Since the first study of Kanner in Kanner 1943, social limitations that has been stressed in individuals with ASD showed itself in the structure of items in this study as well. The items under this factor group comprised limitations in social interaction and communication. This result supports the grouping implemented in the DSM 5.

Items that were listed under the second factor included problematic behaviors and repetitive–limited behaviors. Although problematic behaviors are not among the diagnosis criteria of ASD, they are usually observed extensively in individuals affected by ASD. Murphy et al. (2009) identified the rate of problematic behaviors displayed by children with ASD as 82%. Aggression, stereotypes, self-destructive behaviors, and disruptive behaviors are usually mentioned among problematic behaviors (Matson and Rivet 2008). More than one of these behaviors is frequently observed in individuals with ASD (Emerson et al. 2001). The high factor values of coexisting problematic behaviors observed with in this study are compatible with findings in the literature.

Limited communication skills, limited social skills, and repetitive behaviors are considered important factors in problematic behaviors in ASD (Dominick et al. 2007). Turner (1999) stated that lower-level repetitive–limited behaviors may include harming and aggression by children demonstrating limited cognitive functions or at younger ages, and the grouping of problematic and repetitive–limited behaviors under

Table 6 Cut-off scores obtained for children who were able to speak

Score intervals	DSM 5 support need level
0–4	Very low probability of ASD
5–16	Require Mild Support
17–25	Require Moderate Support
26–49	Require Severe Support

the same factor appeared to be parallel to this evaluation. These items did not separate from each other during three- or four-factor analysis. The largest load value observed was related to the 17th item ("S/he displays temper tantrums"). This item was followed by other situations that were also related to problematic behaviors (e.g., Item 38: S/he sometimes harms; Item 24: S/he harms others by displaying behaviors such as biting, pushing, and kicking). The finding that these items are not observed together in situations related to social interaction but are found in repetitive–limited behaviors was considered to reveal a close relationship between the two behavior groups. Other problematic behaviors listed under the factor were observed to be frequently mentioned together with repetitive and routine behaviors in the literature (Esbensen et al. 2009) (e.g., Item 28: S/he harms her/himself; Item 10: S/he displays violent reactions against changes in routine or around her/him). These situations are usually evaluated in the framework of behaviors that appear as a result of receiving a sensory stimulus or anxiety caused by breaking out of a routines.

In terms of item load, situations related to repetitive–limited behaviors followed problematic behavior items (e.g., Item 31: S/he frequently whips, twists, or crushes objects). *Object obsessions* (e.g., Item 7: S/he insists on keeping some objects with her/him), *recurrent body movements* (e.g., Item 1: S/he spins around her/himself for a long time), and *insistence on routines* (e.g., Item 44: S/he insists on eating similar meals) are among these behaviors. The load values of these items were fairly low, which implies that limited and recurrent behaviors exist in a dispersed pattern in children with ASD.

Items with low load values and high overlap include behaviors related to *cognitive functions* (e.g., Item 2: S/he learns an easy task but forgets it quickly), *physical contact* (e.g., Item 19: S/he resists being touched or hugged), and *sensory differences* (e.g., Item 23: S/he usually walks on tiptoe). The occurrence of these and similar items in children with ASD is randomly and independent from other situations, which means these items may exert little effect in terms of ASD assessment. The moderate relationship observed between the factors ($r = .46$) can be accepted as an expected finding considering the general structure of ASD. Because both core qualities were seen together in ASD, a moderate level relationship was observed between two factors.

Findings on comparisons of AABC scores in terms of different variables usually coincided with literature results. The AABC scores of girls and boys did not reveal significant gender differences regarding gender, which indicates that girls and boys are affected by ASD at equal levels. Pilowsky et al. (1998) conducted a study using the ADI-R and CARS, and Holtmann et al. (2007) used the ADOS-G and ADI-R to assess this relation; both groups were unable to find any significant difference between genders. Posserud et al. (2008), however, found different results in their work. In a comprehensive screening study conducted using the Autism Spectrum Screening Questionnaire, boys showed higher average score than girls and were affected by ASD at a higher level than girls. According to Hartley and Sikora (2009), overall developmental profiles and strong/weak aspects are similar among boys and girls; however, communication skills were more limited for girls than boys, and boys showed more limited and recurrent behaviors than girls. Tonge and Einfeld (2003) found that girls who were diagnosed with ASD revealed more social limitations than boys. However, because no significant difference in terms of gender in sub-factors, the results of the present study did not support these previous findings.

The second variable evaluated in this study is the effect of age on AABC scores. The symptoms of children with ASD are often relieved after they receive qualified education; in fact, reversal of the initial diagnosis may even be achieved (Fein et al. 2013). Thus, the AABC scores of the children may be expected to decrease as their education and age increase. In the present study, no significant relationship between age groups and AABC scores was observed, which means the age variable does not influence the ASD level of the children. This finding may be explained by the state of special-education services in Turkey. Although the children grow older, the education they receive usually stays insufficient in terms of both quality and quantity. Thus, the symptoms of ASD may not be adequately relieved. Considering the lack of data regarding education and related variables (e.g., type, intensity, and standards of education received by the children), the researchers are unable to comment on the relationship between educational status and the AABC scores of the children.

AABC scores displayed differences in terms of the speech behaviors of the children. Children with speech are generally observed to present milder ASD symptoms than those with no speech (Charman et al. 2003). This situation is generally explained by the relationship between pre-speech behaviors and speech. Individuals with ASD demonstrate limitations in pre-speech social behaviors, including joint attention, imitation, and playing games, all of which show a strong relationship with communication skills in later years (Toth et al. 2006). Thurm et al. (2007) added early-period nonverbal intelligence to these speech-related skills. Children with these skills are affected less by ASD than those without and are usually able to speak in the following years. Children lacking these skills, namely, those affected more by ASD, are usually unable to speak. The findings of the present study also support this observation.

A significant relationship between intellectual disability and AABC scores was determined in the present study. Individuals who were diagnosed with intellectual disability also showed higher AABC scores, similar to findings in the literature. Ben-Itzchak and Zachor (2007), for example, performed a one-year educational program and found that initial findings on cognitive function level were directly related to developmental outcomes at the end of the program. In their literature review, Matson and Shoemaker (2009) stated that children with both ASD and intellectual disability showed fewer adaptive behaviors and displayed more problematic behaviors than those with ASD but without intellectual disability. These findings reveal that intellectual disability, in addition to ASD, affects the functions of children.

Comparison of discrimination scores among groups (autism, atypical autism, and intellectual disability) indicated significant differences in average scores, which means the checklist can successfully detect ASD during child assessment. Children with "atypical autism" are affected by ASD to a lesser extent than those with typical autism and could be thus expected to receive significantly lower scores than participants in the "autism" group. The average score of the intellectual disability group was lower than those of the other groups, which was also expected.

Cut-off scores determined by ROC analysis revealed satisfactory sensitivity and specificity. When the cut-off score was 13, ideal sensitivity and specificity scores were achieved. ROC analysis showed that AABC was successful at distinguishing between ASD and intellectual disability. An important point in terms of evaluating the ROC findings is related to the characteristics of participants. Some of the intellectual disability-group data collected for this study were taken from special-education centers.

Turkish children with moderate to severe intellectual disability are often educated in these institutions but may also show symptoms of ASD, especially in social interaction and social communication (e.g., difficulty in completing the tasks, limited communication with peers). On the one hand, as some common conditions are observed in both groups, the scores of some children from the intellectual disability group were relatively high. On the other hand, individuals who were affected by intellectual disability at moderate or severe levels or demonstrated remarkable syndromes or apparent skeletal-nerve system deformations were diagnosed at earlier periods than those without. Thus, individuals with moderate or severe intellectual disability are unlikely to be diagnosed with ASD. In particular, children with mild intellectual disability received lower scores from the checklist than those with high intellectual disability. Considering these findings, AABC appears to be successful in terms of distinguishing individuals with ASD from those without it.

The correlation ($r = .73$) between the AABC and the GARS-2 TV indicated a significant relationship between checklists. Findings revealed that individuals highly affected by ASD generally obtained higher scores whereas individuals affected by ASD at lower levels obtained lower scores from both checklists. As the two checklist implemented the same measurements to evaluate ASD, they may be considered to include similar measurement approaches. A number of studies determining the correlations of different instruments (e.g., Stone et al. 2000; LeCounteur et al. 2007; Oosterling et al. 2010; Schanding Jr et al. 2012) are available in the literature. These studies are important in terms of demonstrating the structure validity of the instruments. The analyses performed in the scope of the present study presents significant contributions to validity studies of ASD assessment instruments in Turkey.

Internal consistency and item analyses revealed satisfactory results. High scores in various internal consistency items (KR-21 analysis), except speech, were obtained. Since an internal consistency of .70 or higher is considered acceptable in the literature (Büyüköztürk 2011), the internal consistency of AABC was deemed acceptable. Point-biserial correlation analysis revealed that all of the items in the checklist presented a significant relationship with the total score. This finding significantly contributed to internal consistency evaluations of the instrument.

Finally, test–retest analysis was performed. The correlation coefficient obtained ($r = .82$) indicated a high level of test–retest reliability. Other studies in the literature revealed findings at various levels. The correlation coefficients of test–retest analyses performed by Ehlers et al. (1999); Bryson et al. (2008); Krug et al. (2008); Köse et al. (2010); Diken et al. (2012), for example, were $r = .90$, $r = .61$, $r = .76–.99$, $r = .72$, and $r = .99$, respectively. Thus, the correlation coefficient found in this study is comparable with those obtained in previous works.

The skewness and kurtosis values of the dataset in this study ranged from −1 to +1, indicating a normal distribution. However, because the p value was set to the.01 level during Shapiro–Wilk analysis, the distribution of the dataset could not be considered normal. Thus, the raw scores were not transformed into standard scores or distributed in accordance with the deviances. On the other hand, considering the number of participants ($n = 969$) and the results of validity–reliability analyses, the scores taken from the checklist appear to closely reflect the conditions of individuals with ASD. Thus, to interpret the scores, separate cut-off scores for individuals who were able to speak and those who were unable to speak were identified.

In conclusion, the AABC appears to be a suitable tool for diagnosing ASD in Turkish children with good validity and reliability. Considering the scarcity of resources on the assessment of children with ASD, the current study presents significant contributions to ASD studies in Turkey. The development and adaptation of more instruments is necessary to promote evidence-based practices on autism in Turkey. Future studies should investigate usefulness of AABC in clinical and educational settings. Also predictive validity of the checklist can be examined in a longitudinal study.

Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest Author A declares that he has no conflict of interest. Author B declares that he has no conflict of interest.

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