

Review

Autism screening tests: A narrative review

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Abstract

As screening tests are tools to quantify communication-interactive abilities of speech and language; therefore, to evaluate, screen, diagnose and treat various aspects of one's abilities, they are necessary. The purpose of this study is to review the existing autism screening tools, their subtests, administration, scoring, and application in clinical and research contexts in children and adults. This study was a review of autism screening tools; hence, an electronic search through databases such as PubMed, Scopus, Medline, SID, and Magiran was performed from 2000 to 2021. The tests were examined in terms of year of publication, duration, age range, assessment method, subtests, and psychometric properties and furthermore, they were reviewed in details. In this study, 19 autism screening tests were evaluated and The Autism Spectrum Quotient was found to have the shortest administration time while The Gilliam Autism Rating Scale had the longest, and the only test that varied in duration was the Autism Screening Instrument for educational planning. Autism screening is a complex issue. Reviewing these articles reveals that some tests have been used more in recent years due to their specialized subtests or easy and fast administration. Prompt testing is extremely crucial especially in emergency situations like the current COVID-19 pandemic the world is struggling with today. A review of speech tone tests shows that the CARS-2 is one of the most widely validated autism assessments.

Introduction

Autism spectrum disorder is a neurodevelopmental disorder associated with communication deficits, repetitive patterns, behaviors, and activities.¹ Autism is a lifelong disorder that usually manifests in the first years of life and is sometimes associated with some degree of intellectual disability, characterized by problems in social interactions, communication, stereotyped behaviors, and limited interests.^{2,3} The prevalence of autism has increased dramatically in recent years, reaching about 1 in 54 children born in the United States.⁴ Due to the problems that this disorder causes to children, parents, and society, evaluation and treatment are essential.⁵ Autism screening is a complex procedure that

requires a piece of standard information and validated tools to help professionals in this process.⁵ Early autism screening plays a crucial role in treating and modifying the disorder.⁶ Although autism can get diagnosed before the age of three, many children do not officially get diagnosed until they are five or older.⁷ This delay in diagnosis has a devastating impact on society's health and therefore doubles the importance of screening children.⁸ Studies show that symptoms of autism manifest in the first two years of life.⁹ Therefore, if there is a suitable screening tool with a simple procedure that specialists can administer in a short time, these children could get diagnosed at an early age and thus have the opportunity for positive interventions.¹⁰ Tests with short administration time are specially needed now since with the outbreak of the COVID-19, it may not be safe to visit speech therapy clinics several times and for long durations. Therefore, this study aims to review the characteristics of pediatric screening tests. So far, autism screening tests, especially in Iran, have not been studied and categorized. Knowing these tests evaluates awareness and is useful in clinical and research areas in children. Therefore, we conducted the present study to investigate autism screening tests in detail, comparing them with each other and making them easier to access to help therapists select the appropriate test.

Design and methods

This study is a review of autism screening tests. For this purpose, we performed an electronic search in the databases of Web of Science, PubMed, Scopus, Medline, Google Scholar, and Ovid from 2000 to 2021. This study aims to collect data about the titles, authors, years of publication, age range, duration, subtests, administration, and scoring of the existing tests. We performed the searching process in two general steps. First, to obtain a comprehensive list of screening tests using the keyword "autism" along with at least one of the terms "screening", "examination" and "tools", searching was conducted in the databases. If these words were used in the title, abstract, or keywords of the article, we would include them in the study. To check whether the tests had been translated and validated in Iran and Persian, we also searched the keywords "tool", "test", "screening", and "autism" in SID and Magiran. Thus, we extracted a list of autism screening tests, and

Significance for public health

Autism spectrum disorder is a neurodevelopmental disorder associated with communication deficits, repetitive patterns, behaviors, and activities. Autism screening is a complex procedure that requires a piece of standard information and validated tools to help professionals in this process. Early autism screening plays a crucial role in treating the disorder and enhancing the quality of life and increasing the health level. Studies show that symptoms of autism manifest in the first two years of life. Therefore, if there is a suitable screening tool with a simple procedure that specialists can administer in a short time, these children could get diagnosed at an early age and thus have the opportunity for positive interventions. Tests with short administration time are specially needed now since with the outbreak of the COVID-19. Therefore, we conducted to investigate autism screening tests to access to help therapists select the appropriate test.

19 tests that met the inclusion criteria were selected. Inclusion criteria were having access to the full text of the article and published studies in English or Persian. Papers presented at the conferences were not included. In the second step, which aimed to search for more detailed information, the name of the test with at least one of the words “validity”, “reliability”, “accuracy” was searched again in the above databases and articles containing these words in title, abstract or keywords were included in our research.

Results

After searching various databases, 19 autism screening tests were chosen, and their details were extracted. These tests are for different age ranges; however, most of them are designed for children and only a small number for adults. While reviewing these screening tests in terms of administration, 1 confrontation game, 8 checklists, and 10 questionnaires were recorded. The minimum operation time belongs to the Autism Spectrum Quotient - 10 (5 minutes), the maximum duration belonged to the Gilliam Autism Rating Scale-2nd Edition (29 minutes), and the only test that varied in duration was the Autism Screening Instrument for Educational Planning. Information about the general characteristics of these tests and their psychometric properties is given below.

Screening Tool for Autism in Toddlers and Young Children (STAT)

This test was designed in 2000 for 36 to 34-month-olds as a confrontation game based on the scores obtained in 4 areas, including play, movement imitation, request, and direct attention. STAT takes 20 minutes to administer.¹¹ This test has 95% content validity and internal reliability, its sensitivity is 92%, and its specificity is 85%.¹²

Asperger Syndrome Diagnostic Scale (ASDS)

This test was made in 2001 for 5-18-year-olds as a yes / no checklist based on obtained scores in 5 areas, including cognition, incompatibility, language, social communication, and sensorimotor skills. ASDS lasts for 10-15 minutes.¹³ This test has 93% validity and 85% internal reliability.¹⁴

Autism Spectrum Quotient (AQ)

This test was designed in 2001 for 4-year-olds and older and in the form of a questionnaire based on the obtained scores in 5 areas, including social skills, attention shifting, attention to details, communication, and illustration, and it lasts 20 minutes.¹⁵ This test has internal validity and reliability. Its sensitivity is 93%, and its specificity is 52%.¹⁶

Modified Checklist for Autism in Toddlers (M-CHAT)

This test was made in 2001 for 16-48-month-olds as a yes / no checklist based on scores obtained in 4 areas, including role play, pointing, pointing follow-up, gesture imitation, and it lasts 5-10 minutes.¹⁷ This test has differentiating validity, concurrent validity, and reliability. Its sensitivity is 97-95%, and its specificity is 99%.^{18,19}

Developmental Behavior Checklist: Autism Screening Algorithm (DBC-ASA)

This test was designed in 2002 for 4-18-year-olds as a parental

report developmental checklist and lasts 5-10 minutes.²⁰ This test has 53% validity, 99-97% reliability, its sensitivity is 94%, and its specificity is 0.46%.²¹

Childhood Autism Screening Test (CAST)

This test was made in 2002 for 4-11-year-olds as a yes/no checklist, and it lasts 5-10 minutes.²² The sensitivity of this test is 100%, its specificity is 97%. Information about its validity and reliability has not been reported.¹⁷

Gilliam Asperger Disorder Scale (GADS)

This test was designed in 2003 for 3 to 22-year-olds as a questionnaire based on the scores obtained in 4 areas of social interaction, limited behavioral patterns, cognitive patterns, and pragmatic skills.²³ GADS lasts 10-15 minutes.²³ This test has a validity of 82%, and sensitivity and specificity have not been reported.¹⁷

Krug Asperger's Disorder Index (KADI)

This test was made in 2003 for 6 to 22-year-olds as a questionnaire, and it lasts 15-20 minutes.²⁴ KADI has 90% validity, 90% reliability, 78% sensitivity, and 91% specificity.¹⁷

The Pervasive Developmental Disorders Screening Test-II (PDDST-II)

This test was designed in 2004 for 12 to 48-month-olds as a questionnaire that lasts 10-20 minutes.²⁵ It has validity and reliability, and its sensitivity and specificity are 92 and 91% for stage one, 73% and 49% for stage two, and 58% and 60% for stage three, respectively.²⁶

Developmental Behavior Checklist – Early Screen (DBC-ES)

This test was made in 2005 for 18 to 48-month-olds as a questionnaire, and it lasts 10 minutes.²⁷ It has an internal validity of 8%, reliability of 55-88%, sensitivity of 79%, and specificity of 69%.²¹

Social Responsiveness Scale (SRS)

This test was designed in 2005 for 3 to 18-month-olds as a questionnaire based on obtained scores in 4 areas of social awareness, social cognition, social motivation, autistic behaviors and lasts 10-25 minutes.²⁸ It has a structural, concurrent validity and inter-subject reliability of 97-91%, sensitivity of 67%, and specificity of 78%.²¹⁻²⁹

Early Screening of Autistic Traits (ESAT)

This test was conducted in 2006 for ages of 14-15 months as a checklist based on obtained scores in 8 areas of pretend play, joint attention, interest in others, eye contact, verbal and non-verbal communication, stereotyped response to sensory stimuli, emotional response and social interaction. ESAT lasts 10-15 minutes if administered by parents and 20-30 minutes if done by the babysitter.³⁰ This test has validity and reliability. Its sensitivity is 88%, and its specificity is 14%.²¹

Gilliam Asperger's Disorder Scale: Second Edition (GADS-2)

This test was conducted in 2006 for 3-22-year-olds as a questionnaire and based on the scores obtained in 4 areas of social interaction, patterns, limited behavioral patterns, cognitive patterns, and pragmatic skills. GADS-2 lasts 15-29 minutes.³¹ This test has validity and reliability, but its sensitivity and specificity have not been reported.³²

Autism Behavior Checklist (ABC)

This test was designed in 2008 for 3-14-year-olds and as a checklist organized in five domains: Sensory, Relating, Body Concept, Language, and Social & Self-Help, and it lasts 10-15 minutes.³³ This test has a structural validity of 88%, reliability of 86%, a sensitivity of 77%, and a specificity of 91%.^{34,35}

Autism Screening Instrument for Educational Planning – Third Edition (ASIEP-3)

This test was conducted in 2008 for 2-3-years-olds and as a checklist organized in 5 areas of behavior, communication, speech, education, and learning rate, and its duration varies.³⁶ This test has 81% content validity, 81% test-retest reliability, 100% sensitivity and 81% specificity.^{37,38}

Childhood Autism Rating Scale: Second Edition (CARS-2)

This test was designed in 2010 in two different age ranges of 0-6 years old and over 6 years old, as a questionnaire with a duration of 15 minutes.³⁹ This test has 75% content validity, 76% reliability, its sensitivity is 81%, and its specificity is 87%.^{40,41}

Quantitative Checklist for Autism in Toddlers (Q-CHAT)

This test was conducted in 2012 in two parts for 16-30-month-olds as a checklist organized in 5 areas of joint attention, pointing, pretend play, language development, repetitive behaviors, and other aspects of social communication, and it lasts 5-10 minutes.⁴² Q-CHAT has internal stability above 85%, its sensitivity is 88%, and its specificity is 91%.⁴³

Autism Spectrum Quotient - 10 items (AQ-10)

In 2012, this test was designed in two parts for 18-24-month-olds as a questionnaire that lasts 5 minutes.⁴⁴ It has a sensitivity of 77%, specificity of 74%, and its validity and reliability have not been reported.²¹

Screening tool for Iranian Preschoolers with Autism: Hiva (HIVA)

This test was administered in 2015 in two parts for 3-11-year-olds as a questionnaire organized in 3 areas of social interaction, stereotyped behaviors, and communication, and its duration is variable.⁴⁵ It has a sensitivity of 100%, specificity of 96.9%, and its validity and reliability have not been reported.⁴⁶

Discussion

This study aimed to collect and compare autism screening tests so that therapists can easily access their desired tools. In addition to aiding with data collection, categorizing, and feature expressions of autism screening tests, this study also provides a comprehensive view of the tests including the used tasks, target community, screened areas, administration, validity, and reliability. Therefore, it is a good source for getting acquainted with the most widely used tools. Among these tests, 63.1% are completed as a questionnaire by parents. One possible reason for this is that parents know more about their children's emotions and feelings. Autism diagnosis is crucial to reduce the negative effects of the disorder and to improve language, and social function at an early age. Hence, most screening tests are designed for young age ranges. PDDST, CARS, and ESAT are designed for young children, while AQ and KADI are designed for children over 4 years. No information was found about the ESAT. The STAT test is an interactive scale designed to screen autism, and it has 12 items.¹¹ Psychologists, pediatricians, speech-language pathologists, preschool teachers, and early intervention specialists use this test. This tool examines important social and communicational behaviors such as imitation, play, requesting, and directing attention.¹¹ Utilizing the STAT, specialists can identify younger children at risk for autism and refer them for further evaluation.¹¹⁻¹³ Administering this test is fun for both the child and the test taker.¹¹⁻¹⁵ Asperger's Syndrome is difficult to diagnose because its characteristics are often similar to those of autism, behavioral disorders, attention deficit hyperactivity disorder, and learning disabilities.¹⁵ ASDS, GADS, and KADI are designed specifically to screen Asperger's Syndrome. ASDS is an easy-to-use, quick rating scale that helps screen children and adolescents with Asperger's Syndrome and is very similar to the GADS scale.¹⁵ Anyone who knows the child well can complete this scale. GADS is a standard tool that effectively differentiates people with Asperger's Syndrome from people with autism or other problems.²³ This scale has 32 items and describes specific, and measurable behaviors. In addition to screening, GADS can be used to control the effectiveness of the intervention.²³ KADI also differentiates people with Asperger's from those with high-functioning autism and helps determine their educational needs and can be scored by parents, caregivers, or therapists.²⁴ Over the past decade, AQ has been the most common autism screening tool.¹⁵ AQ is a self-administered questionnaire used to measure the severity of autism in adults with average IQ. It has been modified in the Netherlands and Japan.¹⁵ AQ is a 50-item test, while AQ-10 has a ten-item version and is designed because of the need for simple tools to determine the severity of autism.⁴⁴ M-CHAT is a two-step parent-centered screening tool that identifies the risk of autism spectrum disorder. The score of this test should be considered general as evidence shows that its subsets alone cannot illustrate sufficient psychometric properties.¹⁷ DBC is a set of tools for assessing the behavioral-emotional problems of children, adolescents, and adults with developmental problems, and it can be administered by parents, general practitioners, and therapists.²⁰ It has been translated into multiple languages including Arabic, Bulgarian, Cambodia, Chinese, Croatian, Dutch, Finnish, French, German, Greek, Hindi, Italian, Japanese, Malay, Norwegian, Portuguese, and Spanish.²⁰ CAST, formerly known as the Childhood Asperger Syndrome Test, is designed to identify children that might be on the autism spectrum.²⁰⁻²² PDDST-II is designed for early screening of autism. It is simple to administer and can be performed by the parents or the child's primary caregiver.²⁵ DBC-ES is a set of screening tools for behavioral and emotional problems in children, adolescents, and adults with disabilities. It is completed by parents, other primary caregivers or teachers and shows reported problems over a six-

month period. Each behavioral explanation is recorded with a score of 0, 1, 2, with 0 being incorrect, 1 being somewhat or sometimes correct, and 2 being completely correct or often correct.²⁷ SRS is a diagnostic screening tool. It depicts a social defect associated with autism and indicates the severity of the disorder. This test is extremely sensitive that detects even the tiniest symptoms, and is specific enough to differentiate clinical groups in autism and other disorders.²⁸ While some autism tests require trained professionals to score behaviors observed in clinical settings, SRS requires teachers, parents, and others to evaluate the symptoms they have noticed over time. SRS often reveals aspects of social functioning that might not be recognized in a clinical setting using a “yes/no” scoring system. This feature is highly important because even mild social disorders can harm children and adults.²⁸ This test simplifies the differential diagnosis and clearly distinguishes the nature of autism from that in ADHD, anxiety disorder, and other diseases.³⁰ GARS-2 is a screening tool for autism spectrum disorders designed to differentiate between people with autism and people with severe behavioral disorders.³¹ Parents and professionals can administer this test at home and school. The administrator must be someone who knows the person well and has been in close contact with him/her for at least two weeks; that is why parents are often the best fit for scoring.³¹ The ABC Screening Checklist examines maladaptive behaviors and reflects an individual’s challenges to respond appropriately in everyday life.³³ Parents and the school’s teaching team can complete this checklist. The tool includes a list of abnormal behaviors in autism pathology and is designed to screen children who are likely to have autism, to differentiate and refer them for educational intervention. Due to its ease of use and low cost, it is widely used by health professionals in various countries in research and clinical contexts. Although this scale has little psychometric force; it is useful in screening children who are suspected to have autism.³³ Children with overall scores equal to or greater than 68 points are classified as autistic, scores between 54 and 67 indicate a moderate probability of autism, and scores below 47 indicate that the child is not autistic.³³ The ASIEP-3 screening tool was developed to facilitate the diagnosis of autism and to monitor the academic progress of people with autism. The Autism Behavior Checklist (ABC) is the most widely used subset of ASIEP.³⁶ The CARS-2 test covers the entire spectrum of autism, including Asperger’s Syndrome, and has become one of the most widely validated empirical assessments since it was first released. It is especially effective in differentiating between children with autism and children with severe cognitive impairments and also in differentiating between various severities of autism.³⁹ In addition to maintaining simplicity, brief administration, and articulation, CARS-2 has forms and features that help therapists integrate diagnostic information, determine functional capabilities, provide parental feedback, and design targeted intervention.³⁹ Q-CHAT is a tool for detecting autism. Unlike CHAT, the Q-CHAT covers language development, social communication, and repetitive behaviors. Overall, this study showed that Q-CHAT is useful in the early diagnosis of autism and is available in English, Chinese, French, Dutch, Spanish (Chile), Spanish (Argentina), Israeli, Indonesian, Magyar, Polski, Romanian, Serbian Translated into Slovenian.⁴² Hiva is a screening tool made in Iran that includes questions from the ten most common symptoms in autism that can promptly be administered by parents and pediatricians. These items are taken from the GARS-2 scale. Three of its ten cases (cases 1, 5, 9) are also available in M-CHAT.⁴⁵ This scale is available in Kurdish and Persian. In general, the Hiva scale is more effective than M-CHAT in terms of sensitivity, specificity, and positive predictive value. Hiva is more suitable for older school children; while, M-CHAT is designed to use in younger children. Hiva contains ten items according to the AQ-10 scale and is specifically designed for use in Iran and, it may have specific limitations in other countries.⁴⁵ The findings indicate that none of the autism screening tools performs better than the other; each test

examines skills in children and adults based on treatment goals, and each addresses some aspects of the disorder. It is best to use various tests that complete one another to assess all aspects of autism, as each autism diagnostic tool is designed for different purposes.⁴⁷⁻⁴⁸

Conclusions

A review of several tests showed that among the various autism screening tools, AQ was the most common test;¹⁵ however, after the publication of the CARS-2 in 2010, it became one of the most common, valid, and differential assessments of autism.³⁹ DBC has been translated into many languages including Arabic, Bulgarian, Cambodia, Chinese, Croatian, Dutch, Finnish, French, German, Greek, Hindi, Italian, Japanese, Malay, Norwegian, Portuguese, and Spanish.²⁰ SRS is highly sensitive and detects subtle symptoms.²⁸ ABC is easy to use, inexpensive, and widely used in many countries in research and clinical practice.³³ The Hiva test was designed in Iran and is used in Persian and Kurdish.⁴⁵

Limitations

In this study, only the articles published in both English and Persian were reviewed, and studies in other languages were not included. On the other hand, not all existing tests have been reviewed in all languages and cultures, and therefore their advantages and limitations cannot be generalized.

Recommendation

To this date, studies on autism screening tests and their comparison with each other have been limited. Also, due to the diversity of abilities, and disabilities in patients, it is recommended to conduct more extensive studies to treat patients with autism in different languages. This way, speech therapists can use clinical trials with more confidence, and they can also design new effective treatments.

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