

Psychometric properties of the 10-item Autism Quotient in an acute psychiatric sample

Chloe C. Hudson^{1,2,3*}

Harris E. Bajwa^{2,4}

Courtney Beard^{2,3}

Thröstur Björgvinsson^{2,3}

¹Virginia Polytechnic Institute and State University

²McLean Hospital

³Harvard Medical School

⁴University of Montana

*Corresponding author. 890 Drillfield Drive, Blacksburg VA 24060. E-mail:

chloehudson@vt.edu. Phone: 540-231-7030.

Key words: autism; AQ; factor structure; reliability; validity

Acknowledgment: We thank the staff and patients at McLean Hospital's Behavioral Health

Partial Hospital for making this study possible.

Abstract

Purpose: Diagnoses of autism spectrum disorder (ASD) are commonly missed among psychiatric patients. As such, a brief screening tool that reliably captures ASD symptoms could help to facilitate access to diagnosis. We evaluated the factor structure, internal consistency, and convergent validity of the 10-item Autism Spectrum Quotient (AQ-10; Allison et al., 2012) in a diagnostically diverse sample of patients with acute mental illness.

Methods: Participants ($n = 305$) were patients with a variety of mood, anxiety, personality, and psychotic-spectrum disorders seeking treatment at a cognitive-behavioral therapy partial hospital program. They completed the AQ-10 on their second day of the treatment program.

Results: Results suggests that a unifactorial structure of the AQ-10 had poor model fit and internal consistency. A modified, 5-item version (AQ-5) demonstrated acceptable unidimensional model fit and internal consistency; however, the items exclusively assess the social aspects of ASD and neglect restricted, repetitive patterns of behaviors, interests, or activity, therefore limiting validity. Indeed, while the AQ-5 and the AQ-10 demonstrated similar convergent validity with measures of social functioning, the AQ-5 demonstrated poor convergent validity with overall functional impairment relative to the AQ-10.

Conclusion: Our findings highlight that the AQ-10 may not be well suited to assess ASD symptoms among patients with acute mental illness.

Key words: autism; AQ; factor structure; reliability; validity

Psychometric Properties of the 10-item Autism Quotient in an Acute Psychiatric Sample

Autism spectrum disorder (ASD)¹ is a lifelong neurodevelopmental disorder characterized by deficits in social communication and interaction (Criterion A) as well as the presence of restricted, repetitive patterns of behavior, interests, or activities (Criterion B; American Psychiatric Association, 2022). Autistic people (i.e., those with a diagnosis of ASD) experience high rates of comorbid mental health difficulties, including depression (Hudson et al., 2019), suicidal ideation (Hedley & Uljarević, 2018), and anxiety (van Steensel, Bögels, & Perrin, 2011). Not surprisingly, autistic people are overrepresented in psychiatric populations. Although the prevalence of ASD in the general population is approximately 2% (Maenner et al., 2021), the prevalence of ASD in psychiatric outpatient and inpatient populations is estimated to be approximately 10% (Mandell et al., 2012; Tromans et al., 2018), with a recent study finding that nearly 20% of adult outpatients met criteria for ASD (Nyrenius et al., 2022). Yet, most patients seeking psychiatric care do not have a diagnosis of ASD (e.g., Mandell et al., 2012). Given that adaption to standard treatment protocols is needed for psychiatric patients with comorbid ASD (e.g., Spain et al., 2015), identifying patients who meet criteria for ASD is crucial in providing effective treatment.

Although numerous ASD screening questionnaires have been developed for children, relatively few exist to screen for ASD in adult populations (see e.g., Lai, Lombardo, & Baron-Cohen, 2014 for a review). Among the available screening tools for adults, the 10-item Autism Spectrum Quotient (AQ-10) is frequently used, likely due to its short length and ease of administration. The AQ-10 was developed to alert clinicians when a referral for a full ASD

¹ We use the term autism spectrum disorder (ASD) throughout the manuscript in order to remain consistent and reference symptom clusters described by the Diagnostic and Statistical Manual of Mental Disorders (APA, 2022). However, when possible, we also use identity affirming language that is preferred by the majority of members of the autism community (Monk et al., 2022).

diagnostic assessment may be warranted (Allison et al., 2012). Items were selected for this scale from a longer, 50-item measure of autistic traits (Baron-Cohen et al., 2001) based on how well they discriminated autistic people from non-autistic people. Initial research suggests that the AQ-10 demonstrated strong reliability and adequately distinguished between autistic people and community samples without mental illness (e.g., Allison et al., 2012; Booth et al., 2013). Based on these findings, the AQ-10 has been recommended as a screening tool for ASD by the National Institute for Health and Care Excellence (NICE), a government-sponsored organization that provides clinical guidelines for healthcare in the United Kingdom. However, emerging research findings suggests that the AQ-10 demonstrates poor internal consistency in samples recruited from the general population (e.g., Jia et al., 2019; Sizoo et al., 2015; Taylor et al., 2020) and poor test-retest reliability in an undergraduate sample (Cheung et al., 2023). In addition, three studies investigating the factor structure of the AQ-10 in the general population indicates poor model fit (Taylor et al., 2020) and several poorly fitting items (Jia et al., 2019; Lundin et al., 2019). Further, some researchers have questioned the appropriate cut-off to inform referrals for specialist diagnostic assessment (e.g., Waldren et al., 2021). Taken together, this research calls into question the psychometric rigor of the AQ-10 in the general population.

To date, research studies have not examined the psychometric properties of the AQ-10 in patients seeking treatment for other forms of mental illness that are commonly comorbid with ASD. There is some reason to believe that the AQ-10 may have better psychometric properties in psychiatric samples relative to samples of non-clinical adults. The prevalence of ASD and ASD traits are higher in psychiatric samples than community samples (e.g., Fusar-Poli et al., 2020; Matsuo et al., 2015), which may reduce floor effects that hinder adequate psychometric properties (Franco-Martínez et al., 2023). Further, knowledge of the psychometric properties of

the AQ-10 in psychiatric samples is crucial given that the AQ-10 is currently being used to screen for ASD among psychiatric patients in both research and clinical settings (e.g., Groot et al., 2022; Pilling et al., 2012; Pyle et al., 2019), and as a measure of autistic traits in psychiatric populations (e.g., Cole et al., 2023; Tchanturia et al., 2013; Zheng et al., 2021). Consequently, research is needed to determine whether this tool is adequately capturing ASD traits. Inadequate psychometric properties may indicate that this screening tool is not reliably capturing ASD symptoms, perpetuating missed ASD diagnosis or mischaracterization of symptoms.

In the current study, we investigated the psychometric properties of the AQ-10 in a mixed clinical sample of psychiatric patients with diverse mental health diagnoses attending a partial hospital treatment program. We conducted a series of secondary analyses from data that was intended to inform patient care and internal program evaluation; as such, our methods were limited to existing measures. Nevertheless, such research has important implications for the use of the AQ-10 in psychiatric samples. First, we examined the factor structure of the AQ-10 using an exploratory factor analysis. Understanding the underlying structure of the AQ-10 is crucial to know whether the questionnaire is assessing an underlying construct (i.e., ASD) or constructs (i.e., ASD symptom clusters) we intend to assess. Second, we examined the internal consistency of the AQ-10 to determine whether responses are generally consistent across items. Finally, we assessed convergent validity to determine whether scores on the AQ-10 were related to other variables that, theoretically, should be related. Specifically, we investigated the relation of the AQ-10 with measures of overall functional impairment and social functioning.

Method

Participants

Participants were 305 patients attending the <blinded for review> virtual partial hospital

program from January 2021 to August 2021. Participants ranged from 18-73 years old ($M = 34.65$, $SD = 13.48$). Fifty-six percent of participants identified as female, 42.3% identified as male, and 1.3% identified as non-binary or gender non-conforming. Most participants identified as Non-Hispanic White (80.0%), followed by multiracial (5.2%), Asian (4.9%), Hispanic/Latinx (4.6%), and Black or African American (3.3%). An additional 0.3% of participants did not disclose their race and 0.7% reported not knowing their race. Education was used as an indicator of socioeconomic status. The majority of participants had post-college education (33.7%), followed by a four-year college degree (31.7%), some college (26.4%), and high school graduate/General Educational Development (GED; 8.3%). Clinical conditions of the sample were assessed using structured diagnostic interviews and are presented in Table 1.

Measures

Symptoms of ASD were assessed using the short Autism Quotient (AQ-10), a 10-item self-report questionnaire. Each question is rated on a 4-point Likert-type scale ranging from 1-*definitely agree* to 4-*definitely disagree*. Four items were reverse coded. Higher scores indicate more autistic traits. The authors of this scale dichotomized scores, resulting in a binary score format (0 = symptom not endorsed, 1 = symptom endorsed). We chose to keep items continuously scored to maximize variability. Results of all analyses with the scores dichotomized generally resulted in worse psychometric properties; these results are available on our OSF website: *<link blinded for review>*.

Overall functional impairment was assessed using the Work and Social Adjustment Scale (WSAS; Mundt et al. 2002), a 5-item self-report questionnaire in which participants report the extent to which their mental health problems impair their ability to function in important areas of their lives (e.g., work, home management, leisure activities). Each item is rated on a 9-point

Likert-type scale ranging from 0-*not at all* to 8-*very severely*. Higher scores indicate greater functional impairment. Relationship problems were assessed using the Behaviour and Symptom Identification Scale Revised – Relationship Subscale (BASIS24-RS; Cameron et al., 2007), a 5-item self-report measure (e.g., “*How much difficulty do you have getting along well in social situations?*”). Each question is rated on a 5-point Likert-type scale ranging from 0-*no difficulty* to 4-*extreme difficulty*. Higher scores indicate more difficulties with relational functioning. Lastly, the tendency to consider other people’s psychological perspectives (e.g., thoughts, feelings, desires) was assessed using the 7-item Perspective-Taking subscale of the Interpersonal Reactivity Index (IRI-PT; Davis 1980; Davis, 1983). The IRI-PT is rated on a 5-point Likert-type scale ranging from 0-*does not describe me well* to 4-*describes me very well*. Higher scores indicate greater propensity to consider others’ perspectives. The WSAS, BASIS24-RS, and IRI-PT have demonstrated adequate reliability, validity, and sensitivity (Cameron et al., 2007; Davis, 1980; Mundt et al., 2002). In the current study, all three measures, the WSAS, BASIS24-RS, and IRI-PT demonstrated good internal consistency ($\alpha = .83, .79, \text{ and } .83$, respectively).

The Mini-International Neuropsychiatric Interview (Sheehan, 2016) and the borderline personality module of the Structured Clinical Interview for DSM-5 Personality Disorders (First et al., 2016) was administered in the initial individual therapy session by an advanced clinical psychology doctoral student, postdoctoral fellow, or staff psychologist to assist with conceptualization and treatment planning. All trainees were supervised by a licensed psychologist. In the current study, diagnoses obtained from these interviews were used to characterize the sample. Both interviews have demonstrated strong inter-rater reliability, test-retest reliability, and validity (First et al., 2016; Lecrubier et al., 1997; Paap et al., 2022).

Procedure

Participants were attending a virtual partial hospital treatment program <citation blinded for review>. Participants completed the WSAS, BASIS24-RS, and IRI-PT on their first day of treatment. The AQ-10 and diagnostic interviews were completed on the second day of treatment. Self-report questionnaires were completed using Research Electronic Data Capture, a secure web-based platform for managing and storing data (Harris et al., 2009). All data collected were used by treatment teams to inform patient care and internal program evaluation. A de-identified dataset was obtained for the current study and deemed exempt by <blinded for review> Institutional Review Board. This study was not preregistered. De-identified data and syntax are available at our OSF website for this project: <blinded for review>.

Data Analysis

We used Mplus version 8.8 (Muthén & Muthén, 2017) to perform the exploratory factor analysis (EFA) with a geomin rotated solution, which is recommended because it produces factor loadings and factor correlations similar to those of confirmatory factor analysis without having to specify the factor loading pattern (Hattori et al., 2017; Schmitt, 2011). Appropriate EFA factor structure was determined using the use following fit criterion: non-significant chi-square; root mean square error approximation (RMSEA) and standardized root mean square residual (SRMR) less than .08; comparative fit index (CFI) and Tucker-Lewis Index (TLI) greater than .90; Akaike information criterion (AIC), Bayesian information criterion (BIC), and adjusted BIC with lower values indicating a better fit; and the interpretability of the factor structure.

Internal consistency was evaluated using Cronbach's alpha, MacDonald's omega, and permutation-based estimates of split-half reliability. Convergent validity was assessed using Pearson's correlations between AQ scores with overall functional impairment (WSAS), relationship problems (BASIS24-RS), and perspective-taking (IRI-PT). The relative strength of

correlations were compared based on effect sizes and the Fisher's z method. Permutation-based estimates of split-half reliability were computed using the splithalf package for R (Parsons, 2021). All remaining analyses were performed in SPSS version 28.

Results

Exploratory Factor Analysis

We used EFA to examine the underlying factor structure of the AQ-10. For all EFAs conducted, fit indices are presented in Table 2 and factor loadings are presented in Table 3. The AQ-10 one factor solution yielded inadequate model fit. Model fit was improved in the two- and three-factor solution; however, items 1 (“I often notice small sounds when others do not”), 2 (“I usually concentrate more on the whole picture, rather than the small details”), and 8 (“I like to collect information about categories of things; e.g., types of car, types of bird, types of train, types of plants etc.”) had factor loadings less than $|\cdot 3|$ in all three factor solutions, and consequently, these items were removed, and the factor analysis was re-run with the remaining 7 items (referred to moving forward as the AQ-7).

Although all AQ-7 items loaded onto a one-factor solution, the model fit had room for improvement. The two-factor solution had substantially better fit; however, it contained a factor with only two items: 3 (“I find it easy to do more than one thing at once) and 4 (“If there is an interruption, I can switch back to what I was doing very quickly”). Because factors with less than three items generally have poor reliability (Raubenheimer, 2004), we excluded the two items loading onto the second factor of the AQ-7 and conducted a third EFA. We referred to the remaining 5-item scale as the AQ-5. The AQ-5 unidimensional factor structure yielded good model fit.

Internal Consistency

We used estimates of internal consistency to determine whether responses are generally consistent across AQ-10 items. Estimates of internal consistency for the AQ-10, AQ-7, and AQ-5 are presented in Table 4. Internal consistency of the AQ-10 did not meet the traditional threshold for acceptability (i.e., .70; Field et al., 2012; Nunnally & Bernstein, 1994; Taber, 2017). Across indices, the AQ-5 yielded the strongest internal consistency estimates, with each index meeting traditional thresholds for acceptability.

Convergent Validity

Finally, we assessed convergent validity to determine whether scores on the AQ-10 were related to variables that should be theoretically related. Correlations between overall functioning, relationship problems, and perspective taking with total scores on the AQ-10, AQ-7, and AQ-5 are presented in Table 5. Across all versions of the AQ, higher autistic traits were associated with greater impairments in functioning and less frequent perspective-taking, providing evidence for convergent validity. However, the AQ-10 and AQ-7 demonstrated significantly stronger convergent validity with overall functional impairment relative to the AQ-5 ($z > 1.69, p < .046$). Importantly, the pattern of results did not change with the inclusion of demographic or clinical covariates. As such, the most parsimonious analyses without covariates are presented here.

Discussion

Our study is the first to examine the psychometric properties of the AQ-10 in a psychiatric sample. Although the authors of the AQ-10 summed all items into a single factor (Allison et al., 2012), results of the current study suggest that a unifactorial structure had inadequate model fit and internal consistency in a psychiatric sample. These findings suggest that the AQ-10 is not reliably capturing a single latent construct, at least when assessed among

patients with acute mental illness. In other words, psychiatric patients' total AQ-10 scores are not assessing a single "autism symptoms" latent factor, and results of these total scores may not be particularly meaningful.

Consistent with the DSM-5 criteria for ASD, many popular ASD assessment measures yield a two-factor solution: social communication deficits (Criterion A), and restricted and repetitive behaviors (Criterion B; e.g., Frazier et al., 2007; Shuster et al., 2013). Our results suggest that the AQ-10 is adequately capturing social communication deficits, but not restricted and repetitive behaviors. Consistent with past research studies in community samples (Jia et al., 2019; Lundin et al., 2019), we found that the five items designed to assess restricted and repetitive behaviors on the AQ-10 were contributing to poor model fit. After removing these 5 items, a modified, 5-item "AQ-5" demonstrated acceptable unidimensional model fit and internal consistency; however, the remaining five items only assess social communication deficits (Criterion A). As such, the 5-item version of the AQ has limited construct validity, unless the user is only interested in screening for Criterion A of ASD. Indeed, the results of our validity analyses support these conclusions. Although all versions of the AQ demonstrated similar convergent validity with measures of social functioning, the AQ-5 demonstrated poor convergent validity with overall functional impairment relative to the AQ-10. As such, the impairments associated with restricted, repetitive, behaviors, interests, or activities are not captured by the AQ-5.

The results of the current study should be interpreted in light of the following two notable limitations. First, given the lack of sociocultural diversity in our sample, these findings may not generalize to more heterogenous populations. Second, our data was limited to what is routinely collected as a part of clinical care in a partial hospital treatment setting. As such, the convergent

validity of the AQ-10, AQ-7 and AQ-5 was not assessed with other measures of ASD symptoms, or alongside diagnoses of ASD. Given that the AQ is a self-reported measure, the presence of clinician-rated measures would provide useful comparisons. Finally, our study was limited to evaluating the psychometric properties of one ASD screening questionnaire: the AQ-10. Future research evaluating the psychometric properties of other ASD screening questionnaires is warranted.

In conclusion, our results demonstrate that the AQ-10 has inadequate model fit and internal consistency when completed by patients with acute mental illness. Given these results, as well as the results of prior studies that suggest poor psychometric properties of the AQ-10 in community samples (Jia et al., 2019; Sizoo et al., 2015; Taylor et al., 2020), we advise caution when using this scale as a screening tool for ASD. Nevertheless, the prevalence of ASD in psychiatric patient populations remains high, suggesting that ASD screening is warranted in psychiatric treatment programs. Other self-report questionnaires designed to screen for ASD have also demonstrated poor predictive validity in psychiatric samples (e.g., Conner et al., 2019). As such, mental health clinicians may benefit from training in ASD to learn to identify symptoms without reliance on self-report questionnaires. Ultimately, improving screening efforts will help to facilitate proper diagnoses and improve the treatment outcomes by tailoring the treatment to their needs and improve quality of life for an underserved population.

Statements and Declarations

Conflict of Interest

There are no conflicts of interest to report.

Ethical Approval

A de-identified dataset was obtained for the current study and deemed exempt by the local Institutional Review Board

References

- American Psychiatric Association. (2022). *Diagnostic and statistical manual of mental disorders* (5th ed., text rev.). <https://doi.org/10.1176/appi.books.9780890425787>
- Allison, C., Auyeung, B., & Baron-Cohen, S. (2012). Toward brief “red flags” for autism screening: the short autism spectrum quotient and the short quantitative checklist in 1,000 cases and 3,000 controls. *Journal of the American Academy of Child & Adolescent Psychiatry, 51*(2), 202-212. <https://doi.org/10.1016/j.jaac.2011.11.003>
- Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (AQ): Evidence from asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders, 31*(1), 5-17. <https://doi.org/10.1023/A:1005653411471>
- Booth, T., Murray, A. L., McKenzie, K., Kuenssberg, R., O'Donnell, M., & Burnett, H. (2013). Brief report: An evaluation of the AQ-10 as a brief screening instrument for ASD in adults. *Journal of Autism and Developmental Disorders, 43*(12), 2997-3000. <https://doi.org/10.1007/s10803-013-1844-5>
- Cameron, I. M., Cunningham, L., Crawford, J. R., Eagles, J. M., Eisen, S. V., Lawton, K., ... & Hamilton, R. J. (2007). Psychometric properties of the BASIS-24©(behaviour and symptom identification scale—revised) mental health outcome measure. *International Journal of Psychiatry in Clinical Practice, 11*(1), 36-43. <https://doi.org/10.1080/13651500600885531>
- Cole, R. H., Elmalem, M. S., & Petrochilos, P. (2023). Prevalence of autistic traits in functional neurological disorder and relationship to alexithymia and psychiatric comorbidity. *Journal of the Neurological Sciences, 120585*. <https://doi.org/10.1016/j.jns.2023.120585>

- Conner, C. M., Cramer, R. D., & McGonigle, J. J. (2019). Examining the diagnostic validity of autism measures among adults in an outpatient clinic sample. *Autism in Adulthood, 1*(1), 60-68. <https://doi.org/10.1089/aut.2018.0023>
- Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalog of Selected Documents in Psychology, 10*(85).
- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology, 44*(1), 113–126. <https://doi.org/10.1037/0022-3514.44.1.113>
- Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. SAGE Publications.
- First, M. B., Williams, J. B., Benjamin, L. S., & Spitzer, R. L. (2016). *SCID-5-PD: Structured Clinical Interview for DSM–5 Personality Disorders*. American Psychiatric Association.
- Fusar-Poli, L., Ciancio, A., Gabbiadini, A., Meo, V., Patania, F., Rodolico, A., ... & Aguglia, E. (2020). Self-reported autistic traits using the AQ: A comparison between individuals with asd, psychosis, and non-clinical controls. *Brain Sciences, 10*(5), 291. <https://doi/10.3390/brainsci10050291>
- Franco-Martínez, A., Alvarado, J. M., & Sorrel, M. A. (2023). Range restriction affects factor analysis: Normality, estimation, fit, loadings, and reliability. *Educational and Psychological Measurement, 83*(2), 262-293. <https://doi.org/10.1177/00131644221081867>
- Frazier, T. W., Youngstrom, E. A., Kubu, C. S., Sinclair, L., & Rezai, A. (2008). Exploratory and confirmatory factor analysis of the autism diagnostic interview-revised. *Journal of autism and developmental disorders, 38*, 474-480. <https://doi.org/10.1007/s10803-007-0415-z>

- Groot, I. Z., Venhuizen, A. S. S., Bachrach, N., Walhout, S., de Moor, B., Nikkels, K., ... & Arntz, A. (2022). Design of an RCT on cost-effectiveness of group schema therapy versus individual schema therapy for patients with Cluster-C personality disorder: the QUEST-CLC study protocol. *BMC Psychiatry*, *22*(1), 1-18.
- Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, *42*(2), 377–381. <https://doi.org/10.1016/J.JBI.2008.08.010>
- Hattori, M., Zhang, G., & Preacher, K. J. (2017). Multiple local solutions and geomin rotation. *Multivariate behavioral research*, *52*(6), 720-731. <https://doi.org/10.1080/00273171.2017.1361312>
- Hedley, D., & Uljarević, M. (2018). Systematic review of suicide in autism spectrum disorder: current trends and implications. *Current Developmental Disorders Reports*, *5*(1), 65-76. <https://doi.org/10.1007/s40474-018-0133-6>
- Hudson, C. C., Hall, L., & Harkness, K. L. (2019). Prevalence of depressive disorders in individuals with autism spectrum disorder: A meta-analysis. *Journal of Abnormal Child Psychology*, *47*(1), 165-175. <https://doi.org/10.1007/s10802-018-0402-1>
- Jia, R., Steelman, Z. R., & Jia, H. H. (2019). Psychometric assessments of three self-report autism scales (AQ, RBQ-2A, and SQ) for General Adult Populations. *Journal of Autism and Developmental Disorders*, *49*, 1949–1965. <https://doi.org/10.1007/s10803-019-03880-x>
- Lai, M. C., Lombardo, M. V., & Baron-Cohen, S. (2014). Autism. *The Lancet*, *383*(9920), 8-14, 896-901. [https://doi.org/10.1016/S0140-6736\(13\)61539-1](https://doi.org/10.1016/S0140-6736(13)61539-1)

- Lecrubier, Y., Sheehan, D. V., Weiller, E., Amorim, P., Bonora, I., Sheehan, K. H., ... & Dunbar, G. C. (1997). The Mini International Neuropsychiatric Interview (MINI). A short diagnostic structured interview: reliability and validity according to the CIDI. *European Psychiatry, 12*(5), 224-231. [https://doi.org/10.1016/S0924-9338\(97\)83296-8](https://doi.org/10.1016/S0924-9338(97)83296-8)
- Lundin, A., Kosidou, K., & Dalman, C. (2019). Measuring autism traits in the adult general population with the brief autism-spectrum quotient, AQ-10: Findings from the Stockholm public health cohort. *Journal of Autism and Developmental Disorders, 49*(2), 773-780. <https://doi.org/10.1007/s10803-018-3749-9>
- Maenner, M. J., Shaw, K. A., Bakian, A. V., Bilder, D. A., Durkin, M. S., Esler, A., ... & Cogswell, M. E. (2021). Prevalence and characteristics of autism spectrum disorder among children aged 8 years—autism and developmental disabilities monitoring network, 11 sites, United States, 2018. *MMWR Surveillance Summaries, 70*(11), 1. <https://doi.org/10.15585/mmwr.ss7011a1>
- Mandell, D. S., Lawer, L. J., Branch, K., Brodtkin, E. S., Healey, K., Witalec, R., ... & Gur, R. E. (2012). Prevalence and correlates of autism in a state psychiatric hospital. *Autism, 16*(6), 557-567. <https://doi.org/10.1177/136236131141205>
- Matsuo, J., Kamio, Y., Takahashi, H., Ota, M., Teraishi, T., Hori, H., ... & Kunugi, H. (2015). Autistic-like traits in adult patients with mood disorders and schizophrenia. *PLoS One, 10*(4), e0122711. <https://doi.org/10.1371/journal.pone.0122711>
- Monk, R., Whitehouse, A. J., & Waddington, H. (2022). The use of language in autism research. *Trends in Neurosciences, 45*(11), 791-793. <https://doi.org/10.1016/j.tins.2022.08.009>

RUNNING HEAD: PSYCHOMETRICS OF AQ-10 IN PSYCHIATRIC SAMPLE

- Mundt, J. C., Marks, I. M., Shear, M. K., & Greist, J. M. (2002). The Work and Social Adjustment Scale: a simple measure of impairment in functioning. *The British Journal of Psychiatry, 180*(5), 461-464. <https://doi.org/10.1192/bjp.180.5.461>
- Muthén, L. K., & Muthén, B. O. (2017). 1998–2017. Mplus User's Guide. Los Angeles, CA: Muthén & Muthén.
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). NY: McGraw-Hill.
- Nyrenius, J., Eberhard, J., Ghaziuddin, M., Gillberg, C., & Billstedt, E. (2022). Prevalence of Autism Spectrum Disorders in Adult Outpatient Psychiatry. *Journal of Autism and Developmental Disorders, 52*, 3769–3779. <https://doi.org/10.1007/s10803-021-05411-z>
- Paap, M., Heltne, A., Pedersen, G., Germans Selvik, S., Frans, N., Wilberg, T., & Hummelen, B. (2022). More is more: Evidence for the incremental value of the SCID-II/SCID-5-PD specific factors over and above a general personality disorder factor. *Personality Disorders, 13*(2), 108. <https://doi.org/10.1037/per0000426>
- Parsons, S. (2021). Splithalf: Robust estimates of split half reliability. *Journal of Open Source Software, 6*(60), 3041. <https://doi.org/10.21105/joss.03041>
- Pilling, S., Baron-Cohen, S., Megnin-Viggars, O., Lee, R., Taylor, C. (2012). Recognition, referral, diagnosis, and management of adults with autism: summary of NICE guidance. *British Medical Journal Psychiatry, 18*, Article 222. <https://doi.org/10.1136/bmj.e4082>
- Pyle, M., Broome, M. R., Joyce, E., MacLennan, G., Norrie, J., Freeman, D., ... & Morrison, A. P. (2019). Study protocol for a randomised controlled trial of CBT vs antipsychotics vs both in 14–18-year-olds: Managing Adolescent first episode Psychosis: a feasibility study (MAPS). *Trials, 20*(1), 1-13. <https://doi.org/10.1186/s13063-019-3506-1>

- Schmitt, T. A. (2011). Current methodological considerations in exploratory and confirmatory factor analysis. *Journal of Psychoeducational Assessment, 29*, 304–321.
doi:10.1177/0734282911406653
- Sheehan, D. V. (2016). *M.I.N.I. International Neuropsychiatric Interview, 7.0.2*
- Shuster, J., Perry, A., Bebko, J., & Toplak, M. E. (2014). Review of factor analytic studies examining symptoms of autism spectrum disorders. *Journal of Autism and Developmental Disorders, 44*, 90-110. <https://doi.org/10.1007/s10803-013-1854-3>
- Sizoo, B. B., Horwitz, E. H., Teunisse, J. P., Kan, C. C., Vissers, C. T. W., Forceville, E. J. M., ... & Geurts, H. M. (2015). Predictive validity of self-report questionnaires in the assessment of autism spectrum disorders in adults. *Autism, 19*(7), 842-849.
<https://doi.org/10.1177/136236131558986>
- Spain, D., Sin, J., Chalder, T., Murphy, D., & Happe, F. (2015). Cognitive behaviour therapy for adults with autism spectrum disorders and psychiatric co-morbidity: A review. *Research in Autism Spectrum Disorders, 9*, 151-162.
- Raubenheimer, J. (2004). An item selection procedure to maximize scale reliability and validity. *SA Journal of Industrial Psychology, 30*(4), 59-64.
<https://hdl.handle.net/10520/EJC89023>
- Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education, 48*(6), 1273-1296.
<https://doi.org/10.1007/s11165-016-9602-2>
- Taylor, E., Livingston, L., Clutterbuck, R., & Shah, P. (2020). Psychometric concerns with the 10-item Autism-Spectrum Quotient (AQ10) as a measure of trait autism in the general population. *Experimental Results, 1*, e3, 1–6 doi:10.1017/exp.2019.3

- Tchanturia, K., Smith, E., Weineck, F., Fidanboyly, E., Kern, N., Treasure, J., & Baron Cohen, S. (2013). Exploring autistic traits in anorexia: a clinical study. *Molecular Autism*, 4(1), 1-8. <https://doi.org/10.1186/2040-2392-4-44>
- Tromans, S., Chester, V., Kiani, R., Alexander, R., & Brugha, T. (2018). The prevalence of autism spectrum disorders in adult psychiatric inpatients: A systematic review. *Clinical Practice & Epidemiology in Mental Health*, 14, 177–187. <https://doi.org/10.2174/1745017901814010177>
- Van Steensel, F. J., Bögels, S. M., & Perrin, S. (2011). Anxiety disorders in children and adolescents with autistic spectrum disorders: a meta-analysis. *Clinical Child and Family Psychology Review*, 14(3), 302-317. <https://doi.org/10.1007/s10567-011-0097-0>
- Zheng, S., Chua, Y. C., Tang, C., Tan, G. M. Y., Abdin, E., Lim, V. W. Q., ... & Magiati, I. (2021). Autistic traits in first-episode psychosis: Rates and association with 1-year recovery outcomes. *Early Intervention in Psychiatry*, 15(4), 849-855. <https://www.doi.org/10.1111/eip.13021>

Table 1.

Psychiatric Conditions Assessed by the Mini International Neuropsychiatric Interview and the Structured Clinical Interview for DSM-5 Personality Disorders

Psychiatric Conditions	Current <i>n</i> (%)	Lifetime <i>n</i> (%)
Major Depressive Episode	136 (55.97)	221 (94.44)
Manic Episode	3 (1.28)	51 (21.89)
Hypomanic Episode	0 (0)	1 (0.55)
Generalized Anxiety Disorder	127 (60.19)	–
Panic Disorder	40 (17.54)	52 (22.81)
Agoraphobia	18 (7.96)	–
Social Anxiety Disorder	64 (28.32)	–
Obsessive Compulsive Disorder	43 (19.20)	–
Alcohol Use Disorder	50 (22.62)	–
Substance Use Disorder	55 (25.46)	–
Mood Disorder with Psychotic Features	4 (1.92)	25 (12.02)
Psychotic Disorder	2 (0.96)	5 (2.4)
Bulimia	10 (4.78)	–
Binge Eating Disorder	10 (4.83)	–
Borderline Personality Disorder	55 (23.11)	–

Table 2.

Exploratory Factor Analysis Fit Indices for AQ-10, AQ-7, and AQ-5

Scale Version	Number of Factors	(df) χ^2	AIC	BIC	Adj BIC	RMSEA	CFI	TLI	SRMR
AQ-10	1	(35) 136.09***	7649.21	7761.01	7665.87	0.1	0.78	0.72	0.07
	2	(26) 52.39**	7583.5	7728.84	7605.16	0.06	0.94	0.9	0.04
	3	(18) 20.41	7567.53	7742.69	7593.62	0.02	1	0.99	0.02
AQ-7	1	(14) 96.25***	5040.46	5118.72	5052.12	0.14	0.81	0.72	0.08
	2	(8) 27.56***	4983.77	5084.4	4998.76	0.09	0.96	0.88	0.04
	3	(3) 2.26	4968.475	5087.73	4986.24	0	1	1	0.01
AQ-5	1	(5) 26.11***	3464.07	3519.93	3472.36	0.12	0.94	0.87	0.05
	2	(1) 1.63	3447.59	3518.34	3458.08	0.05	1	0.98	0.01

Note. df = degrees of freedom; AIC = akaike information criterion; BIC = Bayesian information criterion; Adj BIC = Adjusted BIC; RMSEA = root mean square error approximation; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root mean square residual. *** $p < .001$; ** $p < .01$

Table 3.

Exploratory Factor Analysis Factor Loadings for AQ-10, AQ-7, and AQ-5

Item	One-factor	Two-factor		Three-factor			
	Factor 1	Factor 1	Factor 2	Factor 1	Factor 2	Factor 3	
AQ-10	1	0.05	-0.04	0.18	0.11	-0.02	0.22
	2	0.19	0.08	0.23	0.29	0.03	-0.11
	3	0.34	0.1	0.5	0.6	0.02	-0.12
	4	0.38	0	0.86	0.82	-0.05	0.01
	5	0.8	0.74	0.09	0.25	0.66	0.01
	6	0.6	0.68	-0.11	0.04	0.62	-0.05
	7	0.47	0.46	0.01	-0.02	0.51	0.44
	8	0.03	0	0.06	0.04	0	0.11
	9	0.56	0.68	-0.19	-0.02	0.65	-0.19
	10	0.6	0.59	0.03	0.02	0.64	0.42
AQ-7	3	0.33	0.55	0.07	0.56	0.17	-0.01
	4	0.37	0.8	0	0.68	0	0.18
	5	0.8	0.12	0.73	0.01	0.59	0.24
	6	0.6	-0.1	0.68	-0.24	0.73	0.02
	7	0.47	0.03	0.45	0.01	0.02	0.54
	9	0.56	-0.18	0.68	-0.32	0.75	-0.01
	10	0.6	0.03	0.59	-0.02	0	0.8
AQ-5	5	0.76	0.52	0.28	---	---	---
	6	0.63	0.68	0.01	---	---	---
	7	0.48	-0.04	0.63	---	---	---
	9	0.59	0.69	-0.04	---	---	---
	10	0.61	0.08	0.68	---	---	---

Note. Bolded numbers represent items that load substantially (greater than .3) on a given factor.

Table 4.

Internal consistency of the 10-item, 7-item, and 5-item versions of the Autism Quotient

	AQ-10	AQ-7	AQ-5
Alpha	.64	.73	.75
Omega	.62	.71	.75
Split-half	.59	.65	.73

Table 5.

Convergent Validity of the 10-item, 7-item, and 5-item Versions of the Autism Quotient with Overall Functional Impairments, Relationship Problems, and Perspective-Taking

	AQ-10	AQ-7	AQ-5
Impairments in Functioning	.32***	.29***	.16**
Relationship Problems	.19***	.15*	.15*
Perspective-Taking	-.29***	-.33***	-.33***

Note. *** $p < .001$, ** $p < .01$, * $p < .05$