



Wender Utah Rating Scale: Psychometrics, clinical utility and implications regarding the elements of ADHD

Thomas E. Gift^a, Matthew L. Reimherr^b, Barrie K. Marchant^{c,*}, Tammy A. Steans^c,
Frederick W. Reimherr^{c,d,**}

^a Department of Psychiatry, University of Rochester, Rochester, NY, USA

^b Department of Statistics, Penn State University, State College, PA, USA

^c Psychiatric and Behavioral Solutions LLC, 1522 South 1100 East, Salt Lake City, UT, USA

^d Department of Psychiatry, University of Utah School of Medicine, Salt Lake City, UT, USA

ARTICLE INFO

Keywords:

Wender Utah Rating Scale
Psychometrics
Adult ADHD
Anxiety
Depression
Childhood symptoms

ABSTRACT

The Wender Utah Rating Scale (WURS) is a self-report instrument completed by adults assessing a range of childhood symptoms and behaviors consistent with ADHD persisting into adulthood. Many items reflect emotional dysregulation. Although over 30 publications have examined its psychometric properties, reliance on non-clinical samples has limited conclusions from these reports, as have sub-optimal statistical approaches in most previous publications. None compared the full WURS to the abbreviated WURS-25. We evaluated both versions with adults presenting for treatment: 137 with ADHD and 230 with GAD or MDD, along with 120 normal controls. Factor analysis was performed on the full WURS using the clinical cohorts. The WURS versions were compared using ANOVA, logistic regression, ROC and confusion matrices. Consistent with two previous reports, the full WURS generated five factors: Disruptive mood & behavior, ADHD, Anxiety/dysphoria, Social and Academic. The ADHD factor correlated $r > 0.8$ with the Disruptive mood/behavior and the Academic factor. ADHD patients scored higher than GAD/MDD subjects ($p < .001$) on the Disruptive mood & behavior, ADHD, and Academic factors. The WURS-25 produced good separation of ADHD subjects from normal controls with ROC (AUC = 0.974) and logistic regression (Sensitivity = 91%, Specificity = 92%). Conversely, the full WURS better separated ADHD subjects from psychiatric controls with both ROC (AUC = 0.995) and logistic regression (Sensitivity = 84%, Specificity = 94%). Use of the full WURS with its five factors proved more successful at distinguishing ADHD from MDD and GAD than did the WURS-25. Its factors identify symptoms, including those of emotional dysregulation, critical to understanding ADHD.

1. Introduction

Although Attention Deficit Hyperactivity Disorder (ADHD) was first regarded as an illness of children, it is now seen as affecting adults also. The American Psychiatric Association's Diagnostic and Statistical Manual (DSM) approach to diagnosing ADHD in adults requires, but does not define a threshold for, childhood symptoms of ADHD. In 1993 the Wender Utah Rating Scale (WURS) was introduced to allow adult subjects to systematically describe aspects of their childhood (Ward et al., 1993). It differs from the specific DSM criteria in that its items reflect childhood adjustment broadly and features of childhood more easily

recalled, including items addressing emotional dysregulation symptoms often seen in ADHD (Reimherr et al., 2020). In addition, it provides a threshold score that suggests that ADHD was present in childhood.

A 61-item version of the scale was presented (Ward et al., 1993), but a 25-item scoring was recommended; this 25 item set has been designated the WURS-25. This original paper documented its utility in distinguishing adults with childhood ADHD from those with major depression. Many researchers have used this subset of 25 items. One of the items in the 61 item set is “tomboyish” and it was meant to apply only to girls. A different number of items for boys and girls has proved awkward, and investigators have typically omitted this item when

* Corresponding author. 611 N. 26th St, Lincoln, NE, 68503.

** Corresponding author. Psychiatric and Behavioral Solutions, 1522 South 1100 East, SLC, UT, 84105.

E-mail addresses: tgift@rochester.rr.com (T.E. Gift), mlr36@psu.edu (M.L. Reimherr), barriemarchant@aol.com (B.K. Marchant), tammys@pb-solutions.net (T.A. Steans), fred.reimherr@hsc.utah.edu (F.W. Reimherr).

<https://doi.org/10.1016/j.jpsychires.2021.01.013>

Received 2 September 2020; Received in revised form 10 December 2020; Accepted 4 January 2021

Available online 14 January 2021

0022-3956/© 2021 Elsevier Ltd. All rights reserved.

working with the (almost) full version, which with this omission has 60 items. Throughout this paper we use the term “total WURS” for the entire 60 item scale and “WURS-25” for the 25-item version.

The WURS has been translated into more than a dozen languages, including Spanish (Rodríguez-Jiménez et al., 2001), Italian (Fossati et al., 2001), German (Retz-Junginger et al., 2003), French (Baylé et al., 2003), Turkish (Oncü and Sentürk, 2005), Finnish (Kivisaari et al., 2012), Arabic (Abdelkarim et al., 2015), Farsi (Sarrami-Foroushani, 2008), Japanese (Matsumoto et al., 2015) Chinese (Chang and Chuang, 2000), Korean (Seo et al., 2014) and Swedish (Kouros et al., 2018); Google Scholar suggests that it has been cited over 3000 times. Multiple reviews have documented its utility in assessing adult ADHD patients (Murphy and Adler, 2004; Rösler et al., 2004; Taylor and Unwin, 2011).

In our 1993 publication, we showed that ADHD subjects applying for treatment had significantly more childhood evidence of ADHD than patients with depression applying for treatment. In reviewing past WURS publications, five (Brevik et al., 2020 – clinic patients vs normal controls, WURS-25 separates with/without ADHD; Dakwar et al., 2012 – cocaine addicts, WURS-25 separates with/without ADHD; Notzon et al., 2016 – marijuana users seeking treatment, WURS-25 separates with/without ADHD; Oncu and Senturk, 2005 – WURS-25 separates ADHD subjects from established, stable patients with affective disorders; Weibel et al., 2017 – borderline personality, WURS separates with/without ADHD) have reported on use of the scale in a similar manner.

However, no investigations of the diagnostic utility of the WURS used patients presenting with acute depression and/or anxiety as is typical of psychiatric outpatient clinics, thus limiting the value of findings for clinical use. Major depressive disorder (MDD), generalized anxiety disorder (GAD) and ADHD are relatively common disorders. Consequently, identifying patients with MDD and/or GAD who have a history consistent with childhood ADHD is of clinical significance.

At least 26 papers have examined the psychometric properties of the WURS. Within this group, sixteen have described the factor analytic structure of the WURS. These analyses are important because they facilitate a more comprehensive understanding of ADHD as a psychiatric condition. There have been three reports (Calamia et al., 2018; Mancini et al., 1999; Stein et al., 1995) of factor analyses of the total WURS. Stein and Calamia reported a five factor solution very similar to the results we report herein. At variance with these findings, Mancini in examining patients entering an anxiety disorder clinic arrived at a 3 factor solution.

Interestingly, only one paper reported a logistic regression analysis using the WURS to support the diagnosis of ADHD in adulthood. Kivisaari et al. (2012) using the total WURS and factor scores derived from an earlier report on the WURS-25 (Suhr et al., 2009) compared ADHD subjects to a group of subjects with dyslexia. They found that ADHD adults differed from individuals with dyslexia on 3 factors: Conduct Problems, Impulsivity Problems and Inattention/Anxiety.

The use of receiver operating characteristics (ROC) statistics has become increasingly accepted as the optimal approach to establishing a cutoff score with a psychometric instrument. Three reports have used this technique comparing ADHD subjects' WURS scores to normal controls' (Brevik et al., 2020; Retz-Junginger et al., 2003, 2007). A single report has used this technique to differentiate ADHD patients from patients with other diagnoses typically seen in psychiatric practice or psychiatric clinics. Kouros et al. (2018) compared newly admitted ADHD subjects to stable psychiatric outpatients in ongoing treatment, but they employed a sample very restricted in age (18–25). The use of this sample leaves uncertain the strength of the WURS combined with ROC statistics in diagnosing psychiatric patients more generally.

1.1. Aims of the study

- 1) Using carefully selected adult patients with ADHD, MDD, or GAD presenting for evaluation and treatment, what is the factor structure of the WURS?

- 2) Using ANOVA, how do the identified WURS factors differ between these three groups?
- 3) Using logistic regression, ROC curves, AUC statistics and confusion matrices, are the WURS factors useful in distinguishing adults with ADHD from adults with GAD or MDD as well as non-clinical controls? Further, are the factors more or less successful than the WURS-25 in categorizing patients?

2. Material and methods

We have used similar intake procedures in evaluating adults for clinical trials of psychotropic medications for a variety of different psychiatric indications. Individuals were asked to complete an intake questionnaire dealing with current emotional symptoms, somatic problems, history of use of psychotropic medications, past and current psychiatric symptoms, behavioral/academic problems in childhood, current social adjustment, history of legal problems, and use of substances of abuse. The intake package contains the total WURS. This information was then reviewed by both an intake social worker and a clinic psychiatrist in separate intake interviews. Both confirmed the patient's psychiatric diagnosis using DSM criteria and level of symptoms with a disorder specific clinician administered rating scale. Finally, a week later, these assessments were repeated at the actual start of the clinical trial.

These charts were subsequently reviewed by three of the authors several years after intake. Decisions regarding inclusion in the current analysis are noted below.

2.1. Subjects

As described above, data for these analyses were obtained from the intake assessments of patients entering treatment for ADHD or seeking to participate in one of 22 clinical trials of psychotropic medications. Eight investigated major depression (MDD), 6 generalized anxiety disorder (GAD) and 8 ADHD. This later chart review did not include the WURS. Particular attention was paid to the subject's history, including past medications during childhood and adulthood, diagnoses given by other clinicians and impairment in work, school and family life.

The investigation was carried out in accordance with the latest version of the Declaration of Helsinki, and informed consent of the participants was obtained after the nature of the procedures had been fully explained for each study. Ethical approval was also granted for this later re-examination by the University of Utah IRB.

2.2. Subjects with ADHD

We carefully reviewed our intake data for 333 patients with ADHD. 196 patients were excluded for the following reasons: 56 met criteria for ADHD during adulthood but had limited evidence of childhood symptoms. 6 met criteria for ADHD during childhood but on more intensive review fell short of meeting criteria for adulthood. For 26 patients, the evidence for ADHD was inconclusive. For 44 subjects, information was incomplete or presented in a contradictory manner. 64 patients had ADHD, but its expression was complicated by multiple additional DSM diagnoses that frequently included personality disorders. Exclusion of these patients left 137 subjects meeting criteria for adult ADHD, including childhood onset, and are included in this analysis.

2.3. Subjects with major depression or generalized anxiety disorder (MDD/GAD)

Following the procedures noted above allowed identification of a group of patients with either MDD or GAD uncomplicated by ADHD, high levels of substance abuse or multiple DSM diagnoses.

Patients with Major Depression or Generalized Anxiety Disorder: There were 350 patients who met DSM-IV criteria for either diagnosis.

120 patients were excluded for the following reasons: 25 had strong evidence of ADHD in addition to MDD or GAD, 88 presented information that was inconclusive, 7 had multiple additional DSM diagnoses, frequently personality disorders. 230 subjects demonstrated uncomplicated MDD or GAD were considered appropriate for this analysis.

The calculations reported below were initially conducted treating MDD (total $n = 121$) and GAD (total $n = 107$) subjects as separate samples, but the differences between them were minimal. Specifically, there were no differences between the MDD and GAD patients on the WURS-25 ($t = 0.60$, $df = 228$, $p = .55$). In addition the two groups did not differ significantly in any of the 5 factors of the full WURS. Consequently, we combined them for this report and will refer to them as “MDD/GAD”.

2.4. Non-clinical control subjects

Data from 120 individuals constituting a community control sample are included in the analysis of sensitivity and specificity. As described in a previous report (Marchant et al., 2013) these data were generated during collection of psychometric data for the Wender Reimherr Adult Attention Deficit Disorder Scale (WRAADDs). Exclusion criteria included current psychiatric disorders, including personal or family history of ADHD. By design, participants were evenly distributed by gender and across the age groups 20 to 29, 30 to 39, and 40 to 49.

2.5. Measures

WURS: This is a self-rating instrument on which adults rate their childhood symptoms and behavior. It uses a five-point scale ranging from “Not at all or very slightly” to “Very much”. A 25-item subset of the WURS can be used in scoring the WURS, as described in the Introduction, and as noted we will refer to this version as the WURS-25 as opposed to the total WURS. In all the analyses performed with the full version, we removed item #33 (tomboyish), as noted above. A score of 46 yielded by these 25 items has been reported to indicate that ADHD was present during childhood (Ward et al., 1993).

Copies of the WURS and scoring procedures are available as an appendix to the Data in Brief publication associated with this article.

2.6. Data analysis

Statistical testing was done using SPSS version 23 and R. Factor analysis was done with Principal Component Analysis for extraction and Varimax with Kaiser Normalization for rotation. In doing the factor analyses we only used the patients with ADHD, MDD or GAD. Because our focus was understanding the structure of ADHD in clinical populations we excluded our non-clinical control subjects. Effect sizes were gauged with Cohen’s d .

Factor scores were calculated based on the items that loaded most heavily on each factor (Table 2). Factor scores were calculated as the average of all such heavily loading items. Several items were reverse scored so that higher scores indicated greater impairment. The use of item averages means that all 5 factors have a range 0–4. To be confident that this calculation did not skew the results of the logistic regression and ROC curves, we also calculated them using the more standard method of multiplying each response by the loading shown in the factor table and summing the results of all 60 items. These 2 methods of calculating factor scores produced almost identical results in logistic regression, ROC curves and confusion matrices. ANOVA was used to calculate between groups differences for the 5 factors. This was followed by t -test comparisons of ADHD subjects with the other 2 groups.

Logistic regression was used to compare the ADHD sample to each of the other two groups using the five factors generated by our first step. Positive coefficients indicate that a predictor increases the probability of being in the ADHD group.

ROC curves were generated to give a visual representation and area

under the curve (AUC) was calculated to generate a statistic to evaluate the WURS’s ability to separate ADHD from the other two conditions.

Logistic regression was used to generate confusion matrices to clarify the ability of these factors to accurately predict clinical group. The confusion matrices were used to calculate sensitivity, specificity, positive predictive value (ppv) and negative predictive value (npv), and were generated in the following manner:

Categorizing subjects and generation of confusion tables using the 5 factors:

- 1) In scoring each factor, we selected all items with a factor loading above 0.4 for that factor. If the loading was above 0.4 for more than one factor, it was only included in the factor with the highest loading. Table 2 is organized such that items associated with each factor are arranged together. Calculate factor scores for each subject by averaging the items within each factor as indicated in Table 2. These factor scores can range from 0 to 4.
- 2) Use these factor scores and the “estimate” values from Table 4 to calculate a fitted value in the following manner:
 - a . To compare ADHD with MDD/GAD patients create fitted values using the following equation: $-3.665 + (\text{Disruptive mood/behavior factor score} \times 0.516) + (\text{ADHD factor score} \times 2.844) + (\text{Academic factor score} \times 0.839) + (\text{Social factor score} \times -1.590) + (\text{Anxiety/dysthymia factor score} \times -1.061) = \text{fitted value}$
 - b . To compare ADHD with non-clinical controls create fitted values using the following equation: $-6.451 + (\text{Disruptive mood/behavior factor score} \times 2.011) + (\text{ADHD factor score} \times 3.013) + (\text{Academic factor score} \times 0.136) + (\text{Social factor score} \times -0.757) + (\text{Anxiety/dysthymia factor score} \times 0.289) = \text{fitted value}$.
- 3) The fitted values computed in step 2 represent the predicted log odds of the patient having ADHD. If the fitted value is greater than 0 then the patient is categorized as ADHD. Negative scores are categorized as the comparator group.

Generation of confusion tables using the WURS-25 scores:

- 1) Calculate the WURS-25 total score for each patient.
- 2) Calculate a fitted value for each patient using the “Estimate” value from Table 4.
 - a . To compare ADHD with MDD/GAD patients create fitted values using the following equation: $-3.658 + (25\text{-item total} \times 0.079) = \text{fitted value}$.
 - b . To compare ADHD with non-clinical controls create fitted values using the following equation: $-6.003 + (25\text{-item total} \times 0.203) = \text{fitted value}$.
- 3) If the fitted values created in step 2 are equal to or greater than 0 the patient is categorized as ADHD. Negative scores are categorized as the comparator group.

3. Results

As displayed in Table 1, ADHD patients were younger than the MDD/

Table 1
Subject characteristics.

	ADHD	MDD/GAD	Non-clinical controls
Number	137	228	120
Percent male	67%	34%*	50%
Age ^a	31.2 \pm 9.0	38.2 \pm 11.6*	34.7 \pm 8.6
WURS-25 item ^a	51.5 \pm 15.7	28.9 \pm 16.4	14.5 \pm 10.0
WURS-25 – males ^a	51.7 \pm 16.2	30.8 \pm 15.1	16.5 \pm 10.2
WURS-25 – females ^a	51.0 \pm 14.5	27.9 \pm 16.9	12.5 \pm 9.6

Definitions: ADHD = Attention Deficit Hyperactivity Disorder; MDD = Major Depressive Disorder; GAD = Generalized Anxiety Disorder.

* $p = .0001$ compared with the ADHD cohort.

^a means and standard deviations shown.

GAD patients ($t = 6.05$, $df = 363$, $p = .0001$) and more likely to be male ($\chi^2 = 37.32$, $df = 1$, $p = .0001$). The non-clinical controls were predetermined to be evenly weighted in sex and age. The gender ratios are similar to most clinical trials of ADHD, GAD/MDD treatment of adults. There is a consistent pattern of ADHD patients having the highest WURS scores, the non-clinical controls having the lowest scores and the MDD/GAD group falling between them.

3.1. Factor analysis using subjects with ADHD, MDD/GAD

Scores using the 60 items of the total WURS from ADHD and MDD/GAD patients were combined for the factor analysis displayed in Table 2, which shows the 5 factors after rotation. The items are reordered based on factor loading scores such that the items most associated with each factor are adjacent to each other. The WURS-25 items contained in that scoring system are underlined. The solution shown accounted for 45% of the variance and is very similar to those generated by Calamia et al. (2018) and Stein et al. (1995). The factor labels assigned are: 1) Disruptive mood/behavior, 2) ADHD, 3) Academic problems, 4) Social and 5) Anxiety/dysphoria.

As seen in Table 3, there were significant group differences for all 5 factors. ADHD patients had higher levels of symptoms than both comparison groups on three factors: Disruptive mood/behavior, ADHD and Academic problems. The ADHD group differed from the other 2 groups with effect sizes of $d = 1.0$ and higher for these 3 factors. The same is true for the WURS-25 summation scores. On the Anxiety/dysphoria factor the two clinical groups were quite similar and had higher scores than the non-clinical control group. The ADHD group exceeded the non-clinical controls on all five factors.

3.2. Correlations among factors

The ADHD factor correlated very highly ($r > .8$) with both the Disruptive mood/behavior and the Academic factors. These are the same three factors that appear to best differentiate between ADHD subjects and the MDD/GAD subjects in Table 3. In contrast, the Anxiety/dysphoria factor correlated with these three factors at more moderate levels, around $r = 0.5$.

3.3. Logistic regression using the WURS

As seen in Table 4, use of the WURS-25 proved successful in distinguishing ADHD patients from both the non-clinical controls and the GAD/MDD patients. However, logistic regression using the 5 factors proved even more successful in separating ADHD from MDD/GAD. All but one of the factors provided statistically significant information to categorize these two groups.

The relative usefulness of the 5 factors of the WURS versus the unitary WURS-25 score is seen in the ROC and the AUC calculations. Fig. 1 shows the ROC curves and AUC calculations for the WURS-25 item score contrasting the ADHD group with the other 2 groups. Fig. 2 shows the ROC curves and AUC calculations for the 5 factors contrasting the ADHD group with the other 2 groups. Comparing the two figures shows that the 5 factors created better separation between the ADHD subjects and the GAD/MDD subjects than did the 25-item score. However, the WURS factors and the WURS-25 did not differ for the non-clinical controls.

3.4. Diagnostic utility of the WURS

The logistic regression was carried out with the five factors of the total WURSs as the independent variables and classification (ADHD versus MDD/GAD) as the dependent variable. Fitted values are calculated using the 5 factors and the formulas provided in the Methods section. Analogous to a cut point, a fitted value of greater than zero implies the patient is ADHD, less than zero implies the patient is not ADHD. As noted, the formula used to separate ADHD from MDD/GAD is

Table 2

Factor analysis of the total WURS (factor loading scores).

Item	Disruptive mood/behavior	ADHD	Academic problems	Social	Anxiety/dysphoria
Eigenvalue & percent of variance	12.8, 21%	4.9, 8.1%	4.6, 7.6%	2.6, 4.3%	2.3, 3.8%
Disruptive mood/behavior					
5. Nervous, fidgety	.503	.398	.109	-.037	.417
7. Hot- or short-tempered, low boiling point	.721	.153	.058	.037	.075
9. Temper outbursts, tantrums	.699	.209	-.013	.062	.006
11. Stubborn, strong-willed	.523	.208	-.068	-.244	.146
13. Incautious, dare-devilish, involved in pranks	.491	.324	.182	-.334	-.095
15. Disobedient with parents, rebellious, sassy	.648	.299	.106	-.146	-.045
17. Irritable	.748	.190	-.044	.164	.225
20. Moody, ups and downs	.650	.106	.021	.077	.349
21. Angry	.721	.001	.061	.216	.283
27. Losing control of myself	.636	.349	.069	.056	.194
28. Tendency to be or act irrational	.599	.398	.142	.064	.185
34. Running away from home	.607	.041	.059	.137	-.130
35. Getting into fights	.750	.059	.187	.042	-.034
36. Teasing other children	.641	.030	.204	-.094	-.080
40. Trouble seeing things from someone else's point of view	.482	.313	-.071	-.086	.100
41. Trouble with authorities, trouble with school, visits to principal's office	.595	.173	.157	-.064	-.146
42. Trouble with police, booked, convicted	.447	-.022	.401	-.134	-.144
ADHD					
3. Concentration problems, easily distracted	.262	.700	.318	.011	.112
6. Inattentive, daydreaming	.263	.670	.257	.068	.147
10. Trouble with stick-to-itiveness, not following through, failing	.251	.734	.26	.084	.062
19. Sloppy, disorganized	.188	.812	.098	.064	.025
23. Well-organized, tidy, neat	-.089	-.622	-.147	-.178	.274
24. Acting without thinking, impulsive	.451	.501	.058	-.235	.174
25. Tendency to be immature	.369	.531	.232	.028	.099
57. Bad handwriting	.056	.428	.402	-.009	.061
59. Not achieving up to potential	.177	.584	.256	.102	.076
Academic problems					

(continued on next page)

Table 2 (continued)

Item	Disruptive mood/behavior	ADHD	Academic problems	Social	Anxiety/dysphoria
50. Overall a good student, fast	-.156	-.272	-.599	-.158	.172
51. Overall a poor student, slow learner	.179	.341	.670	.170	-.021
52. Slow in learning to read	.091	.146	.769	.075	-.033
53. Slow reader	.074	.162	.775	.038	-.001
54. Trouble reversing letters	-.030	.073	.567	.014	.034
55. Problems with spelling	-.031	.135	.742	.022	-.059
58. Able to read pretty well but never really enjoyed reading	-.020	.084	.414	-.069	-.064
61. Suspended or expelled	.421	-.041	.431	-.098	-.129
Social					
1. Active, restless, always on the go	.385	.272	.071	-.441	.111
8. Shy, sensitive	.084	-.225	.098	.593	.252
16. Low opinion of myself	.202	.054	.130	.564	.350
18. Outgoing, friendly, enjoyed company of people	.048	.080	.027	-.789	.019
22. Friends, popular	-.028	-.147	.070	-.751	.073
29. Unpopular with other children, didn't keep friends for long, didn't get along with other children	.174	.403	-.073	.510	.000
30. Poorly coordinated, did not participate in sports	.001	.278	.069	.542	.152
32. Well-coordinated, picked first in games	.129	-.221	.048	-.550	.010
37. Leader, bossy	.379	-.002	-.141	-.490	.148
39. Follower, led around too much	-.008	.149	.335	.430	.164
Anxiety/dysphoria					
4. Anxious, worrying	.261	.109	.088	.166	.693
2. Afraid of things	.089	.041	.194	.289	.599
12. Sad or blue, depressed, unhappy	.280	-.079	.117	.420	.505
26. Guilty feelings, regretful	.248	.134	.104	.153	.479
31. Afraid of losing control of self	.261	.205	-.057	.016	.400
43. Headaches	.184	-.105	-.016	-.035	.429
44. Stomachaches	.052	.148	-.212	.045	.502
45. Constipation	-.155	.077	-.031	.109	.472
46. Diarrhea	-.026	.195	-.215	-.067	.455
Not connected items					
14. Not getting a kick out of things, dissatisfied with life	.363	.030	.059	.371	.377
38. Difficulty getting awake	.213	.320	.150	.169	.073
47. Food Allergies	-.089	-.069	-.047	-.045	.303

Table 2 (continued)

Item	Disruptive mood/behavior	ADHD	Academic problems	Social	Anxiety/dysphoria
48. Other allergies	-.119	-.063	-.004	-.102	.294
49. Bedwetting	.189	.085	.205	.047	.082
56. Trouble with mathematics or numbers	.079	.305	.374	.095	-.012
60. Repeating grades	.086	.006	.332	-.022	.042

Loadings of 0.4 or greater are in bold. Underlined items are part of the WURS-25. Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization Rotation converged in 6 iterations.

Table 3

WURS scores as a function of diagnostic categories: WURS item averages and WURS-25 scores (Means \pm Standard deviations).

	ADHD	MDD/GAD	Non-clinical control	ANOVA statistic
Disruptive mood/behavior	1.7 \pm 0.7	0.9 \pm 0.7 <i>p</i> < .001 ^a <i>d</i> = 1.2 ^b	0.5 \pm 0.4 <i>p</i> < .001 ^a <i>d</i> = 2.2 ^b	F (2,482) = 119.9, <i>p</i> < .0001
ADHD	2.9 \pm 0.7	1.3 \pm 0.8 <i>p</i> < .001 ^a <i>d</i> = 2.2 ^b	0.9 \pm 0.6 <i>p</i> < .001 ^a <i>d</i> = 3.1 ^b	F (2,482) = 294.4, <i>p</i> < .0001
Academic problems	1.4 \pm 1.0	0.6 \pm 0.6 <i>p</i> < .001 ^a <i>d</i> = 1.0 ^b	0.6 \pm 0.6 <i>p</i> < .001 ^a <i>d</i> = 1.0 ^b	F (2,482) = 70.8, <i>p</i> < .0001
Social	1.7 \pm 0.8	2.1 \pm 0.5 <i>p</i> < .001 ^a <i>d</i> = -0.5 ^b	1.6 \pm 0.5 <i>p</i> < .001 ^a <i>d</i> = 0.2 ^b	F (2,482) = 30.2, <i>p</i> < .0001
Anxiety/dysphoria	1.1 \pm 0.7	1.1 \pm 0.7 <i>P</i> = .495 ^a <i>d</i> = -0.02 ^b	0.5 \pm 0.4 <i>p</i> < .001 ^a <i>d</i> = 1.1 ^b	F (2,482) = 37.5, <i>p</i> < .0001
WURS - 25	51.5 \pm 15.7	28.9 \pm 16.4 <i>p</i> < .001 ^a <i>d</i> = 1.4 ^b	14.5 \pm 10.0 <i>p</i> < .001 ^a <i>d</i> = 2.9 ^b	F (2,482) = 134.6, <i>p</i> < .0001

Definitions: ADHD = Attention Deficit Hyperactivity Disorder; MDD = Major Depressive Disorder; GAD = Generalized Anxiety Disorder. *d* = Cohen's *d*.

^a *p*-values reflect difference from the ADHD cohort.

^b *d* values are the effect size difference from the ADHD cohort (Cohen's *d*).

Table 4

Logistic regression comparing ADHD with GAD, MDD and non-clinical controls.

Factor	Estimate	STD Error	z-value	p-score
Logistic Regression using the WURS-25				
ADHD versus MDD/GAD				
(Intercept)	-3.658	0.382	-9.587	<i>p</i> < .0001
25-item total	0.079	0.009	9.141	<i>p</i> < .0001
ADHD versus non-clinical controls				
(Intercept)	-6.003	0.817	-7.347	<i>p</i> < .0001
25-item total	0.203	0.027	7.491	<i>p</i> < .0001
Logistic Regression using the 5 WURS factors				
ADHD versus MDD/GAD				
(Intercept)	-3.665	0.788	-4.650	<i>p</i> < .0001
Disruptive	0.516	0.330	1.561	<i>p</i> = .118
ADHD	2.844	0.367	7.760	<i>p</i> < .0001
Academic problems	0.839	0.285	2.938	<i>p</i> = .003
Social	-1.590	0.366	-4.348	<i>p</i> < .0001
Anxiety/dysphoria	-1.061	0.343	-3.094	<i>p</i> = .002
ADHD versus non-clinical controls				
(Intercept)	-6.451	1.119	-5.768	<i>p</i> < .0001
Disruptive	2.011	0.719	2.798	<i>p</i> = .005
ADHD	3.013	0.503	5.990	<i>p</i> < .0001
Academic problems	0.136	0.402	0.339	<i>p</i> = .734
Social	-0.757	0.471	-1.608	<i>p</i> = .108
Anxiety/dysphoria	0.289	0.563	0.514	<i>p</i> = .607

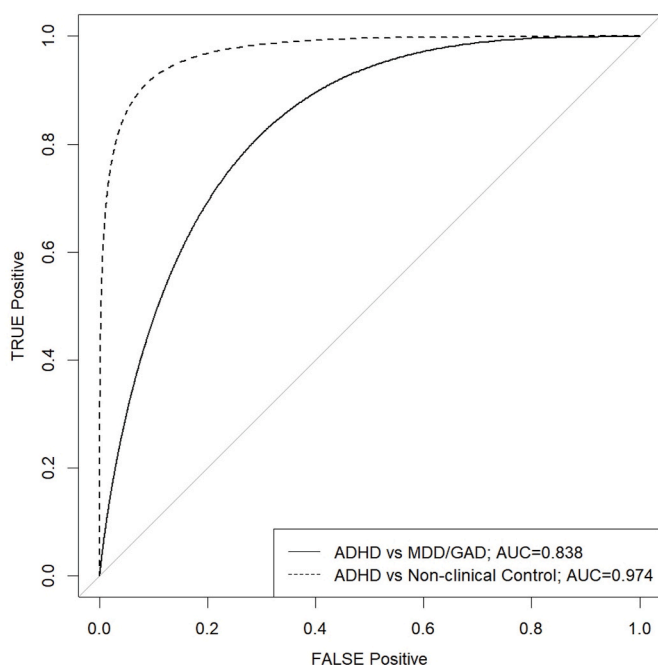


Fig. 1. ROC curves and AUC calculations contrasting ADHD subjects with GAD/MDD subjects and non clinical controls using with WURS 25

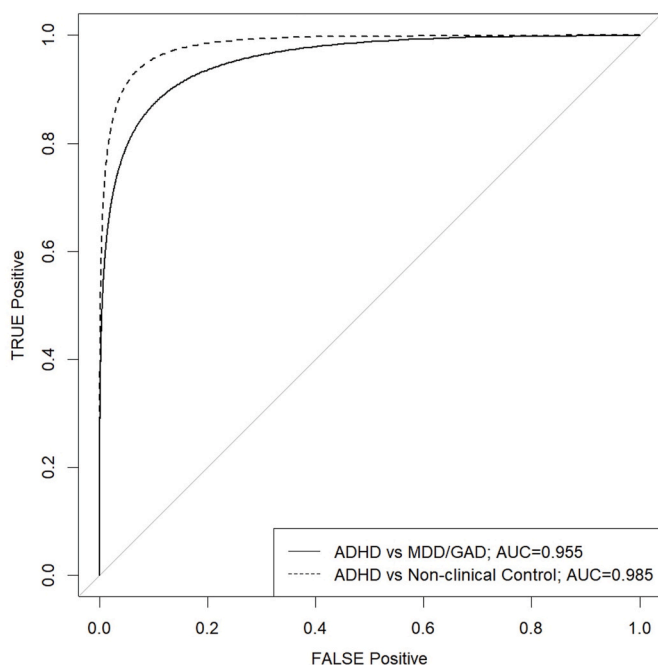


Fig. 2. ROC curves and AUC calculations contrasting ADHD subjects with GAD/MDD subjects and non clinical controls using the 5 factors of the WURS

different than the formula to separate ADHD from a non-clinical group.

Logistic regression using the 5 factors proved very successful in distinguishing between ADHD and the other 2 groups. As displayed in Table 5, comparing MDD/GAD with ADHD the fitted values correctly identified 327 patients and incorrectly classified 37.

A logistic regression was also carried out using the WURS-25 score as the independent variable and classification (ADHD versus MDD/GAD) as the dependent variable. This 25-item WURS score was less successful in distinguishing ADHD from ADD/GAD. As seen in Table 5, comparing MDD/GAD with ADHD the fitted values correctly identified 280 patients

Table 5

Confusion matrices and sensitivity calculations comparing ADHD with MDD/GAD and non-clinical controls using both the WURS-25 Score and the 5 WURS factor scores.

Calculations based on the WURS-25 score		
TRUE Diagnosis	Predicted Diagnosis	
	MDD/GAD	ADHD
MDD/GAD	195	33
ADHD	52	85
Sensitivity = 62% Specificity = 86% PPV = 73% NPV = 79%		
Non-clinical Control	ADHD	
	MDD/GAD	ADHD
Non-clinical controls	110	10
ADHD	12	125
Sensitivity = 91% Specificity = 92% PPV = 93% NPV = 90%		
Calculations based on the 5 WURS factor scores		
Non-clinical Control	ADHD	
	MDD/GAD	ADHD
MDD/GAD	213	15
ADHD	22	115
Sensitivity = 84% Specificity = 94% PPV = 88% NPV = 91%		
Non-clinical Control	ADHD	
	MDD/GAD	ADHD
Non-clinical controls	113	7
ADHD	7	130
Sensitivity = 95% Specificity = 94% PPV = 95% NPV = 94%		

Definitions: PPV = Positive predictive value; NPV = Negative predictive value.

and 84 incorrectly. Since this analysis involves only one variable, the fitted value can be expressed as a WURS score and can be used to identify cut points distinguishing the ADHD group from the MDD/GAD and the non-clinical groups. The fitted value best distinguishing a non-clinical population from ADHD patients was associated with a cut point of 30. The fitted value that best distinguished ADHD patients from a clinical population consisting of patients with MDD and/or GAD was associated with a cut point of 46.

These calculations can be useful for clinicians in diagnosing ADHD and can be utilized by researchers to replicate our findings regarding characterization of ADHD versus MDD/GAD in clinical populations.

4. Discussion

First, what is the factor structure of the WURS? We found a five factor structure of the total WURS. These factors were disruptive mood and behavior, ADHD, anxiety/dysphoria, social and academic. Despite major differences in subject characteristics, our five-factor solution was very similar to those developed using normal college students (Calamia et al., 2018) and parents of ADHD children (Stein et al., 1995). In this regard the report derived by Mancini et al. (1999) can be seen as an outlier in that they arrived at a three factor solution.

Second, how do these patients differ on our identified WURS factors? As seen in Table 3, compared to the non-clinical controls, ADHD patients had higher symptom levels with effect sizes equal to or greater than 1 on four factors: Disruptive mood/behavior, ADHD, Anxiety/dysphoria, and Academic problems. Comparisons with the clinical controls are more interesting. The ADHD group differed from the MDD/GAD patients with effect sizes of $d = 1.0$ or greater on 3 factors: Disruptive mood/behavior; ADHD and academic problems. Anxiety/dysphoria factor scores for the two clinical groups were quite similar.

Third, while overall the total WURS performed better than the WURS-25, logistic regression, ROC, AUC and confusion matrices suggest a role for both the WURS-25 and the total WURS. Our positive results with the WURS-25 are similar to earlier studies. Conversely, examining the robustness of the logistic regression, we found that, as revealed as well by the ROC curves and the confusion matrices, the 5 factors created better separation between the ADHD patients and the GAD/MDD patients than did the 25-item score. While the WURS-25 is useful in

distinguishing ADHD from MDD/GAD, information contained in the 5 factors evidenced better ability to distinguish the ADHD patients from the GAD/MDD controls. It would be valuable for others to replicate the usefulness of these values with other groups of clinically depressed or anxious patients. In passing, it should be noted that factor analysis of the items contained in the WURS-25 generated 3 factors (data not presented). These factors were analogous to Disruptive mood/behavior, ADHD problems and Anxiety/dysphoria in the full WURS. These 3 factors were all correlated $r = 0.80$ and higher. Differences between the patient groups on these 3 factors mirrored their corresponding factors in the full WURS.

At first glance it may be puzzling why in the logistic regression the Disruptive mood/behavior factor was not significant in distinguishing ADHD from MDD/GAD (Table 4) given that the two groups generated significantly different item average scores (Table 3). The reason can be attributed in part to the correlation between this factor and the ADHD factor. The information contained in these two factors overlaps, and the high predictive power of the ADHD factor made the Disruptive mood/behavior factor less salient when controlling for the other variables in the logistic regression equation.

When considering the use of the WURS in actual clinical settings, these data support the use of the total WURS with a computationally complex scoring system as presented in our Methods section. In such samples a multivariate approach with weighted item averages of all five factors would be more powerful. Generating these 5 factor scores creates a much broader picture of the patient's symptoms, which can be examined by the clinician in the course of patient assessment. It has often been noted that ADHD patients have symptoms beyond just those constituting the diagnostic criteria. We were especially pleased that these WURS factors are quite similar to the diagnostic categories of ADHD children identified in the landmark MTA study (Jensen et al., 2001). They found that their subjects could be divided into 4 general categories: ADHD alone, ADHD with oppositional defiant disorder (similar to our Disruptive Mood/behavior factor), ADHD with emotional problems (similar to our Anxiety/dysphoria factor), and finally ADHD with symptoms in both additional areas.

The use of the WURS-25 with a cutpoint is less cumbersome. Other references have supported a lower cutpoint, but these studies have largely used non-clinical control populations (Brevik et al., 2020; Kourou et al., 2018; Retz-Junginger et al., 2003).

Interestingly, the logistic regression contrasting MDD/GAD with ADHD identified a cutpoint for the WURS-25 similar to the scoring procedure developed by Wender and associates (Ward et al., 1993). This showed good specificity but the sensitivity generated using this cutpoint was lower than anticipated. The selection criteria Wender used often excluded patients with primarily attentional symptoms. The WURS scores published by Wender (1995) were higher than our ADHD and MDD/GAD groups. He reported WURS-25 scores of: ADHD = 62.2, depressed = 34.2.

These data support the complexity of ADHD. As noted above, all 5 WURS factors were elevated versus our non-clinical controls. The ADHD cohort had higher scores than the MDD/GAD cohort for three of the five factors with effect sizes greater than $d = 1.0$. These findings imply that focusing only on a set of items representing attention problems would overlook the breadth of childhood difficulties experienced by adults with ADHD. Many of the items in the Disruptive mood/behavior and the Anxiety/dysphoria factors could be seen as reflecting emotional dysregulation.

Limitations: Some aspects of the history and presentation of study patients were assessed without using standardized instruments. The exclusion of certain potential patients because of their multiple diagnoses and the complexity of their cases was not done in an operationalized fashion. The subjects studied were from a relatively small geographical region and were almost entirely of northern European ancestry.

In conclusion, the WURS is useful in distinguishing between adults

with ADHD and those with GAD or MDD, and provides information as to a range of childhood symptoms and behaviors which may be associated with ADHD in adulthood. The content of the WURS supports a conceptualization of ADHD that extends beyond the criteria contained in the DSM.

Copies of the WURS and scoring procedures are available as an appendix to the Data in Brief publication associated with this article.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Thomas E. Gift: Conceptualization, Methodology, Writing – original draft. **Matthew L. Reimherr:** Writing – review & editing, Formal analysis, Statistical analysis. **Barrie K. Marchant:** Formal analysis, Statistical Analysis. **Tammy A. Steans:** Project administration, Formal analysis, Data curation, Data collection; Analysis, Writing – review & editing. **Frederick W. Reimherr:** Data curation, Data collection and curation.

Declaration of competing interest

Data for patients were collected during the intake process for clinical trials sponsored by clinical Shire; Johnson & Johnson; GlaxoSmithKline; Eli Lilly & Company; Cephalon; Sandoz; Solvay; Astra-Zenica; Bristol Myers Squibb; and Smith Kline conducted by Frederick Reimherr. None of these trials was conducted in the last 2 years. Matthew L. Reimherr, Thomas E. Gift, and Barrie K. Marchant declare no potential conflicts of interest that could be perceived as prejudicing the impartiality of the research reported.

References

- Abdelkarim, A., Salama, H., Ibrahim, S., El Magd, O.A., 2015. The prevalence and characteristics of attention-deficit hyperactivity disorder among a sample of Egyptian substance dependent inpatients. *Egypt. J. Psychiatr.* 36, 9–13. <https://doi.org/10.4103/1110-1105.153771>.
- Baylé, F.J., Krebs, M.O., Martin, C., Bouvard, M., Wender, P., 2003. Version française de la Wender Utah Rating Scale (WURS). *Can. J. Psychiatr.* 48, 132. <https://doi.org/10.1177/070674370304800220>.
- Brevik, E.J., Lundervold, A.J., Haavik, J., Posserud, M.B., 2020. Validity and accuracy of the adult attention-deficit/hyperactivity disorder (ADHD) self-report scale (ASRS) and the Wender Utah Rating Scale (WURS) symptom checklists in discriminating between adults with and without ADHD. *Brain Behavior* Apr 13, e01605. <https://doi.org/10.1002/brb3.1605>, 10.1002/brb3.1605. [Epub ahead of print].
- Calamia, M., Hill, B.D., Musso, M.W., Pella, R.D., Gouvier, W.D., 2018. Factor structure and clinical correlates of the 61-item Wender Utah Rating Scale (WURS). *ADHD Attention Deficit Hyperactivity Disorders* 10, 177–188. <https://doi.org/10.1007/s12402-018-0251-3>.
- Chang, H.L., Chuang, H.Y., 2000. Adolescent hyperactivity and general psychopathology. *Psychiatr. Clin. Neurosci.* 54, 139–146. <https://doi.org/10.1046/j.1440-1819.2000.00649.x>.
- Dakwar, E., Mahony, A., Pavlicova, M., Glass, A., Brooks, D., Mariani, J.J., Levin, F.R., 2012. The utility of attention-deficit/hyperactivity disorder screening instruments in individuals seeking treatment for substance use disorders. *J. Clin. Psychiatr.* 73, e1372–1378. <https://doi.org/10.4088/JCP.12m07895>.
- Fossati, A., Di Ceglie, A., Acquarini, E., Donati, D., Donini, M., Novella, L., Maffei, C., 2001. The retrospective assessment of childhood Attention Deficit Hyperactivity Disorder in adults: reliability and validity of the Italian version of the Wender Utah Rating Scale. *Compr. Psychiatr.* 42, 326–336. <https://doi.org/10.1053/comp.2001.24584>.
- Jensen, P.S., Hinshaw, S.P., Kraemer, H.C., Lenora, N., Newcorn, J.H., Abikoff, H.B., March, J.S., et al., 2001. ADHD comorbidity findings from the MTA study: comparing comorbid subgroups. *American Academy of Child and Adolescent Psychiatry* 40, 147–158. <https://doi.org/10.1097/00004583-200102000-00009>.
- Kivisaari, S., Laasonen, M., Leppämäki, S., Tani, P., Hokkanen, L., 2012. Retrospective assessment of ADHD symptoms in childhood: discriminatory validity of Finnish translation of the Wender Utah Rating Scale. *J. Atten. Disord.* 16, 449–459. <https://doi.org/10.1177/1087054710397801>.
- Kourou, I., Hörberg, N., Ekselius, L., Ramklint, M., 2018. Wender Utah Rating Scale-25 (WURS-25): psychometric properties and diagnostic accuracy of the Swedish

- translation. *Ups. J. Med. Sci.* 123, 230–236. <https://doi.org/10.1080/03009734.2018.1515797>.
- Mancini, C., Van Ameringen, M., Oakman, J.M., Figueiredo, D., 1999. Childhood attention deficit/hyperactivity disorder in adults with anxiety disorders. *Psychol. Med.* 29, 515–525. <https://doi.org/10.1017/s0033291798007697>.
- Marchant, B.K., Reimherr, F.W., Robison, D., Robison, R.J., Wender, P.W., 2013. Psychometric properties of the Wender-Reimherr Adult Attention Deficit Disorder Scale. *Psychol. Assess.* 25, 942–950. <https://doi.org/10.1037/a0032797>.
- Matsumoto, T., Yamaguchi, A., Asami, T., Kamijo, A., Iseki, E., Hirayasu, Y., Wada, K., 2015. Drug preferences in illicit drug abusers with a childhood tendency of attention deficit/hyperactivity disorder: a study using the Wender Utah Rating Scale in a Japanese prison. *Psychiatr. Clin. Neurosci.* 59, 311–318. <https://doi.org/10.1111/j.1440-1819.2005.01376.x>.
- Murphy, K.R., Adler, L.A., 2004. Assessing attention-deficit/hyperactivity disorder in adults: focus on rating scales. *J. Clin. Psychiatr.* 65 (Suppl. 3), 12–17.
- Notzon, D.P., Pavlicova, M., Glass, A., Mariani, J.J., Mahony, A.L., Brooks, D.J., Levin, F. R., 2016. ADHD Is Highly Prevalent in Patients Seeking Treatment for Cannabis Use Disorders *Journal of Attention Disorders*. <https://doi.org/10.1177/1087054716640109>. Mar 31:1087054716640109. [Epub ahead of print].
- Oncü, B., Olmez, S., Sentürk, V., 2005. [Validity and reliability of the Turkish version of the Wender Utah Rating Scale for attention-deficit/hyperactivity disorder in adults]. *Türk Psikiyatri Derg.* 16, 252–259.
- Reimherr, F.W., Roesler, M., Marchant, B.K., Gift, T.E., Retz, W., Philipp, F., Reimherr, M.L., 2020. Types of adult attention-deficit hyperactivity disorder (ADHD): a replication analysis. *J. Clin. Psychiatr.* 81, 19m13077. <https://doi.org/10.4088/JCP.19m13077>.
- Retz-Junginger, P., Retz, W., Blocher, D., Stieglitz, R.D., Georg, T., Supprian, T., Rösler, M., 2003. [Reliability and validity of the Wender-Utah-Rating-Scale short form. Retrospective assessment of symptoms for attention deficit/hyperactivity disorder]. *Nervenarzt* 74, 987–993. <https://doi.org/10.1007/s00115-002-1447-4> [Article in German].
- Retz-Junginger, P., Retz, W., Schneider, M., Schwitzgebe, I.P., Steinbach, E., Henges, G., Rösler, M., 2007. [Gender differences in self-descriptions of child psychopathology in attention deficit hyperactivity disorder]. *Nervenarzt* 78, 1046–1051. <https://doi.org/10.1007/s00115-006-2242-4> [Article in German].
- Rodríguez-Jiménez, R., Ponce, G., Monasor, R., Jiménez-Giménez, M., Pérez-Rojó, J.A., Rubio, G., Palomo, T., 2001. [Validation in the adult Spanish population of the Wender Utah Rating Scale for the retrospective evaluation in adults of attention deficit/hyperactivity disorder in childhood]. *Rev. Neurol.* 33, 138–144 [Article in Spanish].
- Rösler, M., Retz, W., Retz-Junginger, P., Thome, J., Supprian, T., Nissen, T., Trott, G.E., 2004. [Tools for the diagnosis of attention-deficit/hyperactivity disorder in adults. Self-rating behaviour questionnaire and diagnostic checklist]. *Nervenarzt* 75, 888–895. <https://doi.org/10.1007/s00115-003-1622-2> [Article in German].
- Sarrami-Foroushani, P., 2008. [Normalizing and Evaluating the Validity and Reliability of the Wender Utah Rating Scale to Diagnose ADHD in Adults in Isfahan, 1999–2000]. *Isfahan University of Medical Sciences*.
- Seo, J.Y., Lee, C.S., Park, C.S., Kim, B.J., Cha, B.S., Lee, S.J., Ahn, I.Y., 2014. Mediating effect of depressive symptoms on the relationship between adult Attention Deficit Hyperactivity Disorder and quality of life. *Psychiatry Investigation* 11, 131–136. <https://doi.org/10.4306/pi.2014.11.2.131>.
- Stein, M.A., Sandoval, R., Szumowski, E., Roizen, N., Reinecke, M.A., Blondis, T.A., Klein, Z., 1995. Psychometric characteristics of the Wender Utah Rating Scale (WURS): reliability and factor structure for men and women. *Psychopharmacol. Bull.* 31, 425–433.
- Suhr, J., Zimak, E., Buelow, M., Fox, L., 2009. Self-reported childhood attention-deficit/hyperactivity disorder symptoms are not specific to the disorder. *Compr. Psychiatr.* 50, 269–275. <https://doi.org/10.1016/j.comppsy.2008.08.008>.
- Taylor, A., Deb, S., Unwin, G., 2011. Scales for the identification of adults with Attention Deficit Hyperactivity Disorder (ADHD): a systematic review. *Res. Dev. Disabil.* 32, 924–938. <https://doi.org/10.1016/j.ridd.2010.12.036>.
- Ward, M.F., Wender, P.H., Reimherr, F.W., 1993. The Wender Utah Rating Scale: an aid in the retrospective diagnosis of childhood Attention Deficit Hyperactivity Disorder. *Am. J. Psychiatr.* 150, 885–890. <https://doi.org/10.1176/ajp.150.6.885>.
- Weibel, S., Nicastro, R., Prada, P., Cole, P., Rüfenacht, E., Pham, E., Perroud, N., 2018. Screening for attention-deficit/hyperactivity disorder in borderline personality disorder. *J. Affect. Disord.* 226, 85–91. <https://doi.org/10.1016/j.jad.2017.09.027>.
- Wender, P.H., 1995. *Attention-deficit Hyperactivity Disorder in Adults*. Oxford University Press, New York.