



## Review article

# A systematic review of screening tools in non-young children and adults for autism spectrum disorder



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## ABSTRACT

**Background:** Existing reviews of screening tools for Autism Spectrum Disorder (ASD) focus on young children, and not all screening tools have been examined against validated diagnostic procedures.

**Aims:** To examine the validity of screening tools for ASD in non-young children and adults to provide clinical recommendations about the use of these tools in a variety of clinical settings.

**Methods and Procedures:** Electronic databases, including MEDLINE, EMBASE, PsychINFO, Cochrane Library and CINAHL, were searched through March 2017. Studies examining the validity of ASD screening tools against the Autism Diagnostic Observation Schedule and/or the Autism Diagnostic Interview - Revised in non-young children (age 4 or above) and adults were included. Three authors independently reviewed each article for data extraction and quality assessment.

**Outcomes and Results:** 14 studies met the inclusion criteria, of which 11 studies were with children (4–18 years of age) and 3 studies included adults only (19 years of age and above). Included studies were conducted in a general population/low-risk sample (N = 3) and a clinically referred/high-risk sample (N = 11). In total 11 tools were included.

**Conclusions and Implications:** Only three screening tools (the Autism-Spectrum Quotient, the Social Communication Questionnaire, and the Social Responsiveness Scale) were examined in more than 2 studies. These tools may assist in differentiating ASD from other neurodevelopmental and psychiatric disorders or typically developed children. In young adult populations, the paucity of the existing research in this group limits definitive conclusion and recommendations.

## What this paper adds?

This systematic review of existing screening tools in non-young children and adults with Autism Spectrum Disorder (ASD) will provide broad knowledge of psychometric properties of each screening tool. Additionally, in this review, screening tools were

**Abbreviations:** ASD, autism spectrum disorder; ADOS, the autism diagnostic observation schedule; ADI-R-, the autism diagnostic interview, revised; Se, sensitivity; Sp, specificity; PPV, positive predictive value; NPV, negative predictive value; FP, false positive; FN, false negative

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selected through rigorous inclusion criteria – studies were only included when screening tools were examined against validated diagnostic tools, such as ADOS and ADI-R. Furthermore, targeted populations were carefully examined in this review, producing three different groups, which included 1) general population/low-risk sample and 2) clinically referred/high-risk sample. These are strengths of this review, and thus this paper can provide a more comprehensive picture of and actionable information about ASD screening tools in a variety of clinical settings.

## 1. Introduction

Despite increased interest in early detection and intervention, diagnosis of Autism Spectrum Disorder (ASD) frequently occurs at a later age, with one study reporting a mean age of diagnosis of 5 years in a sample of 108 children with ASD (Wiggins, Baio, & Rice, 2006) and other studies revealing that high-functioning populations can be diagnosed with ASD even later (Howlin & Asgharian, 1999; McConachie, Le Couteur, & Honey, 2005). These results imply many children miss the opportunity for early interventions and also suggest that there are a number of preschoolers and school-age children who need to be screened for possible referral to specialists to establish a diagnosis of ASD and to receive appropriate services and treatments. Compared with ASD screening tools targeting young children (generally age 3 or below), however, there are fewer studies investigating the clinical utility of ASD screening tools in school-age children and adolescents. Additionally, no extant review of screening tools is available in these populations.

Likewise, there has been a scarcity of research on ASD screening tools in adult populations. Some studies have shown that ASD can be diagnosed in adult psychiatric outpatients who had no prior clinical ASD diagnosis (Chang et al., 2003; Nylander & Gillberg, 2001). Furthermore, a study using a community sample in England detected ASD in 9.8 per 1000 adults (Brugha et al., 2011). This study could induce an assumption that these cases were likely overlooked in the past. Taken together, it is inevitable that general practitioners and general psychiatrists will need to learn how to identify and screen these populations in daily clinical practice.

Therefore, we conducted a systematic review of existing ASD screening tools in children above age 4, adolescents, and adults. To provide practically useful information on valid screening tools, we restricted our review to studies examining ASD screening tools in comparison to the Autism Diagnostic Observation Schedule (ADOS; Lord, 2002) and the Autism Diagnostic Interview, Revised (ADI-R; C. Lord, Rutter, & Le Couteur, 1994) as they are currently considered the “gold” or “near-gold” standard diagnostic procedures for ASD (Falkmer, Anderson, Falkmer, & Horlin, 2013). Our review includes studies of both general population/low-risk samples and clinically-referred/high-risk samples to provide information about the use of these tools in a variety of settings from pediatricians and general practitioners to psychiatrists’ office visits.

Our comparison of ASD screening tools to the ADOS or the ADI-R specifically examined reporting of information about sensitivity, specificity, positive predictive value, and negative predictive value (Gordis, 2009). Sensitivity (Se) reflects the proportion of individuals with ASD who have a positive screen result. Specificity (Sp) reflects the proportion of individuals without ASD who have a negative screen result. Positive predictive value (PPV) is the proportion of individuals with a positive screen result who receive an ASD diagnosis. Negative predictive value (NPV) is the proportion of individuals with a negative screen result who do not receive an ASD diagnosis.

After implementing the literature review methods described below, studies reporting Se, Sp, PPV, and/or NPV for eleven screening tools were included in our review. For context, we provide a brief description of each:

- 1) The Autism Behavior Checklist (ABC) includes 57 questions about a child’s behavior, consisting of five subscales: Sensory, Relating, Body and Object Use, Language, and Social and Self-Help skills (Krug, Arick, & Almond, 1980).
- 2) The Autism-Spectrum Quotient (AQ) is a 50-item self-rating questionnaire, covering different domains associated with ASD: social skills; communication skills; imagination; attention to detail; and attention switching/tolerance of change (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). An individual with a score of 32 or higher is considered clinically significant levels of autistic traits.
- 3) The Autism Spectrum Screening Questionnaire (ASSQ) is a measure comprised of 4 factors, including social interaction, communication problems, restricted and repetitive behavior, and motor clumsiness and other associated symptoms (Ehlers, Gillberg, & Wing, 1999). Cut-off scores of 19 for parents’ rating and 22 for teachers’ rating are recommended for identifying possible ASD cases.
- 4) The Autism Symptom Interview (ASI), School-Age is a brief phone interview that derived from the ADI-R questions, which can be completed in less than 15–20 min. It is designed to be administered by examiners with minimal training (Bishop et al., 2017). Unlike the ADI-R, the ASI does not produce domain scores.
- 5) The Childhood Asperger Syndrome Test (CAST) is a 37-item parental questionnaire, developed for children with cognitive ability within normal range (Scott, Baron-Cohen, Bolton, & Brayne, 2002). Recommended cut-off score is 15 and higher.
- 6) The Children’s Communication Checklist (CCC) is a 70-item rating scale, assessing language structure, autistic behavior and pragmatic communication (Bishop, 1998).
- 7) The Pervasive Developmental Disorder in Mentally Retarded Persons (PDD-MRS) has been studied in people with intellectual disability; it is a 12-item questionnaire regarding communication, social and stereotyped behavior (Kraijer & de Bildt, 2005).
- 8) The Ritvo Autism Asperger Diagnostic Scale-Revised (RAADS-R) is a modified version of the Ritvo Autism Asperger’s Diagnostic Scale (Ritvo et al., 2008), designed as a screening tool for adult ASD. It is a self-report instrument with 80 items, assessing language, social relatedness, sensory-motor, and circumscribed interest. Recommended cut-off score is 65 or above.
- 9) The Social and Communication Disorders Checklist (SCDC) is a 12-item parent rating questionnaire, measuring reciprocal social

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