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Diagnostic Accuracy of the French Version of the Adult Attention Deficit / Hyperactivity Disorder Self-Report Screening Scale for DSM-5 (ASRS-5)

Stéphanie Baggio[1,2] · Sophie Bayard[3,4,5] · Clémence Cabelguen[6] · Martin Desseilles[7] · Marie Gachet[8] · Charlotte Kraemer[9] · Hélène Richard-Lepouriel[10] · Rosetta Nicastro[10] · Stéphanie Bioulac[11] · Anne Sauvaget[12] · Sébastien Weibel[9,13] · Nader Perroud[10,14,15] · Régis Lopez[16,17]

Abstract

Attention Deficit/Hyperactivity Disorder (ADHD) often persists into adulthood. However, few screening tools have been adapted to assess adult ADHD using the DSM-5 criteria. This study assessed the diagnostic accuracy of a French version of the ADHD Self-Report Screening for DSM-5 (ASRS-5). This multicentric cross-sectional study included 557 participants: 309 adult ADHD outpatients without bipolar disorder (BD)/borderline personality disorder (BPD) ($n = 236$) or with BD/BPD ($n = 36$) and 285 adults without ADHD who were either healthy volunteers ($n = 248$) or outpatients with BD or BPD ($n = 37$). Measures included ADHD diagnosis and the ASRS-5. The ASRS-5 was a good predictor of ADHD diagnosis (cut-off score ≥ 13/24: sensitivity = 84.3%, specificity = 91.9%) in the sample of adult outpatients without comorbid disorders/healthy controls. Performances were lower with this cut-off score in some subgroups, notably low-severity ADHD symptomatology (sensitivity = 63.5%) and participants with BD or BPD (sensitivity = 91.7%, specificity = 54.1%). The French ASRS-5 had acceptable screening properties, even if its performance varied according to clinical variables. Further evidence is needed for patients with comorbid disorders having overlapping symptoms.

Keywords Assessment · Screening · Validation

Nader Perroud and Régis Lopez contributed equally to this work.

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✉ Stéphanie Baggio
stephanie.baggio@hcuge.ch

1 Division of Prison Health, Geneva University Hospitals and University of Geneva, Chemin du Petit Bel Air 2, 1226 Thônex, Switzerland

2 Office of Corrections, Canton Zurich, Zurich, Switzerland

3 University Paul Valéry Montpellier 3, Montpellier, France

4 University of Montpellier, Montpellier, France

5 EPSYLON EA 4556, Montpellier, France

6 Department of Psychiatry, University Hospital of Nantes, Nantes, France

7 Department of Psychology, Faculty of Medicine, University of Namur, Namur, Belgium

8 Department of Emergency Psychiatry & Acute Care, CHU Montpellier, Montpellier, France

9 Department of Psychiatry, University Hospital of Strasbourg, Strasbourg, France

10 Division of Psychiatric Specialties, Department of Psychiatry, University Hospitals of Geneva, Geneva, Switzerland

11 Clinique du sommeil, CHU Pellegrin Boreaux, USR CNRS 3413, Université Bordeaux, Bordeaux, France

12 CHU Nantes, Movement - Interactions - Performance, MIP, EA 4334, Nantes Université, Nantes, France

13 Inserm U1114, Strasbourg, France

14 Department of Psychiatry, Faculty of Medicine, University of Geneva, Geneva, Switzerland

15 Department of Psychiatry, Dalhousie University, Halifax, Nova Scotia, Canada

16 Department of Neurology, CHU Montpellier, Montpellier, France

17 Inserm U1061, Montpellier, France

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Introduction

There is increasing evidence that attention deficit/hyperactivity disorder (ADHD), a child-onset neurodevelopmental disorder, persists in adulthood (Caye et al. 2016; Kooij et al. 2010). It leads to functional impairment in several areas of life: psychosocial functioning, work, health care access and use, criminality and recidivism (Ginsberg et al. 2014; Mohr-Jensen and Steinhausen 2016; Philipp-Wiegmann et al. 2017; Young et al. 2015). Adult ADHD is also associated with comorbid psychiatric disorders, substance use, comorbid somatic diseases, and excess mortality because of the increase risk of suicide and accident (Asherson et al. 2016; Dalsgaard et al. 2015; Instanes et al. 2018; Shaw et al. 2012). Because of this long-term impairment, adult ADHD has become a major health concern (Asherson et al. 2016; Franke et al. 2018). Nevertheless, ADHD is often under-diagnosed and under-treated in adult populations (Weibel et al. 2020). Identifying adult ADHD with reliable screening scales has become crucial in primary care and for public health purposes.

To better take into account adult ADHD, the threshold of ADHD diagnosis has been revised in the fifth version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, APA 2013) compared to the fourth edition (DSM-IV, APA 2000). In the revised version, ADHD diagnosis requires a reduced number of symptoms during adult adulthood (five instead of six). In addition, changes in symptom wording for adolescents and adults have been added and are developmentally more appropriate. These changes better capture ADHD features in adulthood (Matte et al. 2015). Finally, although it does not specifically impact adult ADHD, the age of onset of ADHD symptoms has been changed (twelve instead of six).

To date, however, few screening scales have been adapted to assess adult ADHD using DSM-5 criteria. The widely used Adult ADHD Self-Report Screening Scale (ASRS v1.1), which is the World Health Organization's self-reported screening tool for ADHD in adults (Kessler et al. 2005, 2007), has recently been updated (ASRS-5) to better match DSM-5 ADHD diagnosis (Ustun et al. 2017). The ASRS-5 yields good psychometric properties in a US sample from the general population (Ustun et al. 2017). The ASRS-5 includes four items from the ASRS v1.1 and two new non-DSM criteria (Kessler et al. 2010). To date, this screener has not been tested nor validated in any other language than English. In addition, even if some studies investigated the influence of other variables on the ASRS screening tool and compared psychometric performance across groups (Sonnby et al. 2015; van de Glind et al. 2013), few studies investigated psychometric properties according to clinical characteristics. The impact of comorbidity on psychometric performance is also often neglected, even if ADHD is comorbid with some psychiatric disorders or share similar symptoms with others. For example, bipolar disorder (BD) and borderline personality disorder (BPD) are two highly comorbid disorders which have overlapping symptomatology with ADHD (Perroud et al. 2014; Weibel et al. 2018). The ASRS v1.1 showed reduced psychometric performances among patients with comorbid ADHD and BPD (sensitivity = 72.8%, specificity = 43.9%; Weibel et al. 2018). Similar results were obtained among BD patients (false positives = 40%; Perroud et al. 2014) Therefore, including populations with comorbid disorders is crucial to achieve a better understanding of the psychometric performance of the ASRS-5.

Thus, the aim of our study was to examine the diagnostic accuracy of the French version of the ASRS-5. We also explored whether it was a reliable screening tool in detecting ADHD among different subgroups of the population, according to relevant clinical variables (severity, clinical presentation, and the presence of psychiatric comorbid disorders: BD and BPD).

Methods

Participants and Procedure

From 2018 to 2019 (10 months), 557 participants were included in the study: 309 adult ADHD outpatients without BD/BPD ($n = 236$) or with BD/BPD ($n = 36$) and 285 adults without ADHD who were either healthy volunteers ($n = 248$, no formal ADHD diagnosis) or outpatients with BD or BPD ($n = 37$).

Adult outpatients with ADHD were recruited in six specialized French-speaking centers for the diagnosis and treatment of ADHD, located in France (Bordeaux, Montpellier [two centers], Nantes, and Strasbourg) and Switzerland (Geneva). All patients met the DSM-5 criteria for ADHD that require five symptoms or more in adulthood and six or more before the age of twelve, with significant impairment in at least two areas of daily life during the last 6 months prior to the interview and in childhood. All patients were assessed by clinicians having a long-lasting (more than 5 years) expertise in the assessment of adult ADHD and using structured clinical instruments (the ADHD evaluation adult version, ACE+, Young 2016) or the Diagnostic Interview for ADHD (DIVA 2.0, Kooij and Francken 2010) according to DSM-5 criteria. The presence of ADHD symptoms during childhood was systematically assessed using collateral reports and/or school records. Other mental health disorders, except BD (types 1 and 2) and BPD, were not considered in the study. The three ADHD clinical presentations were defined at the time of the interview: predominantly inattentive, predominantly hyperactive–impulsive, and combined presentation.

Healthy participants were community-dwelling adults who were recruited in Montpellier by means of advertisements, personal contacts, and through snowballing techniques. Three participants were not included due to a past or actual diagnosis of ADHD. They self-completed the ASRS-5 at the Laboratory Epsylon (University Paul Valery Montpellier 3). The interviewers (trained final-year students) ensured that the questionnaire was adequately completed. After that, they had a face-to-face interview including medical information and socio-demographics.

BP/BPD patients without ADHD (BD: $n = 26$, BPD: $n = 11$) were recruited in a specialized center for the treatment of these disorders in Geneva. Detailed information and descriptive statistics on the different centers are reported in Table 1.

All participants provided written informed consent to participate in the study. The study was approved by the local Ethics Committee of the Geneva University Hospitals (no. 2019–00991).

Measures

ADHD Diagnosis The diagnosis of ADHD was made or excluded by experienced clinicians, using validated and structured clinical interviews: the ADHD evaluation adult version (ACE+, Young 2016) or the Diagnostic Interview for ADHD (DIVA 2.0, Kooij and Francken 2010). The ACE+ is a semi-structured interview translated in French designed to assess ADHD in adults according to the DSM-5 criteria. It was used in one center (Geneva, $n = 128$). The remaining centers used the DIVA 2.0 ($n = 181$), a semi-structured clinical interview, originally designed to assess ADHD symptoms and related impairment according to the DSM-IV criteria. The DIVA 2.0 has been slightly modified to fulfil the DSM-5 criteria, by changing the age at onset cut-off from 7 to 12 years of age and lowering the required number of symptoms in adulthood from six to five.

We also created groups according to ADHD severity using the diagnostic interview (DIVA 2.0 and ACE+). We summed up symptoms during adulthood and created groups corresponding to the four quartiles: low (5–9), moderate (10–11), high (12–14), and very high (15–18) severity.

ASRS-5 We used the World Health Organization Adult ADHD Self-Report Screening Scale for DSM-5 (ASRS-5, Ustun et al. 2017). Each of the six items is scored on a four-point Likert-type scale: 0 (*never*), 1 (*rarely*), 2 (*sometimes*), 3 (*often*), and 4 (*very often*), resulting in a scale with scores ranging from 0 to 24. In outpatient centers, the ASRS-5 was administered within 1 month after the clinical evaluation.

The translation process of the scale in French was as follows: (1) the scale was translated in French by the first author (SB); (2) NP translated the French version back into English; and (3) all discrepancies between the original English scale and the French translation were discussed between the two authors until an agreement was reached. The final version of the French ASRS-5 is presented in Supplementary Table S1.

Demographic and Clinical Characteristics We also collected information on gender, age, level of education (*secondary education* vs. *higher education*), and having any prescription of psychotropic medication including psychostimulants (*yes/no*).

Analytical Strategy

Sample Size Calculation We used a non-inferiority test to define how many participants were needed to obtain a similar AUC as in the first validation study (Ustun et al. 2017). We used *alpha* = 5%, *power* = 80%, margin of equivalence = 10% (Salazar et al. 2016), $AUC = 0.94$ (Ustun et al. 2017), and *allocation ratio* = 1. A total of $n = 98$ (49 participants in each group) was needed. For the comorbid sample, we used $AUC = 0.83$ (Ustun et al. 2017). A total of $n = 48$ (24 participants in each group) was needed. The sample size was calculated for our main objective (diagnostic accuracy of the French version of the ASRS-5). The other objective was exploratory.

Preliminary Analyses We first computed descriptive statistics (means/standard deviations or percentages) for all variables and we compared socio-demographics between groups (ADHD patients without BD/BPD vs. healthy control group and BPD/BD patients with ADHD vs. BPD/BD patients without ADHD) using Chi-square tests. We also investigated whether the ASRS-5 was normally distributed using indices of symmetry and skewness along with significance tests.

Then, we performed five sets of analyses:

ASRS-5 in the Whole Sample We first used receiver operating characteristic (ROC) curves to test whether the ASRS-5 was a good indicator of ADHD, using ADHD patients without BD/BPD ($n = 236$) and the healthy control group ($n = 248$). The ROC curve is a probability curve of the diagnostic ability of a binary classifier.

Comparisons between Subgroups Then, we tested whether the ASRS-5 performed equally for different subgroups of the sample. We computed separate ROC curves for (1) ADHD severity and (2) ADHD presentations. The number of participants in each subgroup is reported in Table 1.

Sensitivity Analysis As psychotropic treatments (including stimulants) may affect ADHD symptoms, we ran a sensitivity analysis excluding participants who were on psychotropic medication in the non-BD/BPD ADHD group ($n = 60$). We also computed separated models for participants who had the DIVA 2.0 and the ACE+.

Table 1 Descriptive statistics of the sample

n	ADHD without BPD/BD 236	Healthy volunteers 248	BPD/BD with ADHD 36	BPD/BD without ADHD 37
Socio-demographics				
Gender				
Male	50.4 (115)	44.8 (111)	25.0 (9)	21.6 (8)
Female	49.6 (113)	55.2 (137)	75.0 (27)	78.4 (29)
Missing values	*n* = 8	–	–	–
Age				
Emerging adults (18–29 years)	48.0 (109)	23.0 (57)	27.8 (10)	24.3 (9)
Adults (30–49 years)	44.1 (100)	39.5 (98)	61.1 (22)	51.4 (19)
Ageing adults (50+ years)	7.9 (18)	37.5 (93)	11.1 (4)	24.3 (9)
Missing values	n = 9	–	–	–
Level of education				
Secondary or lower	36.8 (75)	15.3 (38)	75.9 (22)	57.1 (12)
Tertiary	63.2 (129)	84.7 (210)	24.1 (7)	42.9 (9)
Missing values	*n* = 32	–	n = 7	n = 16
Clinical variables				
Any psychotropic medication				
No	70.4 (143)	100 (248)	50.0 (17)	27.0 (10)
Yes	29.6 (60)	0 (0)	50.0 (17)	73.0 (27)
Missing values	*n* = 33	–	–	–
ADHD severity				
Low (5–9 symptoms)	23.0 (52)	–	8.6 (3)	–
Moderate (10–11 symptoms)	21.7 (49)	–	11.4 (4)	–
High (12–14 symptoms)	27.9 (63)	–	34.3 (12)	–
Very high (15–18 symptoms)	27.4 (62)	–	45.7 (16)	–
Missing values	*n* = 10	–	n = 1	–
ADHD presentation				
Inattentive	50.4 (115)	–	27.8 (10)	–
Combined/hyperactive	49.6 (113)	–	72.2 (26)	–
Missing values	n = 8	–	–	–
Comorbid disorder				
Bipolar disorder	–	–	44.4 (16)	70.3 (26)
Borderline personality disorder	–	–	55.6 (20)	29.7 (11)

Percentages and n (shown in brackets) are given

ADHD: Attention Deficit hyperactivity disorder, BPD: borderline personality disorder, BD: bipolar disorder, ASRS: Adult ADHD Self-Report Screening Scale

[1] Education: 4 missing values

[2] Education: 26 missing values

ASRS-5 in BPD/BD Patients with or without ADHD Also using ROC curves, we also tested whether the ASRS-5 was a good indicator of ADHD among participants with comorbid BPD and/or BD. We compared BPD/BD patients with ADHD (n = 36) with the group of BPD/BD without ADHD (n = 37).

For these five sets of analyses, we derived the area under the curve (AUC, which tells how much the model discriminate between those with and without the disease), sensitivity (true positive rate) and specificity (true negative rate). For AUC, the following criteria were used: 0.5: no discrimination, 0.7–0.8:

acceptable, 0.8–0.9: excellent, and > 0.9: outstanding (Mandrekar 2010). For sensitivity and specificity, values close to 100% are ideal (van Stralen et al. 2009). The Youden's *J* statistic allows selecting the optimum cut-off point. It gives an equal weight to sensitivity and specificity, was used to select the best cut-off score: max (sensitivity + specificity – 1).

Analyses were performed with Stata 15. The sample size calculation was performed with easyROC version 1.3.1 (http://www.biosoft.hacettepe.edu.tr/easyROC).

Results

Description of the Population

The description of the sample is reported in Table 1. Overall, there was 55.7% of females and 44.3% of males. The mean age of the participants was 37.9 ± 14.7. A total of 70.7% of participants had a secondary level of education. Participants in the BPD/BD samples (with and without ADHD) were less likely to have a secondary level of education (32.0%). Among ADHD participants, 47.3% had the inattentive presentation and 52.7% the combined/hyperactive presentation (seven participants had the hyperactive presentation). A total of 104 patients (20.9%) were on one psychotropic medication or more.

In the sample without comorbid disorders, participants with ADHD were significantly younger ($p < .001$) and had a lower level of education ($p < .001$) than healthy volunteers. There was no significant difference for gender ($p = .215$). In the sample with comorbid disorders, participants with and without ADHD were not significantly different (gender: $p = .740$, age: $p = .336$, and level of education: $p = .162$).

Description of the French ASRS-5

The distributions of the ASRS-5 score are reported in the Supplementary Figure 1 separately for the ADHD groups (with and without BPD/BD) and the control groups (healthy participants and BPD/BD without ADHD). The ASRS-5 was approximately normally distributed in each group, without floor or ceiling effects. Scores are more often below median for the control groups and above median for ADHD groups. The mean score was 16.1 ± 3.4 in the ADHD groups and 8.2 ± 4.0 in the control groups. Detailed information for all groups (two ADHD groups and two control groups) are reported in Table 2.

ASRS-5 Performances in Patients with ADHD but without BPD/BD and Healthy Controls

The performances of the ASRS-5 in predicting ADHD diagnosis are reported in Table 3. The AUC was outstanding (.945), with the best cut-off score of 13/24 leading to a sensitivity of 84.3% and a specificity of 91.9%.

Table 2 Description of the ASRS-5

	ADHD without BPD/BD	Healthy volunteers	BPD/BD with ADHD	BPD/BD without ADHD
n	236	248	36	37
Items				
1. Difficulties concentrating on what people say to you	2.88 (0.91)	1,37 (0.94)	2.78 (0.76)	1.84 (1.01)
2. Leave your seat in situations in which you are expected to remain seated	1.59 (1.29)	0.63 (0.97)	1.75 (1.11)	1.03 (0.87)
3. Difficulties unwinding and relaxing	2.79 (1.18)	1.47 (1.14)	3.31 (0.98)	2.35 (1.06)
4. Finish others' sentences	2.65 (1.19)	1.46 (1.08)	2.81 (1.09)	2.35 (1.21)
5. Put things off until the last minute	3.45 (0.83)	1.79 (1.12)	3.53 (0.69)	2.73 (1.31)
6. Depend on others to keep your life in order	2.58 (1.22)	0.86 (0.92)	2.69 (1.17)	2.73 (1.48)
Total score				
Sum-score	15.94 (3.47)	7.57 (3.58)	16. 86 (2.84)	12.08 (4.62)
Skewness	−0.36 ($p = .025$)	0.46 ($p = .004$)	−0.29 (ns)	−0.05 (ns)
Kurtosis	2.98 (ns)	2.97 (ns)	2.75 (ns)	2.34 (ns)

ADHD: Attention deficit hyperactivity disorder, BPD: borderline personality disorder, BD: bipolar disorder, ASRS: Adult ADHD Self-Report Screening Scale

ASRS-5 Performances According to Clinical Characteristics

All results obtained in ADHD patients without BPD/BD and healthy controls are summarized in Table 4.

ADHD Severity The performances of the ASRS-5 were separately assessed in each severity group. The AUCs obtained in the four groups were different, with the best performances obtained in the very high-severity group ($AUC = .977$, best cut-off score = 13/24 with $sensitivity = 95.2\%$). In the low-severity group, the AUC was .844, with the best cut-off score of 10/24 leading to a sensitivity of 88.5% and a specificity of 86.0%. For the cut-off score of 13, the sensitivity was rather low (63.5%, false negative rate = 36.5%). The moderate- and high-severity groups displayed good psychometric properties

Table 3 Performance of the ASRS-5 compared to diagnosis of ADHD, general sample ($n = 484$)

Cut-off score	Sensitivity	Specificity
Everybody	100	0.0
≥ 1	100	0.4
≥ 2	100	2.8
≥ 3	100	5.7
≥ 4	100	10.5
≥ 5	100	20.6
≥ 6	100	33.5
≥ 7	98.7	43.6
≥ 8	98.7	52.0
≥ 9	97.5	60.5
≥ 10	95.8	71.8
≥ 11	92.8	79.0
≥ 12	89.4	85.5
≥ 13	**84.3**	**91.9**
≥ 14	78.0	94.0
≥ 15	69.1	95.6
≥ 16	55.5	98.0
≥ 17	46.2	98.8
≥ 18	33.9	99.6
≥ 19	23.3	99.6
≥ 20	17.0	99.6
≥ 21	8.5	100
≥ 22	3.4	100
≥ 23	1.7	100
≥ 24	0.4	100
Nobody	0.0	100

ADHD: Attention deficit hyperactivity disorder, ASRS-5: Adult ADHD Self-Report Screening Scale according to the Diagnostic and Statistical Manual of Mental Disorders, fifth edition

The best model is highlighted in bold

(*AUC* = .958 and .951, *sensitivity* = 89.8% and 87.3% with a cut-off score of 13).

ADHD Presentations Using the cut-off score of 13/24, the screener performed very well for patients with the combined/hyperactive presentation (*AUC* = .970, *sensitivity* = 92.2%). The performance was a little lower for patients with the inattentive presentation (*AUC* = .918, *sensitivity* = 75.7%). A cut-off score of 12 was better (*sensitivity* = 82.6%, *specificity* = 85.5%).

Sensitivity Analysis In the final analysis excluding participants who were on psychotropic medication, the AUC was outstanding (.943) and the cut-off score of 13 yielded acceptable psychometric performances (*sensitivity* = 83.9%, *specificity* = 91.9%).

Performances were similar for participants who completed the DIVA 2.0 with the best cut-off score being 13 ($n = 163$, *AUC* = .951, *sensitivity* = 86.0%) and the ACE+ ($n = 73$, *AUC* = .931, *sensitivity* = 80.8%).

ASRS-5 Performances in BPD/BD Patients with or without ADHD

In patients with BD/BPD, the AUC obtained was fair (.801). The best cut-off score was also 13/24, with a sensitivity of 91.7%, but a specificity of 54.1% leading to a high proportion of false positives (45.9%) (see Table 5).

Discussion

The purpose of this study was to confirm the diagnostic accuracy of the Adult ADHD Self-Report Screening Scale for DSM-5 (ASRS-5) in a sample of French-speaking adults with ADHD and non-ADHD controls.

Performance in Patients with ADHD but without BPD/BD and Healthy Controls

The French version of the ASRS-5 did not perform as well as expected in our sample of French-speaking participants. In the first English validation study, the ASRS-5 offered acceptable performances in identifying ADHD patients in two separate samples, with a sensitivity ranging from 91.4% to 91.9% and a specificity ranging from 74.0 to 96.0% with a cut-off score of 14/24 (Ustun et al. 2017). Applying the same threshold, the sensitivity was 78.0% with a specificity of 94.0% in our study. However, this threshold was not the best one, and we identified a better cut-off score (≥13) with 8.1% of false positives and 15.7% of false negatives. The high rate of misclassification for false negatives was in line with studies reporting that adults are likely to be under-diagnosed (Ginsberg et al. 2014), contrariwise to children (Layton et al. 2018). Consequently, adults with ADHD are likely to be under-treated.

Performance According to Clinical Characteristics

The ASRS-5 did not perform equally among different subgroups of the population. The threshold to define ADHD should be adapted to keep acceptable sensitivity and specificity. This was the case for ADHD patients with a less severe symptomatology (≥10) and ADHD patients with the inattentive presentation (≥12). Thus, researchers and clinicians should be aware that the ASRS-5 probably misses individuals with less severe ADHD symptoms. Indeed, the cut-off score of 13 yielded 36.5% false negatives. This result contradicts previous findings suggesting that the psychometric properties of the ASRS are similar in different groups (van de Glind et al.

Table 4 Performances of the French version of the ASRS-5 according to demographic and clinical characteristics

	Cut-off score	Sensitivity	Specificity	AUC
Severity				
Low severity (5–9 symptoms)	≥10	88.5%	71.8%	.8-84
Moderate severity (10–11 symptoms)	≥13	89.8%	91.9%	.9-58
High severity (12–14 symptoms)	≥13	87.3%	91.9%	.9-51
Very high severity (15–18 symptoms)	≥13	95.2%	91.9%	.9-77
Clinical presentations				
ADHD inattentive	≥12	82.6%	85.5%	.9-18
ADHD hyperactive/combined	≥13	92.9%	91.9%	.9-70

ADHD: Attention deficit hyperactivity disorder, ASRS-5: Adult ADHD Self-Report Screening Scale according to the Diagnostic and Statistical Manual of Mental Disorders, fifth edition, AUC: area under the curve. Percentages and n under brackets are reported

[1] Six participants had the hyperactive presentation

2013). This is an important issue, as even less severe symptomatology can lead to significant impairment in life. A screening tool should be useful for the whole range of the disorder, and not the most severe cases. Future research should focus on accurate identification of mild ADHD.

The ASRS-5 performed better to identify participants having the combined/hyperactive presentations. This might be because three out six items of the ASRS-5 rely to hyperactive/impulsive symptoms (items #2, #3 and #4). Furthermore, patients with combined presentation had a more severe ADHD symptomatology, as they could have 18 symptoms (maximum = 9 symptoms for the inattentive presentation).

Performance among Patients with BPD/BD

Finally, the ASRS-5 performed worse when participants had disorders that share common symptoms with ADHD. Indeed, the screener failed to identify ADHD among patients with BPD or BD, two frequent comorbid psychiatric disorders in ADHD which share common features and overlapping symptoms (i.e., impulsivity, emotional lability/dysregulation, interpersonal deficits, risk-taking behaviors, and inner restlessness, Perroud et al. 2014; Weibel et al. 2018). In participants with BPD or BD, the percentage of false positives was very high (45.9%), meaning that these patients were often misclassified as having ADHD. Therefore, clinicians should keep in mind that the ASRS-5 is not a reliable screener to detect ADHD for

Table 5 Performance of the ASRS-5 compared to diagnosis of ADHD, clinical sample ($n = 73$)

Cut-off score	Sensitivity	Specificity
Everybody	100	0.0
≥ 3	100	2.7
≥ 7	100	5.4
≥ 8	100	13.5
≥ 9	100	21.6
≥ 10	100	40.5
≥ 11	97.2	40.5
≥ 12	97.2	48.7
≥ 13	**91.7**	**54.1**
≥ 14	86.1	59.6
≥ 15	80.6	64.9
≥ 16	75.0	70.3
≥ 17	55.6	81.1
≥ 18	41.7	89.2
≥ 19	27.8	91.9
≥ 20	19.4	94.6
≥ 21	8.3	97.3
≥ 22	5.6	100
Nobody	0.0	100

ADHD: Attention deficit hyperactivity disorder, ASRS-5: Adult ADHD Self-Report Screening Scale according to the Diagnostic and Statistical Manual of Mental Disorders, fifth edition

The best model is highlighted in bold

patients with these comorbid disorders, in line with previous results for the DSM-IV screener (Perroud et al. 2014; van de Glind et al. 2013; Weibel et al. 2018).

Limitations

This study has some limitations. A first shortcoming was that the translation/back-translation process involved two persons. More translators should have been involved, as well as the original author for the English back-translation. Second, patients with ADHD were recruited in specialized ADHD outpatient clinics, a setting that might not be representative of the whole ADHD population, thus limiting the generalization of our findings. For example, a lower frequency of inattentive presentation is usually observed in epidemiological samples (Simon et al. 2009), with more patients being treated by stimulants and psychotropic medications in clinical samples. To take this limitation into account, we ran a sensitivity analysis excluding participants who were on psychotropic medication (including psychostimulants). Findings were similar as those reported in this study. In addition, participants were younger and had a lower level of education in the ADHD group without BD/BPD in comparison with healthy volunteers. Third, the sample size was rather small in some cells (subgroups of participants with comorbidities). As investigating the diagnostic accuracy among subgroups was an exploratory aim, it was not included in the sample size calculation. Because of these differences and issues, our results should be interpreted cautiously. Fourth, we did not assess the performance of the ASRS-5 according to other frequent comorbid conditions in adults with ADHD (e.g., depression, anxiety, substance use or sleep disorders). The comorbid disorders might have inflated sensitivity because other symptoms might increase the severity of ADHD or mimic ADHD symptoms. Another shortcoming of the study was that, in clinical participants, the ADHD assessment was made using two different structured clinical interviews (ACE+ and DIVA 2.0). Even if they rely on the same symptoms, the wording might be slightly different (e.g., examples for each symptom). Furthermore, these two widely used diagnostic tools have not been cross validated. However, they yielded similar psychometric performances in our sensitivity analyses. Nonetheless, future studies should rely on a single DSM-5 diagnostic interview. Other limitations are related to the subgroup analyses. When we used the sum score of symptoms to provide an overview of the severity, we automatically considered that symptoms were equivalent (same weight and same severity), which might not be the case. In addition, when we compared the different presentations (inattentive vs. combined/hyperactive), we should keep in mind that the inattentive presentation might be less severe, as the maximum number of symptoms was 9 (18 for the combined presentation). Finally, even if none of the healthy participants had previously received a diagnosis of ADHD, it was not formally ruled out by the standard diagnostic procedure. Given the low rate of diagnosis of ADHD in adult in the general population (Ginsberg et al. 2014), we therefore cannot exclude that some of them met criteria for ADHD. It might have inflated the rate of false negatives, meaning that the estimates given in the study are conservative.

Conclusion

The ASRS-5 appears as an acceptable tool to screen for ADHD in clinical settings. Nevertheless, researchers and clinicians should be aware of its limitations, namely a lower ability to detect ADHD among patients with a mild symptomatology or having the inattentive presentation. In addition, further evidence is needed for patients with comorbid disorders, and especially disorders with overlapping symptoms. To date, this was the first ADHD screener adapted for the DSM-5 criteria in French and this study will provide an extension to the available screening tools for French clinicians and thus a better detection of ADHD.

Compliance with Ethical Standards

Conflict of Interest Stéphanie Baggio, Sophie Bayard, Clémence Cabelguen, Martin Desseilles, Marie Gachet, Charlotte Kraemer, Hélène Richard-Lepouriel, Rosetta Nicastro, Stéphanie Bouliac, Anne Sauvaget, Sébastien Weibel, Nader Perroud and Régis Lopez declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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