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# Psychometric properties of the Autism Spectrum Disorder in Adults Screening Questionnaire (ASDASQ) in a sample of Italian psychiatric outpatients

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ABSTRACT

*Background:* The present study aimed to examine the reliability and validity of the Italian version of the Autism Spectrum Disorder in Adults Screening Questionnaire (ASDASQ), a screening tool for autism spectrum disorder (ASD) among psychiatric outpatients.
*Methods:* We recruited 340 subjects via an outpatient psychiatric service in Italy. Forty-eight had a diagnosis of ASD, confirmed after a comprehensive clinical assessment and the administration of the Autism Diagnostic Observation Schedule-2 (ADOS-2). The remaining 292 participants had other diagnoses, confirmed after a careful psychiatric evaluation and the administration of the Structured Clinical Interview for DSM-5 (SCID-5). The ASDASQ was administered to contact clinicians of each subject.
*Results:* The ASDASQ showed outstanding accuracy (AUC = 0.96) in discriminating between ASD and non-ASD patients, with good sensitivity (0.85) and specificity (0.92). Agreement with clinical diagnosis was substantial (k = 0.68). Internal consistency of the tool was good (Cronbach's alpha = 0.82), while intra- (ICC = 0.97) and inter-rater reliability (ICC = 0.92) were excellent. We found also a moderate correlation between ASDASQ and ADOS-2 scores in the ASD sample (r = 0.56).
*Conclusion:* Our findings suggest that the ASDASQ, in the Italian adaptation, may be considered a quick, simple, and effective tool to screen for ASD among psychiatric outpatients. Further studies are needed to evaluate its utility in other clinical settings.

## 1. Introduction

Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental disorder. According to the criteria of the Diagnostic and

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Statistical Manual of Mental Disorders, 5th Edition (DSM-5), individuals with ASD are characterized by difficulties in communication and social interaction across multiple contexts, and by the presence of repetitive behavioral patterns or restricted interests and activities (American Psychiatric Association, 2013).

The reported prevalence of ASD in the general population has been rapidly growing over recent years, and it has been estimated that around 1.5 % of the general population might be collocated into the autism spectrum (Baxter et al., 2015; Brugha et al., 2016), with a peak among psychiatric patients (Tromans, Chester, Kiani, Alexander, & Brugha, 2018). ASD is frequently diagnosed during childhood, even if a proportion of cases remain undiagnosed until adulthood (Ashwood et al., 2016). Undiagnosed cases are common both in the general population (Lai & Baron-Cohen, 2015) and among psychiatric patients (Mandell et al., 2012; Tromans et al., 2018). Interestingly, after the changes recently occurred in diagnostic criteria, there is an increasing demand for formal ASD diagnoses in adulthood, which may partially explain the rising prevalence of ASD (Fusar-Poli et al., 2017; Mukaetova-Ladinska, Perry, Baron, & Povey, 2012).

Misdiagnoses may be due to the overlapping symptomatology between ASD and other psychiatric conditions, such as psychoses (Nylander, 2014), personality disorders (De Cagna, Squillari, Rocchetti, & Fusar-Poli, 2019), or intellectual disability (Matson & Shoemaker, 2009). Moreover, a large proportion of people with ASD develop comorbid psychiatric symptoms and disorders during adolescence and adulthood (Hollocks, Lerh, Magiati, Meiser-Stedman, & Brugha, 2019; Lugo-Marín et al., 2019). Comorbidities such as these may cause a diagnostic delay or make the core symptoms go unnoticed, posing problems of differential diagnosis with mental health issues (Tromans et al., 2018). Finally, many individuals with ASD, particularly those with high cognitive abilities and women, may develop coping and camouflaging strategies. These strategies may help them masking autistic core symptoms, thus not being easily identified by clinicians who are not familiar with ASD (Hull et al., 2017; Lai et al., 2017).

Guidelines suggest evaluating adults with suspected ASD through a multistep and multidisciplinary assessment (Pilling, Baron-Cohen, Megnin-Viggars, Lee, & Taylor, 2012; Wolf & Ventola, 2014). The assessment should be undertaken by expert and trained professionals, who should carefully consider information about current and past behavior, including early development. For more complex assessments in adults, it is recommended to support the clinical judgment with standardized tools, such as the Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012), the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994), or the Diagnostic Interview for Social and Communication Disorders (DISCO; Wing, Leekam, Libby, Gould, & Larcombe, 2002). Therefore, making a diagnosis in adulthood is particularly complex and time-consuming for clinicians.

Accordingly, in clinical practice, many professionals rely on self-report tools or non-standardized interviews, which are quick, but less reliable. A poor reliability of self-report tools has been noticed especially in the psychiatric context, as psychiatric patients might over- or under-report their symptoms due to poor insight (Bell, Fiszdon, Richardson, Lysaker, & Bryson, 2007; Selten, Wiersma, & van den Bosch, 2000). For instance, Baghdadli, Russet, and Mottron (2017) reported that the use of screening tools commonly used in clinical practice such as the Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001), or the Ritvo Autism Asperger Diagnostic Scale-Revised (RAADS-R; Ritvo et al., 2011), is questionable due to the low number of studies and the high risk of bias retrieved in the validation studies. More recently, Wigham et al. (2019) confirmed that there is very limited evidence to support the use of structured questionnaires (self-report or informant-completed brief measures developed for ASD screening) in the assessment and diagnosis of ASD in adults. Notably, Wigham states that few screening tools can be used specifically to identify ASD within the adult psychiatric population, potentially due to the atypically developing adaptive skills and the presence of psychiatric comorbidities that could partially mask ASD's core symptoms (Wigham et al., 2019).

The Autism Spectrum Disorder in Adults Screening Questionnaire (ASDASQ) is a clinician-rated tool, originally developed to screen for ASD among adult psychiatric outpatients (Nylander & Gillberg, 2001). The ASDASQ consists of ten simple "yes/no" questions, which have to be completed by the contact clinician. In the validation study, Nylander and Gillberg (2001) screened a sample of 1323 adult psychiatric outpatients, aged between 23 and 100 years, with different psychiatric diagnoses, such as psychoses, affective disorders, anxiety disorders, personality disorders, substance use disorders, as well as individuals without any psychiatric disorder. The authors found that at least 1.4 % of the sample had a definite ASD. Seventeen of these patients had been previously diagnosed with other psychiatric conditions. The authors reported that the ASDASQ has shown very good reliability and internal consistency (Cronbach's alpha = 0.85), with a sensitivity of 0.89 and a specificity of 0.96 (Nylander & Gillberg, 2001). However, to our knowledge, after the validation study, only Chang et al. (2003) have examined the psychometric properties of this tool. The authors used the ASDASQ in a clinical sample of 660 adults seeking treatment at an outpatient psychiatric facility in Taiwan. Patients who scored 5 or higher underwent a clinical interview, and 0.6 % of the sample were found to have ASD. The test-retest stability for total scores, over a 2-month interval, was 0.79 for Kendall's τ-b and 0.85 for Spearman's rho correlation. The inter-rater agreement was fair (k = 0.42). No data were reported on sensitivity and specificity.

With the present study, we aimed to evaluate the psychometric properties of the ASDASQ among a group of outpatients referring to an Italian Psychiatry Unit. Particularly, we investigated its reliability and accuracy in discriminating between ASD and other psychiatric conditions.

## 2. Methods

### 2.1. Participants

From September 2018 to December 2019 we recruited 340 outpatients via a Psychiatry Unit in Southern Italy. Participants had to fulfill the following criteria to be included in the present study:

1) Age $\geq$ 18 years;
2) In contact with our Unit for at least three months;
3) Absence of intellectual disability or major cognitive impairment.

Patients who met the inclusion criteria were approached by their referent psychiatrists. Five people with ASD and 29 without ASD refused to participate. All the other patients provided written informed consent and were thus included in the analysis. No significant differences in age, sex, or diagnosis were detected between those who consent and those who refused to participate. The study was approved by our internal review board and was performed in accordance with the Declaration of Helsinki of 1964, as revised in 2008.

### 2.2. Assessment procedures

All participants had received a diagnosis of ASD or another psychiatric disorder according to the DSM-5 criteria. Codes were input into a database alongside socio-demographic and clinical variables.

Individuals with ASD had received confirmation of their diagnosis by at least two clinicians (one senior psychiatrist and one psychiatry trainee), who investigated the early developmental history and current autistic symptomatology. To support clinical judgment, the Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012) was administered with other standardized tools according to international guidelines (Pilling et al., 2012), as part of the procedures adopted in our clinic when a patient with confirmed or suspected ASD requests a visit for the first time. The ADOS-2 is a semi-structured observation composed of five domains: Communication, Reciprocal Social Interaction, Communication and Social Interaction, Imagination and Creativity, and Stereotyped Behaviors and Restricted Interests. The ADOS-2 consists of five modules addressed to children and adults according to their developmental and language levels. All ASD participants included in the present study have been administered Module 4, which has been developed for adolescents and adults with good verbal fluency. For score calculation, we used the original algorithm proposed by Lord et al. (2012).

Other standardized instruments, such as the Autism diagnostic Interview-Revised (ADI-R; Lord et al., 1994), the Wechsler Abbreviated Scale of Intelligence-2nd edition (WASI-II; Wechsler, 2011) or the Vineland Adaptive Behaviors Scales-2nd edition (VABS-II; Sparrow, Cicchetti, & Balla, 2005) are typically administered during the formal ASD assessment. However, as they do not specifically rely on current autistic behavior, they are not object of the present study.

The participants belonging to the non-ASD group had received an extensive clinical evaluation, similar to individuals with ASD, but without the administration of the ADOS-2. In this group, the evaluation was analogously focused on the developmental history, past personal, medical, and psychiatric history, and current symptomatology. Diagnoses were performed by at least two medical doctors (one senior psychiatrist and one trainee in psychiatry) and diagnoses were confirmed using the Structured Clinical Interview for DSM-5 (SCID-5; First, Williams, Karg, & Spitzer, 2015).

### 2.3. Autism Spectrum Disorder in Adults Screening Questionnaire (ASDASQ)

Senior psychiatrists responsible for the patients were asked to complete the Italian version of the Autism Spectrum Disorder in Adults Screening Questionnaire (ASDASQ), a screening tool developed by Nylander and Gillberg and designed to study the prevalence of autism spectrum disorders (ASD) in adult psychiatric outpatients (Nylander & Gillberg, 2001). Assessors were not blind to patients' diagnosis but were chosen because they had sufficient knowledge of the subjects' behavior to complete the questionnaire. Of note, for participants with ASD, the assessor was a different person from the specialist who had administered the ADOS-2.

To assure cross-cultural equivalence, according to the Brislin's model, the ASDASQ was first translated into Italian by a native Italian speaker. To assure consistency between the English and the Italian versions, the translated ASDASQ underwent a back-translation by an English speaker naïve to the questionnaire. This version was compared to the English version of ASDASQ. Discrepancies were thus corrected (Brislin, 1970).

The ASDASQ is composed of nine questions concerning patient's symptoms, plus one item related to previous contact with child psychiatric services. All items have a "yes/no" response, except the one relating to contact with child psychiatry, for which a third alternative ("not known") is included. The first nine items are scored as 0 ("no") or 1 ("yes"). Possible scores can range between 0 and 9, with higher scores indicating more difficulties in the areas investigated by the tool. The questionnaire must be completed by a clinician with substantial knowledge of the patient's history. According to the original validation study, this questionnaire is considered to be positive when the score obtained is greater than or equal to 5 (Nylander & Gillberg, 2001).

### 2.4. Statistical analyses

All variables were tested for normal distribution before statistical procedures were applied. Socio-demographic and clinical variables of the studied population were presented as mean and standard deviations, percentages or counts as appropriate. *t*-Test or chi-squared test were used to identify differences in the sociodemographic and clinical characteristics of the different groups. For multiple comparisons, one-way ANOVA using Tukey's post-hoc calculation was computed.

We studied the following psychometric aspects of the ASDASQ questionnaire: inter-rater and intra-rater reliability, internal consistency, and accuracy. The correlation with a standardized tool (ADOS-2) was computed only for the ASD subgroup.

Inter-rater and intra-rater stability were determined using intraclass correlation coefficient (ICC). To investigate intra-rater reliability, we randomly selected a sample of participants (n = 60) for which the questionnaire was administered to the same raters 4–6

weeks after the first evaluation. Inter-rater reliability was assessed for a group of patients (n = 60), asking to a second staff member (usually a psychiatry trainee who helped the senior psychiatrist during the visits) to rate the questionnaire. Following guidelines by Koo and Li (2016), we used one-way random effect model for inter-rater agreement and two-way random effect model for intra-rater agreement. Values of ICC were interpreted as follows: <0.5 = poor reliability; 0.5–0.74 = moderate; 0.75–0.9 = good; >0.90 = excellent. Internal consistency was calculated by means of Cronbach's alpha (α), which was interpreted as follows: α < 0.5 = unacceptable; 0.5–0.59 = poor; 0.6–0.69 = questionable; 0.7–0.79 = acceptable; 0.8–0.89 = good; ≥0.9 = excellent (Tavakol & Dennick, 2011). Pearson's correlation coefficient (r) was used to test the correlation between ASDASQ and ADOS-2 scores in the ASD sample. Correlation coefficients were interpreted as follows: 0–0.3 = negligible correlation; 0.3–0.5 = low; 0.5–0.7 = moderate; 0.7–0.9 = high; 0.9–1 = very high (Mukaka, 2012).

Receiver operating characteristic (ROC) analyses were used to evaluate the sensitivity and specificity of the ASDASQ. We used the classification proposed by Hosmer, Lemeshow, and Sturdivant (2013) for the interpretation of AUC values (0.5 = no discrimination; 0.51–0.69 = poor; 0.7–0.79: acceptable; 0.8–0.89: excellent; ≥0.9 = outstanding). Cohen's k was used to calculate the agreement between clinical diagnosis and classification with ASDASQ. For data interpretation, we used the cutoffs proposed by Landis and Koch (1977): 0 = no agreement; 0–0.2 = slight; 0.21–0.40 = fair; 0.41–0.60 = moderate; 0.61–0.80 = substantial; 0.81–1 = almost perfect agreement.

Results were considered statistically significant at the $p < 0.05$ level, and all tests were two-tailed. To adjust for multiple comparisons, Bonferroni correction was applied after calculating the AUC and Cohen's k, and the p-value of 0.05 was divided for the number of comparisons (Bland & Altman, 1995). Statistical analysis was performed using IBM SPSS 23.0 software packages (SPSS, Chicago, IL).

## 3. Results

### 3.1. Socio-demographic and clinical characteristics of the sample

We recruited 340 subjects, of which 48 had a diagnosis of ASD. Twelve participants with ASD had also a comorbid condition (depression, n = 7; anxiety, n = 5). The remaining 292 individuals had other primary psychiatric diagnoses, including depressive disorders (n = 146), psychotic disorders (n = 60), anxiety disorders (n = 34), OCD (n = 26) and other disorders, such as personality

**Table 1**
Characteristics of participants.

| | ASD (n = 48) | Non-ASD (n = 292) | Chi-squared or t-test | p-value |
|---|---|---|---|---|
| Age, mean (SD) | 25.51 (6.13) | 44.77 (15.15) | 8.68 | <0.001* |
| Sex, male (%) | 34 (70.8) | 128 (43.8) | 12.04 | 0.001* |
| Educational level, n (%) | | | 8.59 | 0.07 |
| Primary school | 0 (0) | 35 (12) | | |
| Secondary school | 16 (43.7) | 110 (37.7) | | |
| High school | 24 (47.9) | 108 (37) | | |
| Graduated | 8 (8.3) | 39 (13.4) | | |
| Marital status, n (%) | | | 40.2 | <0.001* |
| Never married | 42 (87.5) | 114 (44.8) | | |
| In a domestic partnership | 2 (4.2) | 17 (5.8) | | |
| Married | 4 (8.3) | 117 (40.1) | | |
| Separated/divorced | 0 (0) | 38 (13) | | |
| Widowed | 0 (0) | 6 (2) | | |
| Employment, n (%) | | | 67.56 | <0.001* |
| Full-time | 2 (4.2) | 84 (28.8) | | |
| Part-time | 3 (6.2) | 7 (2.4) | | |
| Unemployed | 21 (43.8) | 105 (35.6) | | |
| Housewife | 0 (0) | 44 (15.1) | | |
| Student | 22 (45.8) | 24 (8.2) | | |
| Retired | 0 (0) | 28 (9.6) | | |
| ADOS-2 scores, mean (SD) | | | | |
| Communication | 3.62 (1.61) | – | – | – |
| Social Interaction | 6.85 (2.38) | – | – | – |
| Communication and Social Interaction | 10.52 (3.63) | – | – | – |
| Imagination/Creativity | 0.89 (0.66) | – | – | – |
| Restricted interests and repetitive behaviors | 1.85 (1.25) | – | – | – |
| Co-occurrent diagnoses, n (%) | | | | |
| Depressive disorders | – | 146 (42.9) | – | – |
| Psychotic disorders | – | 60 (17.6) | – | – |
| Anxiety disorders | – | 34 (10) | – | – |
| Obsessive-compulsive disorder | – | 26 (7.6) | – | – |
| Others | – | 26 (7.6) | – | – |

* Statistically significant with two-tailed p-value < 0.05.

disorders, substance abuse disorders, euthymic bipolar disorder, eating disorders (n = 26).

Mean age and sex were significantly different between the two groups, the ASD sample was younger (25.51 years vs 44.77 years of non-ASD) and included a larger proportion of males (70.8 % vs 43.8 %). As for education level, we did not find significant differences between the two groups. Participants had mainly completed secondary or high school. Patients with ASD were mainly single (87.5 %), while patients in the non-ASD sample were often married (40.1 %). A large number of participants was unemployed. Among ASD participants there were many students (45.8 %). 31.2 % of the non-ASD sample was employed. Characteristics of the ASD and non-ASD samples have been reported in Table 1.

### 3.2. ASDASQ scores for each diagnostic category

The mean score of ASDASQ in the whole sample (both ASD and non-ASD) was 2.09 (SD = 2.37) (range 0–9). Statistically significant differences were detected between the ASD and the non-ASD group. In fact, participants with ASD obtained a mean score of 6.23 (SD = 1.71), while the non-ASD group had a mean score of 1.41 (SD = 1.66), with a mean difference of 4.81 ($t = 18.50$, $p < 0.001$). One-way ANOVA was computed and found an overall significant difference between groups ($F = 101.91$, $df = 5$, $p < 0.001$) and also between ASD and each individual diagnostic category, after the Tukey post-hoc analysis ($p < 0.001$). Among non-ASD groups, individuals with psychoses had the highest mean score (M = 2.92, SD = 1.91), followed by OCD patients (M = 1.81, SD = 1.57), patients with anxiety disorders (M = 1.09, SD = 1.33), and with depressive disorders (M = 0.85, SD = 1.27). The mixed group comprising subjects with other psychiatric diseases obtained a mean score of 1.15 (SD = 1.34). Fig. 1 represents the average scores obtained by each group of patients.

As for individual ASDASQ items, a significant difference in the proportion of "yes" responses was found for each question between the different diagnostic categories. The least discriminant question for ASD appeared to be Q4, related to difficulties in self-care and wearing adequate clothes, while the highest percentage of "yes" was obtained at Q1 (difficulties in social interaction) and Q6 (abnormalities in language or speech). As for Q10, it is worth noting that 62.5 % of participants with ASD had contact with child psychiatry, in contrast with 11.99 % of the non-ASD group. Interestingly, raters never assigned "not known" at Q10, because clinicians usually ask information about the past psychiatric history during the first visit in our clinic, including contacts with child psychiatry (Table 2).

### 3.3. Internal consistency, inter- and intra-rater reliability, and correlation with ADOS-2 scores

Cronbach's alpha of the ASDASQ was 0.82, indicating good internal consistency. Average measures ICC for inter-rater reliability was 0.92 (95 % CI 0.87−0.95), while average measures ICC for intra-rater reliability was 0.97 (95 % CI 0.95−0.98). Both indicated excellent reliability of the test.

We calculated Pearson's correlation coefficient (r) between total ASDASQ score and ADOS-2 Module 4 scores only in the ASD sample. We have found a moderate positive correlation between ASDASQ scores and subscales of the ADOS-2, including the Communication and Social Interaction scale, which is the scale used to distinguish between ASD and non-ASD in the original algorithm proposed by Lord et al. (2012). The Imagination and Creativity domain was the only one that did not appear to significantly correlate with ASDASQ scores. Correlation coefficients are presented in Table 3.

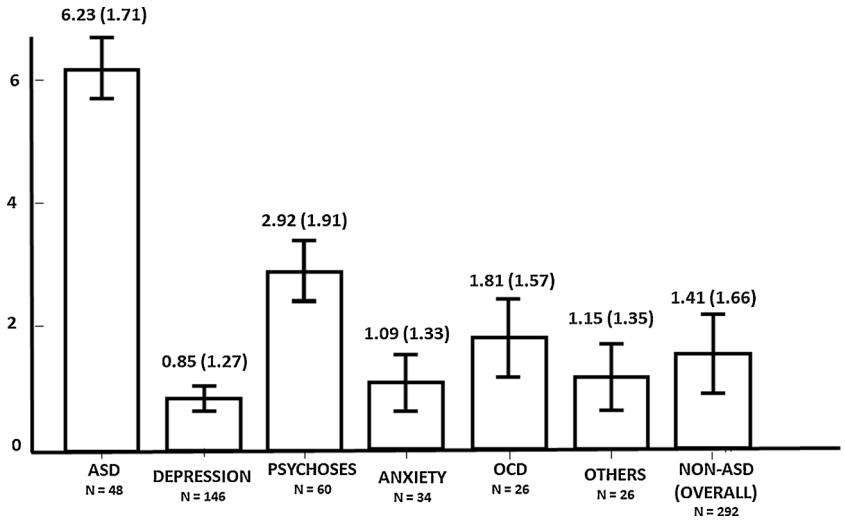


**Fig. 1.** Mean scores (SD) obtained at the ASDASQ by each group.

**Table 2**
Proportion of "yes" responses for each item in the different diagnostic categories.

| Item, n (%) | ASD (n = 48) | Depression (n = 146) | Psychoses (n = 60) | Anxiety (n = 34) | OCD (n = 26) | Others (n = 26) | p-value |
|---|---|---|---|---|---|---|---|
| Q1 | 44 (91.7) | 37 (25.3) | 38 (63.3) | 8 (23.5) | 8 (30.8) | 10 (38.5) | <0.001* |
| Q2 | 32 (66.7) | 12 (8.2) | 23 (38.3) | 3 (8.8) | 4 (15.4) | 4 (15.4) | <0.001* |
| Q3 | 43 (89.6) | 30 (20.5) | 28 (46.7) | 12 (35.3) | 15 (57.7) | 2 (7.7) | <0.001* |
| Q4 | 16 (33.3) | 7 (4.8) | 7 (11.7) | 0 (0) | 2 (7.7) | 0 (0) | <0.001* |
| Q5 | 29 (60.4) | 3 (2.1) | 10 (16.7) | 3 (8.8) | 6 (23.1) | 1 (3.8) | <0.001* |
| Q6 | 44 (91.7) | 7 (4.8) | 16 (26.7) | 3 (8.8) | 4 (15.4) | 2 (7.7) | <0.001* |
| Q7 | 37 (77.1) | 10 (6.8) | 17 (28.3) | 4 (11.8) | 4 (15.4) | 2 (7.7) | <0.001* |
| Q8 | 25 (52.1) | 10 (6.8) | 24 (40) | 2 (5.9) | 1 (3.8) | 8 (30.8) | <0.001* |
| Q9 | 29 (60.4) | 8 (5.5) | 12 (20) | 2 (5.9) | 3 (11.5) | 1 (3.8) | <0.001* |
| Q10 | 30 (62.5) | 6 (4.1) | 15 (25) | 1 (2.9) | 5 (19.2) | 8 (30.8) | <0.001* |

* Statistically significant with two-tailed p-value $< 0.05$.

### 3.4. Accuracy of ASDASQ in discriminating adults with ASD from adults with other psychiatric disorders

ASDASQ showed outstanding accuracy in discriminating between the ASD and non-ASD sample (AUC = 0.96; 95 % CI 0.94−0.98). Of note, we confirm that a score $\geq 5$ can be considered the optimal cut-off, with a sensitivity of 0.85 and a specificity of 0.92. The positive predictive value (PPV) was 0.64, while the negative predictive value (NPV) was 0.97. Agreement between clinical diagnosis and ASDASQ classification was substantial (k = 0.68). Sensitivity, specificity, PPN, NPV, and agreement were calculated to detect the discriminant ability of ASDASQ between ASD and single groups of psychiatric disorders. Only psychoses appeared to be slightly less discriminable from ASD, even if AUC remained still excellent (AUC = 0.89). Fig. 2 represents the ROC curves of ASD vs non-ASD (Fig. 2a) and ASD vs depression, psychoses, anxiety, and OCD (Fig. 2b).

Values of AUC, sensitivity, specificity, PPV, NPV, and Cohen's k are presented in Table 4. After Bonferroni correction (5 comparisons; p = 0.01), all results were regarded as statistically significant with $p < 0.001$.

## 4. Discussion

It is not infrequent for people with ASD to remain undiagnosed or misdiagnosed until adulthood, especially in presence of average or above-average intelligence (Fusar-Poli, Brondino, Politi, & Aguglia, 2020, 2017; Geurts & Jansen, 2012; Happé et al., 2016; Tromans et al., 2018). Also, literature has reported that many adults with ASD have received treatments within the mental health services with other diagnoses (Fusar-Poli, Brondino et al., 2020; Geurts & Jansen, 2012; Tromans et al., 2018). Given the changes in diagnostic criteria and the rising awareness of the condition, the requests for formal ASD assessments are growing considerably, and people may self-refer or be referred by clinicians working in the mental health field (e.g. child and adult psychiatrists, psychologists; Fusar-Poli et al., 2017). However, diagnosing ASD is challenging, time-consuming, and considerable experience and knowledge of the condition is needed to accurately identify such heterogeneous group (Fusar-Poli et al., 2017; Happé et al., 2016). Clinicians often screen for ASD using self-report tools, such as the AQ, or the RAADS-R, which nevertheless might be unreliable, especially in people who refer to metal health services (Baghdadli et al., 2017; Wigham et al., 2019).

In the present paper, we evaluated the internal consistency, reliability, and accuracy of the ASDASQ, a quick, simple, clinician-reported tool, which may help detect individuals with ASD among psychiatric patients. The psychometric properties of the questionnaire were tested in a group of outpatients who referred to an Italian Psychiatry Unit. Participants had established diagnoses of ASD or other psychiatric conditions and were well-known by the clinicians who completed the tool, who were thus unblinded to their condition. In spite of this limitation, our findings are very promising, in line with the results of Nylander and Gillberg (2001) who first developed the tool and used it in clinical practice. Average scores of ASDASQ were significantly different between ASD patients and patients with other psychiatric diagnoses, some of which presented overlapping symptomatology with ASD (e.g. psychoses, OCD). ROC curves confirmed an outstanding accuracy, with a sensitivity of 85.4 % and a specificity of 92.1 %. for ASDASQ scores $\geq 5$. This value represented the cut-off with the best sensitivity-specificity combination, confirming the findings of previous similar studies (Chang et al., 2003; Nylander & Gillberg, 2001).

The group of psychotic patients was the lesser discriminable from ASD through the ASDASQ. This is not surprising since the two conditions present many overlapping symptoms, such as social isolation, socially inappropriate behaviors, low social insight.

**Table 3**
Correlations between ADOS-2 domains and ASDASQ in the ASD group.

| | ADOS-2 | | | | |
|---|---|---|---|---|---|
| | Communication | Social Interaction | Communication and Social Interaction | Imagination/ Creativity | RRB |
| Pearson's r | 0.433** | 0.574** | 0.56** | 0.097 | 0.48** |
| p-value | 0.002 | <0.001 | <0.001 | 0.514 | 0.001 |

** Statistically significant with two-tailed p-value $< 0.01$.

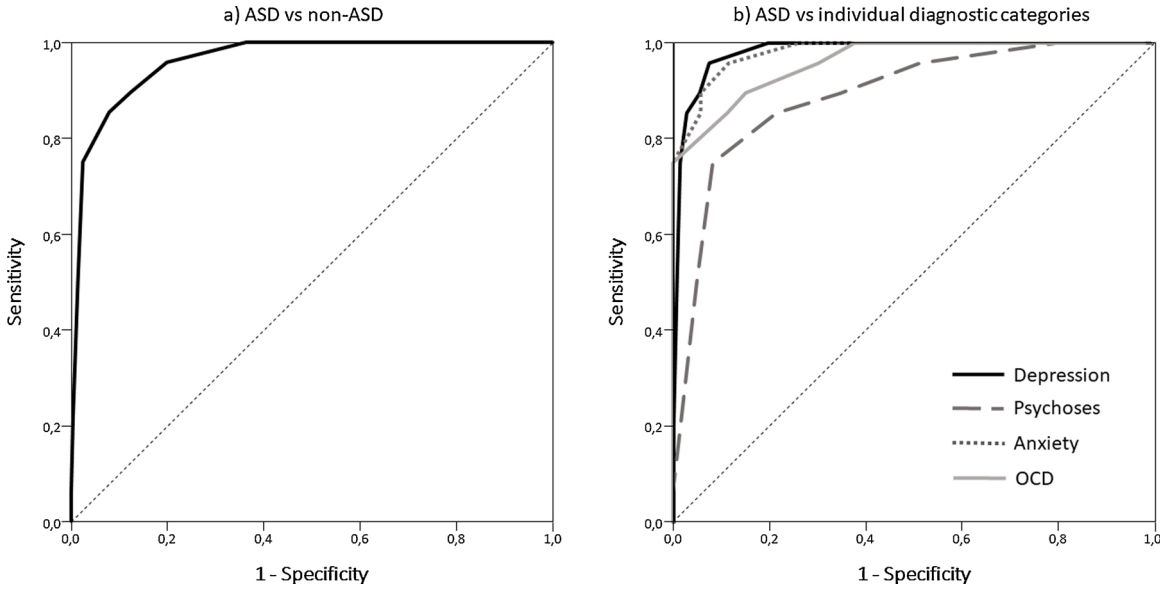


**Fig. 2.** Accuracy of the Italian version of the ASDASQ.

**Table 4**
Accuracy of the ASDASQ and agreement with clinical diagnosis.

| ASD vs. | AUC (95 % CI) | Sensitivity | Specificity | PPV | NPV | Cohen's k |
|---|---|---|---|---|---|---|
| Non-ASD (Overall) | 0.96 (0.94–0.98) | 85.4 % | 92.1 % | 0.64 | 0.97 | 0.68 |
| Depression | 0.98 (0.97–0.99) | 85.4 % | 97.3 % | 0.91 | 0.95 | 0.84 |
| Psychoses | 0.89 (0.83–0.95) | 85.4 % | 78.3 % | 0.76 | 0.87 | 0.63 |
| Anxiety | 0.98 (0.96–1) | 85.4 % | 94.1 % | 0.95 | 0.82 | 0.78 |
| OCD | 0.96 (0.92–0.99) | 85.4 % | 88.5 % | 0.93 | 0.77 | 0.71 |

ASD = Autism Spectrum Disorder; AUC = Area Under Curve; NPV = Negative Predictive Value; OCD = Obsessive-compulsive disorder; PPV = Positive Predictive Value. After Bonferroni correction (5 comparisons; $p = 0.01$), all AUC and Cohen's k values were statistically significant with two-tailed p-value $< 0.001$.

Additionally, thought disorders and the use of an atypical or nonsensical language (e.g. tangentiality, circumstantiality, neologisms) are common to both conditions. In these more challenging cases, the collection of a detailed developmental and clinical history of the individual might be crucial in determining the onset of the disease and thus distinguishing between ASD and psychosis. As ASD typically manifests during early childhood, the onset of psychotic conditions usually lies in adolescence or early adulthood. Moreover, some symptoms, such as delusions or hallucinations, are not common in ASD in absence of a co-occurrent psychosis. Also, some patterns of speech (e.g. the "word salad", in which words are jumbled together without an apparent meaning) are specific of schizophrenia (Fusar-Poli, Ciancio et al., 2020; Lai & Baron-Cohen, 2015; Nylander, 2014). Our finding is not surprising; in fact, it has been reported that other standardized diagnostic tools, such as the ADOS-2, may present some difficulties in discriminating ASD from schizophrenia-like disorders (Bastiaansen et al., 2011; Fusar-Poli et al., 2017; Maddox et al., 2017).

The ASDASQ showed good internal consistency, with a Cronbach's alpha of 0.82, and excellent intra- and inter-rater reliability in two subsamples ($n = 60$ each), indicating the reliability of the test even when administered at different time points or by different clinicians. Notably, ASDASQ scores showed a moderate correlation with ADOS-2 scores, which is the most widely used instrument for the diagnostic assessment of ASD, also in adulthood. It is worth noticing the correlation with the Communication and Social Interaction domain ($r = 0.56$) which according to the ADOS-2 original algorithm is determinant in collocating an individual into the autism spectrum.

Even if our study presents interesting findings, it is important to address several limitations. First of all, we did not conduct a naturalistic study in which we sought to identify misdiagnosed or undiagnosed patients with ASD; conversely, we recruited patients who had already been followed by our Psychiatry Unit for at least three months and had already received a formal psychiatric diagnosis according to the DSM-5 criteria. On one hand, this could be considered a limitation, since clinicians were not blinded to participants'

diagnoses and might have been influenced while completing the questionnaire. On the other hand, psychiatric assessments were extensive and conducted rigorously; in particular, ASD diagnoses were confirmed after a comprehensive clinical assessment and administration of proper standardized tools. We have thus avoided the inclusion of people belonging to the broad autism phenotype or individuals who presented some autistic traits, but not the impairment required by the DSM-5 criteria. Moreover, clinicians had in-depth knowledge of the current and past medical and psychiatric history of the patients for whom they completed the ASDASQ. Another limitation is that we could calculate the correlation between ASDASQ and the ADOS-2 scores only in the ASD sample. In fact, the ADOS-2 was administered only to patients with ASD as part of the standardized assessment, and due to lack of time and personnel it was not possible to Also, the sample size might be not sufficiently large, especially in some groups of patients (i.e. anxiety, OCD). However, we have planned to enlarge the sample to replicate our findings, maybe focusing on specific diagnostic categories. As far as concerns the ASD group, in particular, it is worth mentioning that overall sensitivity was 0.85, thus indicating that a small proportion of subjects with ASD ($n = 7$) did not score above the cut-off of 5. This confirms that some individuals with ASD, especially those with high cognitive abilities or females, may develop coping and camouflaging strategies that help them cover the core symptomatology, which might not be perceived by their contact clinicians (Cage & Troxell-Whitman, 2019); Hull et al., 2017; Hull, Petrides, & Mandy, 2020; Lai et al., 2017). In the future, it would be desirable to evaluate the differences in terms of accuracy between females and males, as the phenotypical presentation might be slightly different and thus not completely caught by the questionnaire. Finally, the study was conducted recruiting only outpatients followed by a Psychiatry Unit in Italy, including only adult subjects without cognitive impairments. Therefore, we cannot generalize our findings to other populations, such as children and adolescents, inpatients, or individuals with intellectual disabilities. Nevertheless, we underline that our results are comparable to the findings of previous studies conducted in Sweden (Nylander & Gillberg, 2001) and Taiwan (Chang et al., 2003), which supports the cross-cultural validity of the ASDASQ.

In conclusion, considering the lack of valid tools for the screening of ASD among psychiatric outpatients, and the importance of timely and correct identification of this condition, especially when psychiatric comorbidities are present, we can suggest clinicians use the ASDASQ to support the identification of suspected cases of ASD. This questionnaire is quick and easy to administer, representing an optimal tool for mental health professionals, general practitioners, and other clinicians. Additionally, it does not require specific training, but only sufficient knowledge of patient's past and present behaviors. Of note, given the high prevalence of medical comorbidities in this population, such as epilepsy and gastrointestinal disorders (Brondino et al., 2019; Fusar-Poli et al., 2019), it is likely that specialists from other disciplines may encounter individuals with ASD that are undiagnosed during their clinical practice.

Crucially, correct identification of suspected cases of ASD may allow the implementation of specific interventions and outcome improvement. In this sense, the administration of ASDASQ might be useful to avoid time-consuming and complex assessment to people who unlikely require a diagnosis of ASD. In fact, it has been reported that the number of people who are asking for first formal ASD assessment in adulthood is rapidly increasing (Lai & Baron-Cohen, 2015), but many of them do not finally receive an ASD diagnosis (Fusar-Poli et al., 2017; Happé et al., 2016). The use of ASDASQ as a screening tool may help avoid unnecessary assessment for the condition. Future research should test the reliability and validity of ASDASQ in different clinical settings, such as child psychiatry, general practice, and pediatrics.

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## Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Declaration of Helsinki of 1964, as revised in 2008.

## Authors' contributions

LF conceived the study, participated in data collection, performed statistical analyses and wrote the first draft of the manuscript. EB participated in data collection and contributed to write the first draft of the paper. NB, IC, TS, ST, AV, and RF participated in data collection and critically contributed to the interpretation of data. LN critically contributed to the interpretation of data and to the first draft of the manuscript. MS and EA supervised the project, participated in data collection, and in writing the manuscript. All authors have read and approved the final version of the paper.

## Data availability statement

Data are confidential are can be provided by the authors upon request.

## Declaration of Competing Interest

LN developed the original version of the ASDASQ. All the other authors declare that they have no conflicts of interest.

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## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.rasd.2020.101668.

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