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## Screening for attention-deficit/hyperactivity disorder in borderline personality disorder

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1 **TITLE PAGE**

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**ABSTRACT**

**Background:** A valid screening instrument is needed to detect attention-deficit/hyperactivity disorder (ADHD) in treatment-seeking borderline personality disorder (BPD) patients.

We aimed to test the performance of the widely-used Adult ADHD Self-Report Scale v1.1 screener (ASRS-v1.1).

**Methods:** 317 BPD subjects were systematically assessed for comorbid ADHD and completed the ASRS-v1.1. 79 BPD patients also completed the Wender Utah Rating Scale (WURS-25).

**Results:** The prevalence of adult ADHD was of 32.4%. The overall positive predictive value of the ASRS-v1.1 was of 38.5%, the negative predictive value 77.0%, the sensitivity 72.8%, and the specificity 43.9%. Combining WURS-25 and ASRS-v1.1 improved sensitivity to 81.8% and specificity to 59.6%.

**Limitations:** Cross-sectional study on treatment-seeking patients.

**Conclusions:** We found a high prevalence of ADHD using structured interviews. The ASRS-v1.1 was not a sensitive screener for identifying possible ADHD cases in a BPD population, with a high number of false positives. When combined with the WURS-25, it offered improved screening.

**Keywords:** adult ADHD; screening; Borderline Personality Disorder; comorbidity; diagnosis; ASRS-v1.1

## 1. Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that persists into adulthood in about two-thirds of individuals (Fayyad et al., 2007; Simon et al., 2009), with an estimated prevalence in adults ranging from 1% to 6% (Fayyad et al., 2007; Kessler et al., 2006; Simon et al., 2009). Adult ADHD has been frequently reported to be comorbid with Borderline Personality Disorder (BPD). In clinical samples of BPD patients, the prevalence of adult ADHD is higher than in the general population, ranging from 16.1% to 38.1% (Asherson et al., 2014; Ferrer et al., 2010; Philipsen et al., 2008; Prada et al., 2014). These high prevalence rates are consistent with the fact that BPD symptoms are more frequent in ADHD adolescents (Burke and Stepp, 2012; Speranza et al., 2011; Stepp et al., 2012). Several studies showed prospectively that ADHD was a risk factor for a subsequent development of BPD (Fischer et al., 2002; Miller et al., 2008; Stepp et al., 2012), with rates of BPD among adults with ADHD ranging from 19% to 37%.

Criterion overlap, i.e. the fact that some symptoms are shared by the two disorders (impulsivity, emotional and affective lability, interpersonal deficits) is not sufficient to explain ADHD and BPD comorbidity (Matthies and Philipsen, 2014). Several hypotheses have been raised to explain this higher-than-chance association: shared genetic and environmental vulnerability (Distel et al., 2011), similar neurobiological dysfunction (Lampe et al., 2007), or ADHD symptoms increasing the chance to live in an invalidating environment during childhood, therefore increasing the chance to develop BPD in adolescence and adulthood (Asherson et al., 2014; Matthies and Philipsen, 2014; Philipsen et al., 2008). Regardless of the reason for the interaction between the disorders, the comorbidity appears to be an important problem. The presence of adult ADHD is associated with more severe symptoms of BPD, more frequent comorbidities, a worse outcome and poor response

to treatment (Philipsen et al., 2008; Storebø and Simonsen, 2014). Observational studies nevertheless suggest that treating BPD patients medically for comorbid adult ADHD improved their response to psychotherapy (Prada et al., 2015).

The identification and treatment of ADHD in treatment-seeking BPD patients may therefore improve the overall outcome. The detection of ADHD in BPD subjects relies mainly on a clinical evaluation aiming at distinguishing symptoms pertaining to one or the other disorder. It is a difficult task for several reasons. ADHD may not have been diagnosed during childhood, or patients may not remember having been diagnosed. Furthermore, several features of BPD overlap with those of ADHD, including emotional instability and dysregulation (affective lability, hot temper, and stress intolerance) (Skirrow and Asherson, 2013), low self-esteem (Harpin et al., 2016), interpersonal deficits (Perroud et al., 2017), impulsivity (Prada et al., 2014), inner restlessness (Jung et al., 2016), and risk-taking behavior (Fossati et al., 2001). The complexities of symptom overlap and comorbidity create a particular problem for general adult mental health services, to which patients with BPD are often referred, but where experience of the diagnosis and clinical management of ADHD is often lacking. Furthermore, the diagnosis of adult ADHD is rather time-consuming and even if the prevalence of ADHD is high, screening can be cost-effective in terms of identifying patients who are likely to have ADHD in order to better allocate resources. It is therefore useful to have a reliable screening tool for ADHD in BPD patients. Several instruments are available for the screening of adult ADHD (Belendiuk et al., 2007). Some of them are in the public domain and show potential for providing a cost-effective approach for confirming current symptoms of ADHD in BPD patients. However, the usefulness of these tools has not yet been tested.

The 6-item version of the World Health Organization Adult ADHD Self-Report Scale v1.1 (ASRS-v1.1) symptom checklist is a short, freely-accessible and largely-used screening tool. This version was developed for optimal consistency with the clinical classification. In the seminal study of ASRS-v1.1, a population survey found that the tool had a sensitivity of 68.7%, a specificity of 99.5% and a positive predictive value (PPV) of 89.3% (Kessler et al., 2005) (see Table 1 for description of psychometrics). Furthermore, the ASRS-v1.1 has demonstrated high internal consistency (Adler et al., 2006) and good test-retest reliability (Matza et al., 2011). In a subsequent primary care study with a slightly larger sample (N=200), Hines et al. (2012) reported high sensitivity (100%) and moderate positive predictive power (52%), suggesting that the ASRS-v1.1 would rarely miss ADHD in an adult with ADHD. This result has been replicated in psychiatric populations, and particularly in comorbid populations, and the screening tool is thought to have high sensitivity, but may lack specificity. In a large study involving patients seeking treatment for substance use disorder, van de Glind et al. (2013) found that the overall PPV of the ASRS-v1.1 was 26%, and its negative predictive value (NPV) was 97%. The sensitivity was good and its specificity was moderate for identifying possible ADHD cases in this population (van de Glind et al., 2013). In another study with cocaine use disorder patients, the NPV was also found to be good (92%), suggesting that ASRS-v1.1 is a useful screener for these patients (Dakwar et al., 2012).

As ADHD comorbidity in BPD patients is now recognized as an important issue, and since ASRS-v1.1 is a widely used and recommended screening tool for ADHD, we suspect that the ASRS-v1.1 is also extensively used in patients with BPD. However, the psychometric properties and relevance of this instrument have not been adequately tested among treatment-seeking BPD patients. Moreover, doubts remain as to how ASRS-v1.1 can identify correctly-

diagnosed ADHD patients with BPD. BPD and/or bipolar disorder type II patients scored highly at the ASRS-v1.1 (Edebol et al., 2012), in the range between ADHD patients and control subjects, and ASRS has been shown to have a low specificity in bipolar disorder patients (Perroud et al., 2014).

The purpose of this study was to assess the clinical relevance of the ASRS-v1.1 in detecting comorbid ADHD among a population of outpatients seeking treatment for BPD; ADHD was assessed by means of a clinical interview that included a semi-structured interview for ADHD during childhood and adulthood. ADHD is typically considered as a neurodevelopmental disorder with symptoms present during childhood, even if this statement was recently challenged by prospective epidemiological studies (Agnew-Blais et al., 2016; Caye et al., 2016; Moffitt et al., 2015). We wondered whether the specificity of the ASRS-v1.1 could be improved by using a self-report questionnaire assessing ADHD symptoms during childhood, namely the Wender Utah Rating Scale (WURS-25) which was used in a subset of patients (Ginsberg et al., 2010; Rao and Place, 2011).

## **2. Methods**

### **2.1. Participants and procedure**

317 French-speaking patients suffering from BPD were recruited in a specialized center for diagnosis and outpatient treatment of adults suffering from ADHD or BPD at the University Hospitals of Geneva.

Patients underwent a clinical evaluation conducted by a trained psychiatrist, to ascertain the diagnosis of BPD and/or ADHD according to DSM-IV criteria, and to exclude any organic condition and/or Axis I disorders that might better explain the disorder.

After providing informed consent, subjects were administered screening instruments (ASRS 1.1 for all subjects, and WURS-25 for a subset of 79 patients), followed by structured diagnostic interviews conducted by trained psychologists. BPD diagnosis was further assessed by the Screening Interview for Axis II disorders (SCID-II) (First and Gibbon, 2004) and other diagnoses, particularly child and adult ADHD by the Diagnostic Interview for Genetic Studies (DIGS) (Nurnberger et al., 1994). A best estimate procedure including the data from the clinical evaluation and from the semi-structured interviews was used to confirm BPD and/or ADHD. Patient were classified as "childhood ADHD" if the symptoms of ADHD were noted during childhood, but not present in adulthood according to DSM-IV criteria, and "adult ADHD" if symptoms of ADHD persisted in adulthood.

The study was approved by the ethics committee of University Hospitals of Geneva.

## 2.2. Assessment instruments

*Adult ADHD Self-Report Scale-Version 1.1:* The 6-item ASRS-v1.1 screener (Kessler et al., 2005) was designed to help screen for ADHD in adults (aged 18 and older). The scale consists of 6 items, each of which can be scaled from 0 to 4 (0 = never; 1 = rarely; 2 = sometimes; 3 = often; 4 = very often). The six questions of the ASRS-v1.1 are consistent with the DSM-IV criteria and address the manifestation of ADHD in adults, with the first four questions relating to inattention, and the two last ones relating to hyperactivity. One point is given for any answer equal or greater than 2 for the first 3 items; one point is given for any answer equal or greater than 3 for the next 3 items. If the score is 4 or more (on a scale of 0 to 6), then the current symptom profile of the individual is considered to be highly consistent with ADHD diagnosis in adults (Adler et al., 2006; Kessler et al., 2007). This screening tool has performed well in studies, with a sensitivity of 68.7%, a specificity of 99.5%, and a PPV of 89.3% (Kessler et al., 2005). Internal consistency (Cronbach alpha) ranges between 0.63 and 0.72

and has a test–retest reliability of 0.58 to 0.77. There is good consistency with the clinician’s diagnosis, with an area under the receiver operator curve of 0.90 (Kessler et al., 2007). The ASRS-v1.1 is the part A of the 18-items ASRS Symptom Checklist (ASRS-18-items), the part B consisting of 12 additional questions corresponds to the remaining DSM criteria for ADHD. In the current study, patients completed ASRS-v1.1, then the part B of the 18-items ASRS Symptom Checklist. The validated French version was used (Caci et al., 2009). As the English version, the French version has a two-factor structure (inattention and hyperactivity/impulsivity) (Caci et al., 2009).. The prevalence of ADHD estimated using the French ASRSv1.1 are similar to the one found when using the English version (Caci et al., 2014).

*Wender Utah Rating Scale 25-items (WURS-25)*: A subset of 79 patients completed the WURS-25. The questionnaire is a self-report instrument assessing retrospectively the childhood diagnosis of ADHD, and features questions addressing attention problems, hyperactivity, behavioral problems at school, impulsivity, over-excitability, and temper outbursts. The 25-item version is a subset of the original 61-item version. Each item is rated 0 (not at all) to 4 (very much). ADHD was assessed using a conservative cut-off ( $\geq 46$ ) that indicates probable ADHD. This cut-off correctly identified 86% of the adults with ADHD, 99% of the “normal” patients, and 81% of the subjects with depression (Ward et al., 1993). We used the validated French version (Caci et al., 2010). Compared to the English version, the French version showed a similar factor structure (Caci et al., 2010), a good internal consistency (Baylé et al., 2003), and similar screening properties (Romo et al., 2010).

*Diagnostic Interview for Genetic Studies (DIGS)*: After completing the screening instruments, patients were interviewed using the French version of the DIGS (Nurnberger et al., 1994;

Preisig et al., 1999). The DIGS is a well-established structured clinical interview, used to make a wide range of DSM-IV diagnoses. As it does not contain a specific adult ADHD module, but only a child ADHD module that includes a question on duration of symptoms, adult ADHD diagnosis was established on a sufficient number of currently-present DSM ADHD symptoms, the presence of the disorder in childhood (before the age of 7), and the persistence of childhood symptoms in the present, following DSM-IV recommendations. All patients were clinically assessed, and diagnosis was based on a best estimate procedure that took into account information from the DIGS, the clinical evaluation and, when available, medical records and relatives.

*Structured Clinical Interview for DSM-IV personality disorders (SCID)*: The SCID is a structured clinical interview ascertaining DSM-IV criteria (First and Gibbon, 2004). It was used to ascertain the BPD diagnosis. Patients had to satisfy at least five of the nine criteria for SCID-II BPD to be considered.

### 2.3. Statistical analysis

Statistical analyses were carried out by Stata 14.1. Diagnoses (ADHD or not) obtained by the mean of the best estimate procedure were used as the external criterion for the calculation of the sensitivity, specificity, positive likelihood ratio (LR+), negative likelihood ratio (LR-), PPV, and NPV of the ASRS-v1.1 (for definitions of these terms, see Table 1). Comparisons between BPD patients with and without adult ADHD were established with a chi square test. Internal consistency for ASRS-v1.1 and ASRS-18 items in the BPD sample was checked using Cronbach's alpha.

< Insert Table 1 about here >

### 3. Results

#### 3.1. Demographic and clinical characteristics

The mean age of the participants was 31.8 years (SD=9.77) and 92.4% were female. Table 2 summarizes comorbid mental disorders. Out of these 317 participants, childhood ADHD was diagnosed in 38.5% of them, and adult ADHD in 32.4%, representing adult persistence in 84.4% of cases (Table 2).

BPD + ADHD patients were more frequently diagnosed with a substance use disorder (except alcohol) than BPD patients without ADHD (54.4 vs. 31.8%). No differences were found between the two groups for other diagnoses (Table 3).

*< Insert Table 2 about here >*

*< Insert Table 3 about here >*

#### 3.2. Validity of screening instruments

In our BPD sample, the internal consistency (Cronbach alpha) for the ASRS-v1.1 was 0.74, which is considered as acceptable. For the ASRS-18-items, the internal consistency was good (alpha=0.89).

ASRS-v1.1 (six items): 61.5 % of patients had four or more positive responses in the six first questions of the ASRS. Table 2 summarizes the validity characteristics (with confidence intervals) of the ASRS screener, and combinations of the ASRS-v1.1/WURS-25 screening instruments.

The sensitivity of the ASRS-v1.1 was quite low (72.8%), with a NPV of 77.0%, suggesting that the screener instrument is unable to detect an important number of cases. Using a less stringent cut-off to improve sensitivity, with the requirement of three positive responses, we

found slightly improved sensitivity and NPV, but in both cases the specificity and PPV were problematic (Table 4).

Combining ASRS-v1.1 and WURS-25 led to better sensitivity, NPV and higher specificity and PPV than ASRS-v1.1 alone (Table 4).

*< Insert Table 4 about here >*

#### 4. Discussion

We found that the ASRS-v1.1, a widely-used screening tool for adult ADHD, was not the best instrument for screening ADHD in BPD patients. The tool was designed for screening in general populations (Kessler et al., 2005), and we found that its properties are not well suited to a population of BPD subjects.

In our unselected sample of patients with BPD, we found that comorbidity with adult ADHD was present in 32.4% of patients, and childhood ADHD in 38.5%. This high prevalence of ADHD in BPD patients has already been reported (Carlotta et al., 2013; Ferrer et al., 2010; Fossati et al., 2015, 2002; Philipsen et al., 2008; Prada et al., 2014). Ferrer et al. (2010) found a prevalence of 38.1%, which is very similar to ours. We found a slightly higher prevalence than Philipsen et al.(2008) (16.1%). In this latter study, ADHD diagnoses were only based on self-questionnaires (ADHD-CL scale: Rösler et al., 2004), which might help explain this discrepancy. To minimize the likelihood of overestimating the prevalence of adult ADHD, the authors used a cut-off in the questionnaire that selected only patients with combined presentation of ADHD. In our sample, by considering only ADHD combined presentation, we found a prevalence of 18.6%, which is very similar to the results of Philipsen et al. In fact, we found that the distribution of ADHD presentations was similar in our sample to the one found

in general population studies, with a majority of cases diagnosed with inattentive and combined presentations (Faraone et al., 2006). An accurate estimation of childhood ADHD is more difficult due to the lack of prospective population-wide studies and the frequent under-diagnosis of ADHD during childhood. Follow-up studies suggested that children suffering from ADHD have a significant risk of developing several forms of personality disorder (Fischer et al., 2002; Miller et al., 2008; Stepp et al., 2012). Miller et al. (2008) investigated the occurrence of personality disorders in a prospective study of young people diagnosed with ADHD, compared with a control group without ADHD. They found that young patients diagnosed with ADHD in childhood had a high risk ( $OR=13.2$ ) of developing BPD in adolescence. Based on retrospective assessments in adult patients, prevalence between 10 and 60% were suggested. In the high range, Fossati et al. (2002) found that 60% of patients with BPD achieved WURS-25 scores deemed as suggestive of childhood ADHD. However, the retrospective assessment with the WURS-25 questionnaire should be considered as approximate, due to the scale's lack of specificity (Glöckner-Rist et al., 2013). In the lower range, Speranza et al. (2011) found 11 % of ADHD in adolescent BPD patients, but it is unclear whether adolescent BPD patients are strictly comparable to a group of adult BPD patients. Our study therefore adds weight to the literature suggesting that adult ADHD is particularly prevalent in BPD. Our estimation of 30% was based on a larger sample using, in addition to a clinical interview, a semi-structured interview. We therefore believe that our results are representative of the rate of comorbid ADHD in an adult BPD population.

The main purpose of the paper was to assess the validity of an ADHD screener. In this perspective, it is crucial for a screening tool to have a correct NPV, in order to minimize the risk of missing patients. We found that the NPV of ASRS-v1.1 was modest, leading to 27% of ADHD comorbid BPD patients being missed. Furthermore, in 62% of cases, the positive

screening was a false alarm. Using a less stringent cut-off for the ASRS score (three positive items), the NPV was marginally improved, at the cost of creating more false positives.

These performances in BPD patients contrast with other clinical situations, in which ADHD is frequently associated. In general psychiatric populations, such as those suffering from comorbid substance use disorder, ASRS-v1.1 showed acceptable screening properties (Daigre Blanco et al., 2009; Dakwar et al., 2012; Rao and Place, 2011; van de Glind et al., 2013).

Conversely, in bipolar disorder, one study suggested that ASRS-v1.1 lacked specificity (Perroud et al., 2014). To explain why ASRS-v1.1 performed poorly in both bipolar disorder and BPD, it could be suggested that a striking similarity between these two disorders is emotional and mood lability, and of course, the high level of impulsivity, which is also a key feature of ADHD (Richard-Lepouriel et al., 2016). However, the six items of the ASRS screener are not related to emotional or impulsive factors, but only to inattention and motor/inner hyperactivity. It is therefore less likely that the overlap of ADHD and BPD symptoms explains poor screening properties. One other hypothesis relates to depression, which is very frequently present in BPD patients (Köhling et al., 2015), even at a sub-threshold level. Depression is associated with cognitive symptoms and particularly inattention. Hence, the screening tool could misattribute symptoms of depression to ADHD, which would explain the high rate of false positives. Lastly, to explain the false negative rate, it is possible that BPD patients had difficulties in observing their own symptoms. Personality disorders are characterized by poor self-knowledge, specifically a distorted sense of self, and tend to lead to inaccurate self-perceptions (Clifton et al., 2005; Morey et al., 2011). Moreover, we can also hypothesize that patients believe that ADHD symptoms are attributable to BPD symptoms (for instance, considering that being unable to finish tasks is only a characteristic of personality). These biases would lead to a high rate of false negatives.

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313 Therefore, questioning patients about childhood might help disentangle symptoms, since BPD  
314 symptoms emerge mostly during adolescence, whereas ADHD symptoms emerge earlier in  
315 childhood, in a neurodevelopmental perspective. In fact, we found better screening  
316 parameters when we used the WURS-25 questionnaire. In a sub-sample of our population, we  
317 found that the sensitivity and the specificity of the instruments were strengthened when  
318 ASRS-v1.1 and WURS-25 were used together. With the combination of instruments, only  
319 18% of comorbid patients are missed, with fewer false alarms, and in most of cases a positive  
320 WURS-25 is indicative of a possible diagnosis of ADHD. In patients with substance use  
321 disorders, the WURS-25 provided better sensitivity and specificity as a screening test than the  
322 ASRS-v1.1 (Notzon et al., 2016; van de Glind et al., 2013) and would appear to be the best  
323 initial choice for the screening of comorbid ADHD in this kind of population.

324

325 Identifying ADHD cases is a challenge in BPD patients. Symptomatology can overlap with  
326 BPD diagnosis or comorbid conditions. Moreover, clinicians may not be trained to correctly  
327 identify this comorbid condition. Unfortunately, even if structured clinical instruments are  
328 helpful in the diagnosis process, they are not easily accessible and remain difficult to  
329 implement in clinical practice. A better allocation of clinical resources would be to administer  
330 a reliable screening instrument, followed by a standardized instrument for all probable cases.  
331 As we found that ASRS-v1.1 is neither sufficiently sensitive nor specific for diagnosing  
332 ADHD in BPD patients, we suggest that associating ASRS-v1.1 and WURS-25 is a valuable  
333 and cost-effective alternative. It allows screening of most cases, and leaves only half of cases  
334 to assess in greater detail.

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An efficient treatment of some ADHD symptoms might decrease part of the symptomatology, allowing patients to better benefit from psychotherapy, which is the main treatment of the core symptomatology. An open trial suggested that methylphenidate is effective in BPD with ADHD comorbidity, not only on ADHD symptoms, but also on BPD severity (Golubchik et al., 2008). Another recent open trial showed that comorbid ADHD-BPD patients treated with methylphenidate were able to draw more benefits from dialectical behavioral therapy (Prada et al., 2015). In a clinical perspective, these findings should be taken into account in order to achieve the best quality of care. Understanding how methylphenidate and other drugs or psychotherapy work on this particular subgroup of patients, and more specifically on their impulsive and aggressive behaviors, requires further research.

Of course, the results of this study should be considered in the context of several limitations. First, the WURS-25 was not administered in our entire sample. Therefore, our conclusions for this scale cannot be as firm as the ones we draw for ASRS-v1.1. Nonetheless, the prevalence of ADHD in the sub-sample that passed the WURS-25 was the same as in the entire sample, suggesting that both groups were similar. Another limitation resides in the fact that we assessed only treatment-seeking patients in a specialized center. Our results can therefore not be generalized to the entire BPD population, especially patients in primary psychiatric care. Then, the diagnosis of childhood ADHD was retrospective. To avoid an overestimation of ADHD diagnosis in childhood, we used a very conservative cut-off score ( $\geq 46$ ), as described previously by Fossati et al. (2002), and the prevalence of childhood ADHD remained high. Nevertheless, the accuracy of our assessment of child ADHD is questionable, as patients with persistent ADHD, being more highly aware of this type of symptoms, might remember them better or be biased to respond positively to the presence of ADHD symptoms during childhood. In the same line, recent studies have suggested that, in general population the

adult-onset ADHD seems more frequent than the traditional neurodevelopmental representation of the disorder (Agnew-Blais et al., 2016; Caye et al., 2016; Moffitt et al., 2015). The adult-onset ADHD diagnosis (without symptoms during childhood) was not taken into account in our study, due to application of DSM criteria, and because these questions were raised after the beginning of the study. More research is requested in order to know if adult-onset ADHD is also frequent in BPD patients. Finally, we used DSM-IV criteria for adult ADHD, while the DSM-5 suggests the possibility of symptoms starting before the age of 12 rather than the age of seven.

## 5. Conclusion

As ADHD is frequently associated with BPD and can be treated, it is essential to diagnose it. When the ASRS-v1.1 is used to identify adult ADHD in BPD patients, clinicians should be aware that the properties of this tool are not optimal. We found a high rate of missed cases, and more false positives than correct positives. Combining it with WURS-25 appears to be a better strategy for the screening of ADHD in BPD, before using structured diagnostic interviews.

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384

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Table 1:

Definitions of psychometrics calculated in this study

|                               |                                                                                 |
|-------------------------------|---------------------------------------------------------------------------------|
| sensitivity                   | Probability of positive screener given disease present = true positive rate     |
| specificity                   | Probability of negative screener given disease not present = true negative rate |
| PPV Positive Predictive Value | Probability that disease is present given positive screener                     |
| NPV Negative Predictive Value | Probability that disease is absent given negative screener                      |
| LR+ Positive Likelihood Ratio | True positive rate/false positive rate (sensitivity/(1-specificity))            |
| LR- Negative Likelihood Ratio | False negative rate/true negative rate ((1-sensitivity)/specificity)            |

Table 2:

Demographic information and comorbidity in the population of BPD patients (N=317).

|                                                          | Mean | SD   |
|----------------------------------------------------------|------|------|
| age (years)                                              | 31.8 | 9.77 |
|                                                          |      |      |
|                                                          | N    | %    |
| females                                                  | 293  | 92.4 |
| single                                                   | 197  | 62.3 |
| having children ( <i>missing value for 71 patients</i> ) | 98   | 39.8 |
| employed                                                 |      |      |
|                                                          |      |      |
| <b><i>ADHD (clinical &amp; DIGS)</i></b>                 |      |      |
| ADHD during childhood                                    | 122  | 38.5 |
| adult ADHD                                               | 103  | 32.4 |
| <i>Adult ADHD presentation</i>                           |      |      |
| Predominantly inattentive                                | 55   | 45.1 |
| Combined                                                 | 59   | 48.4 |
| Predominantly hyperactive/impulsive                      | 8    | 6.6  |
|                                                          |      |      |
| <b><i>Psychiatric comorbidity (DIGS)</i></b>             |      |      |
| Major depressive episode *                               | 256  | 80.7 |
| Bipolar disorder *                                       | 42   | 13.2 |
| Psychosis *                                              | 65   | 20.5 |
| Anxiety disorder *                                       | 98   | 30.9 |
| Eating disorder *                                        | 138  | 43.5 |
| PTSD *                                                   | 111  | 35.3 |
| Alcohol use disorder **                                  | 143  | 45.1 |
| Substance use disorder (except alcohol) **               | 124  | 39.1 |
| Substance use disorder (Any) **                          | 187  | 59.0 |
| * lifetime ** current                                    |      |      |
|                                                          |      |      |
| <b><i>ASRS</i></b>                                       | N    | %    |
| Positive ADHD screening (ASRS-v1.1)                      | 195  | 61.5 |
|                                                          | Mean | SD   |
| number of positive responses (ASRS-v1.1)                 | 3.79 | 1.7  |
| ASRS-18-items total score                                | 42.6 | 12.4 |
|                                                          |      |      |
| <b><i>WURS (N=79)</i></b>                                | N    | %    |
| Positive screening (WURS-25 $\geq$ 46)                   | 53   | 57.1 |
|                                                          | Mean | SD   |
| WURS-25 score                                            | 55.6 | 20.5 |

Table 3:

Psychiatric comorbidities in BPD patients without or with adult ADHD (\* lifetime comorbidity; \*\* current comorbidity)

| <i>Psychiatric comorbidity (DIGS)</i>      | no adult ADHD (N=214) |          | adult ADHD (N=103) |          |                       |          |
|--------------------------------------------|-----------------------|----------|--------------------|----------|-----------------------|----------|
|                                            | %                     | <i>N</i> | %                  | <i>N</i> | <i>X</i> <sup>2</sup> | <i>p</i> |
| Major depressive episode *                 | 79.9                  | 171      | 82.5               | 85       | 0.31                  | 0.58     |
| Bipolar disorder *                         | 13.1                  | 28       | 13.6               | 14       | 0.02                  | 0.90     |
| Psychosis *                                | 17.8                  | 38       | 26.2               | 27       | 3.05                  | 0.08     |
| Anxiety disorder *                         | 31.8                  | 68       | 29.1               | 30       | 0.22                  | 0.63     |
| Eating disorder *                          | 42.1                  | 90       | 46.6               | 48       | 0.58                  | 0.44     |
| PTSD *                                     | 34.6                  | 74       | 36.9               | 38       | 0.16                  | 0.69     |
| Alcohol use disorder **                    | 46.3                  | 99       | 53.4               | 55       | 1.42                  | 0.23     |
| Substance use disorder (except alcohol) ** | 31.8                  | 68       | 54.4               | 56       | 14.90                 | <0.001   |
| Substance use disorder (Any) **            | 53.7                  | 115      | 69.9               | 72       | 7.51                  | <0.005   |

Table 4:

ASRS-v1.1 characteristics comparing standard cut-off with alternative scoring algorithms (N=317), and WURS characteristics alone and associated with ASRS-v1.1 (N=79)

|                                           | Sensitivity<br>% [95% CI] | Specificity<br>% [95% CI] | LR (+)<br>[95% CI] | LR (-)<br>[95% CI] | PPV<br>%         | NPV<br>%         |
|-------------------------------------------|---------------------------|---------------------------|--------------------|--------------------|------------------|------------------|
| ASRS-v1.1<br>(standard: 4 positive items) | 72.8 [63.2-81.1]          | 43.9 [37.2 -50.9]         | 1.30 [1.10-1.54]   | .619 [.436-.879]   | 38.5 [31.6-45.7] | 77.0 [68.6-84.2] |
| ASRS-v1.1<br>(modified: 3 positive items) | 88.3 [80.5-93.8]          | 27.1 [21.3-33.6]          | 1.21 [1.09-1.35]   | .430 [.242-.764]   | 36.8 [30.8-43.2] | 82.9 [72.0-90.8] |
| ASRS-v1.1 score >14                       | 67.0 [57.0-75.9]          | 57.0 [50.1-63.7]          | 1.56 [1.27-1.91]   | .579 [.43-.781]    | 42.9 [35.1-50.9] | 78.2 [70.9-84.4] |
| WURS >= 46 (N=79)                         | 95.5 [77.2-99.9]          | 43.9 [30.7-57.6]          | 1.70 [1.33-2.18]   | .104 [.0149-.719]  | 39.6 [26.5-54.0] | 96.2 [80.4-99.9] |
| ASRS-v1.1 <b>and</b><br>WURS >=46 (N=79)  | 81.8 [59.7-94.8]          | 59.6 [45.8-72.4]          | 2.03 [1.4-2.94]    | .305 [.122-.759]   | 43.9 [28.5-60.3] | 89.5 [75.2-97.1] |
| ASRS-v1.1 <b>or</b><br>WURS >=46 (N=79)   | 100 [84.6-100]            | 24.6 [14.1-37.8]          | 1.33 [1.14-1.54]   | 0 [.-.]            | 33.8 [22.6-46.6] | 100 [76.8-100]   |