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Screening Adults for Asperger Syndrome Using the AQ: A Preliminary Study of its Diagnostic Validity in Clinical Practice

M. R. Woodbury-Smith,[2,3] J. Robinson,[1] S. Wheelwright,[2] and S. Baron-Cohen[2]

The Autism Spectrum Quotient (AQ) has been developed to measure the degree to which an adult with normal intelligence has autistic traits. In this paper it is evaluated for its potential as a screening questionnaire in clinical practice on one hundred consecutive referrals to a diagnostic clinic for adults suspected of having Asperger Syndrome or high functioning autism (AS/HFA). The results indicate that it has good discriminative validity and good screening properties at a threshold score of 26. The implications of these results are discussed.

KEY WORDS: Asperger Syndrome; Autism Quotient; high-functioning autism; screening; diagnosis; validity.

Asperger Syndrome (AS) is now widely believed to lie on the autistic spectrum of conditions (Leekham, Libby, Wing, Gould, & Gillberg, 2000; Mayes, Calhoun, & Crites, 2001; Ozonoff, South, & Miller, 2000; Wing, 1997), differing from 'classical autism' in terms of normal language development and intellectual ability, and in terms of higher prevalence, with one epidemiological study estimating a population prevalence of 0.7% (Ehlers and Gillberg, 1993). In the absence of normal early language development, high functioning autism (HFA) is a possible diagnosis. The exact relationship between AS and HFA is unclear, and, in view of the similarities in clinical presentation between AS and HFA, Asperger Syndrome will be used in the remainder of this paper to loosely apply to both.

[1] Cambridge Lifespan Asperger Syndrome Service and Autism Research Centre, Cambridge, UK.
[2] Departments of Psychiatry and Experimental Psychology, University of Cambridge, Cambridge, UK.
[3] Correspondence should be addressed to: Dr Marc Woodbury-Smith Child Study Center Yale University School of Medicine 230 South Frontage Road PO Box 207900 New Haven, CT 06520 USA Email: marc.woodbury-smith@yale.edu

The diagnosis of AS is often a difficult task, such that it is often delayed until late childhood or even early adulthood (Barnard, Harvey, Prior, & Potter, 2001; Howlin and Moore, 1997; Powell, 2002). Although several different diagnostic instruments for autistic spectrum conditions, including Asperger Syndrome, have now been developed, the most widely used probably being the Autism Diagnostic Interview—Revised (Lord, Rutter, & Le Couteur, 1994), the development of screening questionnaires is important. This is primarily because all diagnostic interviews involve a lengthy assessment, in the region of 3 hours. It is therefore advantageous that only those who are highly likely to have an AS go through this diagnostic process. To this end, the Asperger Syndrome Screening Questionnaire (ASSQ, Ehlers, Gillberg, & Wing, 1999) was developed for possible cases of Asperger Syndrome. Unfortunately this screening questionnaire is designed for use with school-age children.

There are reasons to believe that the development of a screening questionnaire specifically for use by *adults* with suspected AS is also important. First, AS was not recognised as a clinical entity until

relatively recently, with its inclusion only in the most recent editions of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, American Psychiatric Association, 1994) and International Classification of Diseases (ICD-10, World Health Organisation, 1992). As a result, many adults will have 'missed' diagnosis during their childhood. Second, AS is often harder to diagnose than classical autism, with much more subtle impairments in the core clinical phenotypic domains, making it difficult for clinicians to ascertain who should be referred for further assessment. Third, AS is relatively more common that classical autism, and therefore represents a disproportionate number of referrals. And finally, adults with possible AS are quite likely to present to primary care physicians who will need to be able to recognise and refer those who may have the syndrome.

Two adult based screening assessments are available. One is the Australian Scale for Asperger Syndrome (ASAS, Garnett and Attwood, 1995), a clinician rated questionnaire, which can be used for adult assessments. Its major drawback is its lack of clear scoring criteria making it potentially problematic as a screening questionnaire. The other, the Autism Spectrum Quotient (AQ, Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001), is a brief 50 item self-administered questionnaire for adults that identifies the degree to which any individual adult of normal intelligence might have features of the core autistic phenotype.

The 50 questions on the AQ are made up of 10 questions assessing five different areas: social skill, attention switching, attention to detail, communication and imagination. Each question allows the respondent to answer 'definitely agree', 'slightly agree', 'slightly disagree' or 'definitely disagree' according to the degree to which they believe they exhibit the behaviour described in the item. Each item scores one point if the respondent records the abnormal behaviour either mildly or strongly. In order to avoid response bias, approximately half the items are worded to produce a 'disagree' response, and half an 'agree' response. The properties of the AQ have been reported previously (Baron-Cohen *et al*., 2001). In short, 80% of adults with AS or high functioning autism scored above a critical minimum of 32, whereas only 2% of control adults did. It was also shown to have good test–retest and inter-rater reliability. It is therefore potentially useful as a screening questionnaire. It is of interest that parents of children with autism (who may have the broader phenotype but not at the severity level of AS) score significantly higher than controls on two of the subscales of the AQ (Bishop *et al*., 2004).

The current study evaluated the usefulness of the AQ as a screening questionnaire in clinical practice by exploring its properties in 100 consecutive patients who had been referred to a national diagnostic clinic in the UK for adults suspected of having Asperger Syndrome. The aim was to determine whether the questionnaire was able to usefully distinguish between those individuals who turned out to have AS, and those who did not.

METHOD

Participants

The sample consisted of the first 100 patients evaluated in the Cambridge Lifespan Asperger Syndrome Service (CLASS, median age = 32 years, range 18–69; gender, male: female = 4:1). This is a diagnostic clinic for adults, aged 18 years and over, suspected of having Asperger Syndrome or high functioning autism. Referrals are accepted from all health professions, with most referrals being from general practitioners. All patients complete a short ten-item checklist following their referral to the clinic. This simply ensures that the patient themselves are aware of and acknowledge that they have experienced the core phenotypic difficulties. It is not used for screening purposes and does not contribute to the diagnostic process. It does not include items that are included in the AQ. People with a history of mental retardation (learning disability) are specifically excluded from assessment. Furthermore, patients are required to be accompanied by a suitable informant who has known them throughout the developmental period.

Design

In order to evaluate the screening properties of the AQ in clinical practice, each patient referred to the clinic was asked to complete the Autism Quotient (AQ) questionnaire (questionnaire available from authors on request). All patients were subsequently seen for further diagnostic assessment irrespective of their scores on this. This assessment consisted of a detailed interview by two clinicians with the patient and their informant. At the end of the clinical interview, both clinicians independently rated the patient according to the DSM-IV diagnostic criteria for Asperger Syndrome. In this way the DSM-IV

Table I. Discriminative Validity of the AQ

	N	Mean AQ score (s.d.)	*t*-test	AUC	Std. Err.
AS vs non-AS	73	35.62 (6.63)	−5.59***	0.78	0.06
	27	26.22 (9.39)			

***$p < 0.0001$.

diagnosis assigned to each patient was used as the yardstick against which the AQ was evaluated.

Several different aspects of its performance were measured: the discriminative validity of the AQ between adults with AS and those with sub-threshold difficulties in the core domains (i.e., those who do not meet the diagnostic criteria for AS) as measured by parametric statistics and receiver operating curves, the sensitivity and specificity of the AQ at different threshold scores, and the positive and negative predictive values of the AQ. The data were analysed using Stata Version 7 (Stata Corporation, 2001). Significance was set at the conventional 5% level.

RESULTS

Discriminant Power of the AQ

The AQ differentiated well between patients who received a diagnosis of AS and those who did not (Table I). This was demonstrated by significant group differences as measured by parametric statistics. Additionally, the area under the ROC curve was 0.78 (std. err. 0.06, 95% CI 0.7–0.9), representing accuracy of the AQ in the moderate range. The area under the ROC is indicative of the overall accuracy of a test, representing the probability that a randomly selected 'true-positive' individual will score higher on the test than a randomly selected 'true-negative' individual.

Threshold Score for Most Effective Use as a Screening Questionnaire

It has previously been suggested that in a general population study a cut-off of 32 or above should be employed for correctly identifying individuals with 'autistic traits'. However, examination of the receiver operating characteristics for the total AQ suggested that for this clinic referred sample a threshold score of 26 resulted in the correct classification of the greatest numbers (Table II). At this cut off the sensitivity is 0.95, specificity 0.52, positive predictive value 0.84, and negative predictive value 0.78. Of course, other thresholds of cut off may be favoured in different circumstances.

DISCUSSION

This study has attempted to determine whether the AQ has acceptable properties to allow it to be used as a screening instrument in clinical practice. In a clinic population of adults referred for assessment of possible Asperger Syndrome, all referrals completed the AQ and then underwent a more rigorous assessment. The AQ was shown to have good ROC characteristics, and, at a cut-off of 26, its sensitivity and specificity were such that 83% of patients were correctly classified.

Before discussing these findings further, several limitations need to be mentioned. First, the clinicians who saw the patients in the clinic were not blind to AQ scores. This was unavoidable as the AQ was being used as part of clinical practice. It is possible that this influenced their diagnostic decision, and therefore the study needs replication to ensure the validity of our preliminary results. However, for each case, diagnosis was based upon a detailed clinical interview that allowed a DSM-IV diagnosis to be made independent of AQ score.

Another issue to be considered in the interpretation of the AQ is the possibility that other factors might have influenced scores. For example, schizophrenia is known to be associated with the premorbid personality traits of impaired social interaction and communication. It is possible, therefore, that this would also result in higher AQ scores, and result in 'false positives' being referred on for further assessment. This clearly needs further investigation by administering the AQ to adults with schizophrenia. With regard to the clinic population, of the one hundred referrals, only two had a previous diagnosis of schizophrenia: one went on to be diagnosed with AS (with ICD-10 criteria that allows for such comorbidity) and scored 45 on the AQ, the other did not have AS and had scored only 20 on the AQ.

Table II. Detailed report of diagnostic statistics for the Autism Spectrum Quotient (AQ)

Cut-off point	Sensitivity (%)	Specificity (%)	Correctly classified (%)
≥10	100.00	0.00	73.00
≥11	100.00	3.70	74.00
≥13	100.00	7.41	75.00
≥15	100.00	11.11	76.00
≥16	100.00	14.81	77.00
≥19	98.63	18.52	77.00
≥20	98.63	22.22	78.00
≥21	98.63	29.63	80.00
≥23	94.52	29.63	77.00
≥25	94.52	44.44	81.00
≥26	94.52	51.85	83.00
≥27	93.15	51.85	82.00
≥28	87.67	59.26	80.00
≥29	84.93	66.67	80.00
≥30	83.56	70.37	80.00
≥31	79.45	70.37	77.00
≥32	76.71	74.07	76.00
≥33	73.97	74.07	74.00
≥34	65.75	74.07	68.00
≥35	60.27	77.78	65.00
≥36	54.79	77.78	61.00
≥37	47.95	81.48	57.00
≥38	39.73	81.48	51.00
≥39	31.51	85.19	46.00
≥40	27.40	88.89	44.00
≥41	24.66	92.59	43.00
≥42	17.81	92.59	38.00
≥43	13.70	96.30	36.00
≥44	10.96	100.00	35.00
≥45	9.59	100.00	34.00
≥46	6.85	100.00	32.00
≥48	2.74	100.00	29.00
>48	0.00	100.00	27.00

With increasing demands on clinical services to assess for the possibility of Asperger Syndrome, as demonstrated by the large number of referrals currently received at our clinic in Cambridge, it is important to be able to identify those people who are most likely to have AS. We believe our results support the AQ as a useful screening instrument in clinical practice. It provides a quick and reliable method of determining the likelihood of any individual falling on the higher functioning end of the autistic spectrum and warranting further, more detailed, assessment. We suggest that a more conservative threshold score of 26 would ensure that false negatives are limited, and equally avoid cases 'slipping through the net'.

However, if the AQ were being used in a general population screen (and the ethical case for such a use has yet to be demonstrated) the higher cut off of 32 is likely to minimise false positives. We suspect that this is because in the general population there may be a percentage of individuals who have many autistic traits but who do not require any clinical support (and are not seeking this) because of a good cognitive match between their cognitive style or personality, and their family or occupational or social context (Baron-Cohen, 2003). In this sense, whether a high AQ score becomes disabling may depend on environmental factors (tolerance by significant others, or being valued for contribution at work, or a place in a social network, protecting against the risks of secondary depression) rather than solely on factors within the individual. This impression warrants systematic research.

Of importance is that seventy-five percent of the patients seen in the clinic had been referred by their general practitioner. This figure represents all suspected cases referred by primary care practitioners as no one was excluded simply based on their AQ score.

Therefore our results are also relevant in the primary care setting where, as a result of increasing awareness of autistic spectrum conditions, there is likely to be an increase in the numbers of patients seeking assessment. The GP has the difficult task of deciding who should be referred on for in-depth assessment. We believe the AQ will facilitate this process, and is particularly useful in this setting as it is a relatively quick and easy to use screening instrument. There is increasing evidence that by diagnosing even relatively late much can still be done to effectively manage the social impairments and facilitate better social inclusion.

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