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RESEARCH ARTICLE

Psychometric properties of the Self-Report Wender-Reimherr Adult Attention Deficit Disorder Scale

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BACKGROUND: The Self-Report Wender-Reimherr Adult Attention Deficit Disorder Scale (SR-WRAADDS) assesses the same 7 attention-deficit/hyperactivity disorder (ADHD) domains as the interviewer-administered WRAADDS.

METHODS: A normative sample was recruited, and additional participants came from trials involving ADHD, anxiety, or depression. Using the investigator-administered WRAADDS, participants in the ADHD sample were classified as ADHD inattentive presentation or ADHD emotional dysregulation presentation.

RESULTS: In the ADHD sample, the SR-WRAADDS correlated with the investigator-rated version WRAADDS ($P < .001$). In comparing adults with ADHD with normal controls, all SR-WRAADDS domains demonstrated discriminate validity ($P < .001$); a cut point was identified yielding sensitivity of 97% and specificity of 89%. In comparison, in screening for ADHD in depression or anxiety disorders, sensitivity was 87% and specificity, 49%. Internal consistency was satisfactory (Cronbach $\alpha = 0.78$; split-half reliability $r = 0.92$). Factor analysis yielded a 2-factor solution: one reflected emotional dysregulation; the other, inattention and disorganization. Detecting ADHD emotional dysregulation presentation within the ADHD sample, as the "disorder-of-interest," SR-WRAADDS and the investigator-rated WRAADDS agreement was 72% (sensitivity, 87%; specificity, 49%). The SR-WRAADDS detected a methylphenidate vs placebo treatment effect ($P < .001$).

CONCLUSIONS: The psychometric properties of the SR-WRAADDS support its use in research and clinical practice. Emotional domains are integral to its assessment of adult ADHD.

INTRODUCTION

The Self-Report Wender-Reimherr Adult Attention Deficit Disorder Scale (SR-WRAADDS) is derived from the original clinician-administered interview version of the WRAADDS.[1] The origin of the WRAADDS as an interview-based assessment measure is atypical in the area of attention-deficit/hyperactivity disorder (ADHD).

An innovation of DSM-III[2] was the introduction of operational criteria for the full range of psychiatric diagnoses. Its successor, DSM-IV,[3] broadened the criteria for ADHD and split the diagnosis into 3 types: inattentive, hyperactive/impulsive, and combined presentation. These changes in nosologic thinking facilitated the creation of patient self-report instruments for use in the area of adult ADHD, which led to the Conners' Adult ADHD Rating Scale (CAARS)[4] and the Adult ADHD Self-Report Scale,[5] as well as others.[6] Both began as patient self-report instruments and were then developed into interviewer-rating scales.

Beginning in the 1970s, investigators at the University of Utah led by Paul Wender devised the Utah Criteria for the diagnosis of ADHD based on the study of adults. These criteria,[7] which emphasize emotional symptoms along with hyperactivity, impulsivity, and inattention, were a direct outgrowth of earlier studies that identified the diverse symptoms found in adults with ADHD.

The interview-based WRAADDS was devised in order to capture this broader range of symptoms. In addition to inattention, disorganization, impulsivity, and hyperactivity/restlessness—the core symptoms of ADHD in the DSM scheme—the WRAADDS evaluates emotional aspects of ADHD, with items reflecting temper, affective lability, and emotional over-reactivity.

In 2005, we reported that these 3 domains reflecting emotionality could be used to define a subgroup of adults with ADHD-related emotional dysregulation.[8] We noted in that publication that these patients had more ADHD-related impairments than other adults with ADHD, were highly responsive to medications used to treat ADHD, and had symptoms that frequently led to confusion with other DSM Axis I and II diagnoses. Most important, these symptoms improved in parallel with the other ADHD domains during that clinical trial of atomoxetine, whereas measures of depression and anxiety did not improve. Subsequently, the importance of emotional symptoms in ADHD has been supported by additional reports.[9-15]

In 2012, we published a psychometric analysis of the WRAADDS showing that it contains an attentional and an emotional factor. This analysis also showed that in adults, the scale's hyperactivity/restlessness domain was part of its emotional factor. Consequently, we proposed an ADHD classification system based on this analysis: *ADHD inattentive presentation* and *ADHD emotional dysregulation presentation.*[16,17] This alternative classification system has the benefit of including a greater range of ADHD symptoms, and it defines a more severe form of the disorder.

In everyday practice, self-report scales are used more frequently than interviewer-administered scales. In research programs, having both self-administered and interview-based versions of the same scale is a useful option. For these reasons, we developed a self-report version of the WRAADDS. The analysis reported here is based on combined data from a nonclinical community population and from 2 adult ADHD clinical trials, one using osmotic release oral system methylphenidate (OROS MPH)[18] and the other, a methylphenidate transdermal system (MTS),[19] as well as 11 clinical trials of treatment for anxiety or depression.

In prior reports using the SR-WRAADDS, we used item averages to calculate domain scores. Conducting the psychometric analyses described here, it became clear that an alternative scoring method (the score of the highest-rated item within each domain is deemed the domain score) more closely parallels the scoring system used with the interviewer-administered WRAADDS. The scoring instructions for this scale state that "The summary score [of each domain] should not be a simple average of the individual ratings but rather an integration of the extent and severity of the deficits within the domain. For example, if only one question in a group is rated as clearly present, a rating of '4' might be appropriate if this one factor is causing significant problems." This highest-item scoring procedure leads to higher domain ratings than those produced by the WRAADDS, whereas the SR-WRAADDS scoring system used earlier (using the average of the items in each domain) led to lower domain scores.

In this report, the SR-WRAADDS score (which may be designated *SR-WRAADDS total* or simply *SR-WRAADDS*) is the sum of the same 7 ADHD symptom domains assessed by the interviewer-administered WRAADDS. The scale also includes items addressing oppositional defiant disorder, social adjustment, academic problems, and miscellaneous symptoms. Although these items are broadly useful, they were excluded from this psycho-

metric analysis because these characteristics and difficulties are not inherent in the disorder.

In examining the psychometric properties of the SR-WRAADDS, we explored the following questions:

1. Does the SR-WRAADDS have acceptable psychometric properties?
2. Does the SR-WRAADDS have a factor structure similar to the interviewer-administered WRAADDS?
3. Does the scale adequately separate patients with ADHD from normal controls?
4. Does the scale adequately separate ADHD attentional presentation from ADHD emotional dysregulation presentation?
5. Does the scale help separate patients with ADHD from those experiencing anxiety and depressive disorders?

Methods

The University of Utah institutional review board reviewed and approved the studies that supplied data for this analysis. These studies were conducted in accordance with the Declaration of Helsinki.

For the ADHD population, the scale was used in 2 crossover clinical trials at baseline, after each crossover phase, and at the end of a 6-month open-label phase. Data from the double-blind treatment phase were used to evaluate the success of this scale in measuring treatment response.

Participant characteristics

Normative sample. For the community comparison population, we interviewed couples evenly distributed in 3 age groups: 20 to 29, 30 to 39, and 40 to 49 years. Each couple completed self-report scales and was interviewed by one of the authors. The normative sample was recruited specifically for this research project through several churches in Lincoln, Nebraska, and posters placed on the University of Utah campus in Salt Lake City. Recruitment through churches was intended to increase minority participation by including several congregations with large minority membership.

The SR-WRAADDS data were collected at the same time as the normative data for the WRAADDS psychometric analysis. Because we have recommended that the WRAADDS interview be conducted with a participant and a significant other, the normative population was recruited as couples, ie, a participant and an informant. *Couple* was defined as a man and woman living together for >6 months.

The investigators explained the purpose of the research, the data collection procedure, and the compensation offered—couples were compensated $50 for their participation. Individuals who expressed interest were given consent forms to read and sign. Researchers collected patient information, including demographics, psychiatric history, and current medications. Two investigator-rated scales were completed: the Hamilton Depression Scale (HAM-D)[20] and the original version of the WRAADDS. Participants completed the SR-WRAADDS (**APPENDIX**) and the Wender Utah Rating Scale (WURS).

Exclusion criteria included known personal or family history (self, parents, siblings, or children) of ADHD, personal history of an Axis I disorder in the preceding 3 months, any history of a psychotic disorder, or history of psychiatric hospitalization. Although current treatment for an acute or active psychiatric condition led to exclusion from the study, participants could be taking an antidepressant if depressive symptoms were in remission. Ultimately, the outreach to churches with primarily minority congregations resulted in few participants.

ADHD sample. Data were obtained from 45 participants in the clinical trial of OROS MPH[18] and from 73 who participated in the clinical trial of MTS.[19] Participants from both trials were required to meet DSM-IV and/or the Utah Criteria for ADHD in adults and have at least moderate impairment on the Clinical Global Impressions–Severity (CGI-S) scale.[21] Patients were age 18 to 63. The following DSM-IV diagnoses were exclusionary: current major depressive disorder or panic disorder, current or lifetime bipolar disorder, schizophrenia, or other psychotic disorder.

Sample from depression or anxiety trials. Data were obtained at baseline from 93 participants in 7 clinical trials of pharmacotherapy for depression and 4 trials of pharmacotherapy for anxiety. Participants' charts were reviewed retrospectively for evidence of current or childhood history of diagnosis or treatment of ADHD. Participants also completed the WURS. Using these data, participants were categorized as having major depression or generalized anxiety disorder, or one of these disorders plus probable ADHD.

Measures

As described in the Introduction, the WRAADDS is a clinician-administered scale designed to measure the

TABLE 1
Demographics and clinical attributes of participants

Characteristic	Normative	ADHD
Age, years, mean ± SD	34.7 ± 8.6	33.7 ± 11.7
Female, %	50%	29%
Total WRAADDS, mean ± SD	2.0 ± 2.3	21.5 ± 4.1
Inattention Factor score, mean ± SD	0.9 ± 1.0	8.9 ± 1.3
Emotional Dysregulation Factor score, mean ± SD	1.0 ± 1.2	10.8 ± 2.7
ADHD inattentive presentation, %	0%	40%
ADHD emotional dysregulation presentation, %	0%	60%
SR-WRAADDS total, mean ± SD	8.5 ± 4.6	23.4 ± 4.3
CGI-S, mean ± SD	na	4.7 ± 0.7
WURS, mean ± SD	14.5 ± 10.0	53.6 ± 16.7
HAM-D, mean ± SD	2.2 ± 2.3	10.9 ± 5.7
Alcohol abuse, %	0%	40%
Drug abuse, %	0%	23%
Education,[a] %		
Professional	22%	3%
College graduate	41%	37%
Some college	23%	40%
High school graduate	11%	16%
Less than high school	5%	4%
White, %	92.5%	87%

[a]Percentages add up to more than 100% because of rounding.

ADHD: attention-deficit/hyperactivity disorder; CGI-S: Clinical Global Impressions Scale–Severity; HAM-D: Hamilton Depression Rating Scale, 21-item version; na: not applicable; SD: standard deviation; SR: Self-Report; WRAADDS: Wender-Reimherr Adult Attention Deficit Disorder Scale; WURS: Wender Utah Rating Scale.

7 domains of adult ADHD, which are part of the Utah Criteria. Its psychometric properties have been documented.[1] Information to complete this scale is optimally obtained with an informant present[7] in addition to the patient, and in this investigation informants were routinely present.

The WURS is a self-rating instrument of 61 items on which an adult rates his or her own childhood behavior and symptoms.[22] The WURS was used to help ascertain childhood symptoms of ADHD. A 26-item subset of WURS items is used in scoring the WURS, and a score of 46 (95th percentile) or higher on this subset has been shown to indicate that ADHD was present during childhood.[23]

The HAM-D[20] is an investigator-rated scale for depression. The 21-item version was used. Scores of ≥20 are commonly required for admission into clinical trials addressing major depression.

The CGI-S[24] assessed severity of ADHD: 1, normal, not at all ill; 2, borderline ill; 3, mildly ill; 4, moderately ill; 5, markedly ill; 6, severely ill; or 7, extremely ill. In this analysis, scores of 5 (markedly ill) or higher were categorized as a significant impairment, when comparing the 2 groups at baseline. Scores of 3 (mildly ill) or lower were used to categorize improvement during the double-blind phase.

This report is based on a version of the SR-WRAADDS in which the items are presented in a randomized fashion. This is the version we used to collect data. However, in another version of the SR-WRAADDS, the items in each domain are grouped together (available from the authors upon request).

Data analysis

Analyses reported here address the 7 domains of the Utah Criteria for ADHD. The highest individual item score within each domain was deemed the domain score for that subject, as noted above. In addition, domains were combined for some analyses. These groupings follow previously published procedures[1] for factor scoring.

Statistical analyses were carried out using Statistical Package for the Social Sciences (SPSS) version 14 (SPSS Inc.).

RESULTS

Group, age, and sex effects

In the normative sample, 7.5%, or 9 participants, did not identify themselves as white (TABLE 1). As shown in TABLE 1, participants were relatively well educated. Although the education levels of these participants were high compared with national norms, they are similar to the education levels of participants in many adult ADHD trials.[25] For this community sample, scores for the WURS averaged 14.5 ± 10.0. Scores for the 21-item HAM-D averaged 2.2 ± 2.3. There were 23 participants using a prescription medication. The most common medication categories were: antidepressant/anxiolytic (8), antihypertensive (5), cholesterol control (3), and antihistamine (3).

In comparison, the ADHD sample included relatively fewer females, which is typical of populations of patients with ADHD.[26] Participants with ADHD were less

TABLE 2
Mean ± SD for the 7 ADHD domains of the SR-WRAADDS for both normative and ADHD samples

	Normative sample		ADHD sample	
Domain	**Female**	**Male**	**Female**	**Male**
All ages	**n = 60**	**n = 60**	**n = 34**	**n = 88**
Attention Difficulties	1.1 ± 0.9	1.4 ± 1.0	3.8 ± 0.4	3.8 ± 0.6
Hyperactivity/Restlessness	1.3 ± 0.9	1.7 ± 1.2	3.3 ± 1.0	3.2 ± 1.0
Temper	0.9 ± 0.8	0.8 ± 0.8	2.7 ± 1.4	2.6 ± 1.3
Affective Lability	1.2 ± 0.9	1.1 ± 1.0	3.5 ± 0.7	3.5 ± 0.7
Emotional Over-Reactivity	1.4 ± 0.9	0.9 ± 0.9	3.5 ± 0.9	3.2 ± 0.9
Disorganization	1.5 ± 1.2	1.5 ± 1.1	3.9 ± 0.3	3.7 ± 0.7
Impulsivity	1.0 ± 0.9	1.1 ± 0.9	3.5 ± 0.8	3.5 ± 0.8
SR-WRAADDS total	**8.4 ± 4.1**	**8.5 ± 5.1**	**24.1 ± 3.6**	**23.5 ± 3.9**
20- to 29-year-olds	**n = 23**	**n = 17**	**n = 18**	**n = 47**
Attention Difficulties	1.3 ± 1.0	1.4 ± 1.1	3.8 ± 0.4	3.9 ± 0.7
Hyperactivity/Restlessness	1.4 ± 1.0	1.6 ± 1.1	3.6 ± 0.5	3.2 ± 1.0
Temper	0.8 ± 0.9	0.9 ± 1.0	3.1 ± 1.2	2.7 ± 1.3
Affective Lability	1.3 ± 0.6	1.2 ± 1.3	3.5 ± 0.6	3.6 ± 0.7
Emotional Over-Reactivity	1.3 ± 0.8	0.9 ± 1.0	3.5 ± 0.7	3.4 ± 0.9
Disorganization	1.6 ± 1.1	1.2 ± 0.9	3.9 ± 0.3	3.8 ± 0.7
Impulsivity	1.0 ± 0.8	1.3 ± 1.0	3.6 ± 0.7	3.6 ± 0.7
SR-WRAADDS total	**8.7 ± 3.5**	**8.5 ± 5.4**	**25.0 ± 2.7**	**24.0 ± 3.8**
30- to 39-year-olds	**n = 19**	**n = 22**	**n = 9**	**n = 23**
Attention Difficulties	1.0 ± 0.9	1.4 ± 1.0	3.8 ± 0.4	3.8 ± 0.4
Hyperactivity/Restlessness	1.0 ± 0.8	1.8 ± 1.2	2.8 ± 1.2	3.3 ± 0.8
Temper	1.2 ± 0.6	0.7 ± 1.0	2.1 ± 1.4	2.2 ± 1.1
Affective Lability	0.9 ± 1.0	1.0 ± 0.8	3.3 ± 0.9	3.3 ± 0.6
Emotional Over-Reactivity	1.5 ± 0.8	1.0 ± 1.0	3.1 ± 1.3	3.0 ± 0.9
Disorganization	1.7 ± 1.4	1.9 ± 1.1	3.9 ± 0.3	3.7 ± 0.5
Impulsivity	1.0 ± 0.9	1.3 ± 0.8	3.2 ± 1.1	3.6 ± 0.7
SR-WRAADDS total	**8.3 ± 4.6**	**9.2 ± 5.4**	**22.2 ± 5.1**	**22.8 ± 3.2**
40- to 49-year-olds	**n = 18**	**n = 21**	**n = 7**	**n = 18**
Attention Difficulties	0.8 ± 0.5	1.3 ± 1.0	3.8 ± 0.4	3.6 ± 0.7
Hyperactivity/Restlessness	1.4 ± 1.0	1.7 ± 1.3	3.0 ± 1.1	3.1 ± 1.3
Temper	0.9 ± 1.0	0.8 ± 0.9	2.8 ± 1.7	3.1 ± 1.1
Affective Lability	1.6 ± 0.9	1.1 ± 1.1	3.8 ± 0.4	3.5 ± 0.8
Emotional Over-Reactivity	1.4 ± 1.0	0.9 ± 0.7	3.8 ± 0.4	3.2 ± 1.0
Disorganization	1.1 ± 1.2	1.3 ± 1.2	3.9 ± 0.3	3.5 ± 0.9
Impulsivity	0.9 ± 1.0	0.7 ± 0.8	3.4 ± 0.7	3.4 ± 0.9
SR-WRAADDS total	**8.2 ± 4.5**	**7.9 ± 4.8**	**24.4 ± 3.1**	**23.3 ± 4.7**

ADHD: attention-deficit/hyperactivity disorder; SR-WRAADDS: Self-Report Wender-Reimherr Adult Attention Deficit Disorder Scale.

likely to have a professional education, although similar numbers had some college education.

Data for both the normative sample and the ADHD participants as assessed by the SR-WRAADDS are presented in **TABLE 2**, which provides a breakdown by sex and the 3 age groups (20 to 29, 30 to 39, and 40 to 49 years). Nonclinical participants reported less than mild symptoms (scores of 1) on all 7 domains, whereas the patients with ADHD averaged more than moderate symptoms (scores of 2) on all 7 ADHD domains.

TABLE 3
Internal consistency for all 7 domains

Domain	Scale mean if item deleted	Scale variance if item deleted	Corrected item total correlation	Cronbach α if item deleted
Attention Difficulties	19.6	15.3	0.51	0.76
Hyperactivity/Restlessness	20.2	14.1	0.43	0.77
Temper	20.8	12.1	0.45	0.79
Affective Lability	20.0	13.4	0.68	0.72
Emotional Over-Reactivity	20.2	13.4	0.57	0.74
Disorganization	18.7	15.6	0.45	0.77
Impulsivity	20.0	13.5	0.62	0.73
Cronbach α = 0.78				

Using only participants with ADHD, each domain was subjected to analysis of variance (ANOVA) with age and sex as factors. Age emerged as a significant factor for the following domains: temper ($F_{40,75}$ = 2.6; P = .017), affective lability ($F_{40,75}$ = 3.5; P = .003), disorganization ($F_{40,75}$ = 2.6; P = .016), and impulsivity ($F_{40,75}$ = 2.5; P = .019) as well as for SR-WRAADDS total ($F_{40,75}$ = 2.5; P = .02). Although the tables appear to show a curvilinear relationship, with participants in their 30s having the fewest symptoms, the ANOVA calculations did not include these clusters but only the actual age. Under the linear assumptions of the mathematical model, younger age was associated with higher symptom levels. In contrast, none of the domains was significantly associated with sex, and there were no significant interaction effects between age and sex.

Internal consistency

Internal consistency refers to the degree to which the items of a particular scale consistently measure the same construct. This is commonly evaluated using item-remainder coefficients and Cronbach α. Item-remainder coefficients indicate the correlation between each item and the sum of all other items, whereas Cronbach α is an overall summary coefficient that varies between 0 and 1. Scores above 0.7 on the latter generally are considered acceptable. As seen in **TABLE 3**, all 7 domains correlated significantly with the sum of the other domains, indicating acceptable internal consistency. This was further supported by a Cronbach α of 0.78 and only small changes in α with the removal of any domain.

Split-half reliability, another measure of internal consistency, was calculated using an odd-even protocol, and the resulting correlation was corrected using the Spearman-Brown formula. The original Pearson correlation was r = 0.86; df = 93; P < .001. The Spearman-Brown formula correction resulted in a correlation of r = 0.92, strongly supporting the internal consistency of the instrument.

Factor analysis

Scores for each of the 7 domains (attention difficulties, hyperactivity/restlessness, temper, affective lability, emotional over-reactivity, disorganization, and impulsivity) were subjected to factor analysis. All participants with baseline scores from the OROS MPH (n = 45) and MTS (n = 73) trials were included. Because not all domains met assumptions of normality, principal components analysis was selected as the extraction method. Varimax rotation was used and factors met the Kaiser criterion (eigenvalues above 1). The resulting 2-factor solution is shown in **TABLE 4**. The first factor included the emotional domains of temper, affective lability, and emotional over-reactivity plus the domains of hyperactivity/restlessness and impulsivity. The second factor included the domains of attention difficulties and disorganization. This 2-factor solution accounted for 64% of the variance.

Relationship between SR-WRAADDS and WRAADDS

There were significant correlations between the baseline scores on the SR-WRAADDS and the investigator-rated WRAADDS. Total scores for the 2 scales were significantly correlated (r = 0.51; df = 130; P = .001). The emotional dysregulation factor scores were also significantly correlated (r = 0.58; df = 130; P = .001). The attention factors scores

were significantly correlated ($r = 0.28$; $df = 130$; $P = .001$) but at a lower level. It seems likely that this lower correlation resulted from uniformly high scores and thus little variability in the attention and disorganization domains. As seen in TABLE 5, the standard deviations for the 2 attention factor scores are approximately half those of the emotional dysregulation factor scores.

Further, there were high correlations between the net difference in the SR-WRAADDS total on drug and on placebo vs the similar net difference measured with the investigator-rated WRAADDS ($r = 0.78$; $df = 79$; $P < .001$). The correlations between corresponding domains (data not shown) were similar to correlations between noncorresponding domains, suggesting that participants typically experienced a generalized response to treatment with methylphenidate—when they improved in one area, they usually improved in all areas.

As seen in TABLE 6, the total score of the SR-WRAADDS showed a significant treatment effect ($t = 4.1$; $df = 80$; $P < .001$) comparable in magnitude to the treatment effect shown by the investigator-rated WRAADDS ($t = 5.4$; $df = 91$; $P < .001$) for participants in the ADHD clinical trials. The SR-WRAADDS also was successful when used to create a categorical variable. Defining improvement as a 50% reduction of scores from baseline, 17% of participants responded in the placebo arm vs 48% in the active treatment arm ($\chi^2 = 19.3$; $df = 1$; $P < .001$). While significant, this chi-square value was numerically lower than that generated by the WRAADDS ($\chi^2 = 37.7$; $df = 1$; $P < .001$).

Construct validity or known-groups validity

The SR-WRAADDS was evaluated for its ability to separate adults with and without ADHD. Initially, this analysis was done with age and sex as covariates, but they were not significant and are therefore not reported. There was a significant difference between the 2 groups for every domain: attention difficulties ($F_{1,251} = 623.9$; $P < .001$), hyperactivity/restlessness ($F_{1,251} = 168.5$; $P < .001$), temper ($F_{1,251} = 136.2$; $P < .001$), affective lability ($F_{1,251} = 409.7$; $P < .001$), emotional over-reactivity ($F_{1,251} = 313.6$; $P < .001$), disorganization ($F_{1,251} = 377.1$; $P < .001$), and impulsivity ($F_{1,251} = 461.5$; $P < .001$). A total score of 15 on the 7 ADHD domains is near the 95th percentile for the normal participants in this analysis, recommending it as an acceptable cut point in identifying individuals with ADHD. Use of this cut point yields a sensitivity of 97%, specificity of 89%, positive predictive value of 91%, and negative predictive value of 96%.

TABLE 4
Factor analysis of the SR-WRAADDS using varimax rotation with Kaiser normalization and principal components extraction method[a]

Domain	Factor 1	Factor 2
Attention Difficulties	0.182	**0.898**
Disorganization	0.110	**0.885**
Hyperactivity/Restlessness	**0.656**	0.107
Temper	**0.819**	–0.086
Affective Lability	**0.702**	0.399
Emotional Over-Reactivity	**0.529**	0.384
Impulsivity	**0.627**	0.429

[a]Accounts for 64% of the variance.

Primary factor loading are in bold type.

SR-WRAADDS: Self-Report Wender-Reimherr Adult Attention Deficit Disorder Scale.

The SR-WRAADDS of the 93 participants in the depression and anxiety trials were compared with those of the participants in the ADHD trials and normal controls. Participants within the anxiety or depression trials had average SR-WRAADDS total scores (19.6 ± 6.5), which were higher than those of the normal controls (8.5 ± 4.6) ($P = .001$). These scores were lower than the SR-WRAADDS total scores for participants in the 2 ADHD trials (23.4 ± 4.3) ($P = .001$). Further, as seen in TABLE 7, the 16 participants in the anxiety/depression trials who demonstrated clear evidence of current or childhood ADHD had higher SR-WRAADDS total scores than participants without evidence of ADHD ($P = .01$). These 16 participants had SR-WRAADDS total scores (23.9 ± 3.7) similar to those of the ADHD trial participants. Use of a score of 15 successfully identified all those with evidence of ADHD. However, 60% of anxiety/depression trial participants for whom evidence of ADHD was lacking had SR-WRAADDS scores above this threshold. Consequently, the SR-WRAADDS retained high sensitivity in the detection of potential participants with ADHD, but its specificity was reduced.

There was significant agreement between the SR-WRAADDS and the investigator-rated WRAADDS in separating ADHD emotional dysregulation presentation from ADHD inattentive presentation. As referenced earlier, the authors have proposed an alternative classification system for ADHD in adulthood.[16,17] Marked impairment in at least 3 of the 4 emotional domains was used to define ADHD emotional dysregulation

TABLE 5
Relationship between patient and clinician assessments of ADHD symptoms

Domain	SR-WRAADDS score	WRAADDS score	Difference
Attention Difficulties	3.8 ± 0.6	3.6 ± 0.6	0.1
Hyperactivity/Restlessness	3.2 ± 1.0	2.9 ± 1.0	0.3
Temper	2.6 ± 1.4	2.2 ± 1.4	0.3
Affective Lability	3.5 ± 0.8	3.1 ± 1.0	0.2
Emotional Over-Reactivity	3.3 ± 1.0	3.1 ± 1.0	0.2
Disorganization	3.7 ± 0.6	3.5 ± 0.8	0.2
Impulsivity	3.4 ± 0.9	3.1 ± 0.9	0.3
Total score – All domains	23.4 ± 4.3	21.5 ± 4.1	1.9
Attention factor score	10.9 ± 1.7	8.9 ± 1.3	2.0
Emotional dysregulation factor score	11.6 ± 2.6	10.8 ± 2.7	0.8

All scores are mean ± SD.

ADHD: attention-deficit/hyperactivity disorder; SD: standard deviation; SR: Self-Report; WRAADDS: Wender-Reimherr Adult Attention Deficit Disorder Scale.

presentation, whereas patients with less impairment in the emotional factor domains are classified as having ADHD inattentive presentation. There was significant agreement between the SR-WRAADDS and the WRAADDS regarding these 2 ADHD presentations. We assessed agreement for these 2 types using a framework in which ADHD emotional dysregulation presentation was the "disorder-of-interest." Under this assumption, the 2 scales agreed 72% of the time (sensitivity of 87%, specificity of 49%, positive predictive value of 72%, and negative predictive value of 72%). A larger percentage of participants met criteria for ADHD emotional dysregulation presentation using the SR-WRAADDS (73%) than the WRAADDS (60%).

DISCUSSION

The SR-WRAADDS is based on the symptom domains identified by the Utah Criteria[7] for ADHD and the interview-based WRAADDS rather than the DSM criteria. Unlike DSM-based instruments, both were created by assessing the complaints, signs, and symptoms of adults rather than childhood signs. Reflecting its derivation from the study of adults, the SR-WRAADDS has an expanded ADHD symptom base that includes 3 domains that are emotional in content and have been combined for statistical analysis in several publications using the designation *emotional dysregulation.*

The claim that emotional symptoms are integral to ADHD has been made by Rösler et al,[13] Barkley,[28] Skirrow and Asherson,[29] as well as the authors. Psychometric analysis of the WRAADDS gives further support to the understanding that these emotional domains are an integral part of ADHD.[1]

These data indicate substantial agreement between the patient-rated SR-WRAADDS and the clinician-rated WRAADDS. At baseline, the 2 demonstrated significant correlations, especially for similar domains. The assessment of treatment response gave further support to the validity of the SR-WRAADDS. SR-WRAADDS change scores (placebo minus active treatment within crossover designs) correlated highly with the investigator-rated WRAADDS change scores. These correlations were consistently higher than baseline correlations between the instruments. These findings indicate that the SR-WRAADDS successfully measured treatment response in clinical trials of methylphenidate.

The SR-WRAADDS demonstrated acceptable criterion-related validity. The normative sample differed from the ADHD sample, with >4 standard deviations separating the 2 groups. This difference was not substantially affected by age or sex, and it occurred across all symptom domains. These data suggest an SR-WRAADDS cut point above which clinicians should consider a diagnosis of ADHD. A summed score of ≥15 on the 7 ADHD domains correctly identified >90% of the normal participants and patients with ADHD. This

TABLE 6
Treatment response by WRAADDS, SR-WRAADDS, CGI-I, and CGI-S scales

	Placebo	Active medication	Statistic	Effect size[a]
Continuous variables				
SR-WRAADDS total, mean ± SD	19.1 ± 7.4	14.0 ± 7.4	$t = 4.1$; $df = 80$; $P < .001$	$d = 0.7$
Investigator-rated WRAADDS				
Total WRAADDS, mean ± SD	18.9 ± 7.0	12.1 ± 7.8	$t = 5.4$; $df = 91$; $P < .001$	$d = 0.9$
Categorical variables				
SR-WRAADDS total,[b] n (%)	14 (17%)	41 (48%)	$\chi^2 = 19.3$; $df = 1$; $P < .001$	—
WRAADDS total,[b] n (%)	16 (16%)	53 (54%)	$\chi^2 = 37.7$; $df = 1$; $P < .001$	—
CGI-I (1 or 2), n (%)	9 (16%)	38 (59%)	$\chi^2 = 27.8$; $df = 1$; $P < .001$	—
CGI-I (1 or 2), n (%)	9 (16%)	38 (59%)	$\chi^2 = 27.8$; $df = 1$; $P < .001$	—
CGI-S (3 or less), n (%)	20 (21%)	59 (61%)	$\chi^2 = 30.8$; $df = 1$; $P < .001$	—

[a]Cohen's *d*.
[b]Response defined by at least a 50% improvement from baseline.

CGI-I: Clinical Global Impressions Scale–Improvement; CGI-S: Clinical Global Impressions Scale–Severity; SD: standard deviation; SR: Self-Report; WRAADDS: Wender-Reimherr Adult Attention Deficit Disorder Scale.

makes the SR-WRAADDS useful as a screening tool for adult ADHD. In addition, the SR-WRAADDS successfully categorized patients as having ADHD inattentive presentation vs ADHD emotional dysregulation presentation. The SR-WRAADDS agreed with the WRAADDS 72% of the time, displaying a sensitivity of 87% and a specificity of 49%. For screening purposes, high levels of sensitivity are more important than specificity, and depending on investigator or clinician needs, a score <15 could be designated to ensure that even fewer true positives escape detection.

The SR-WRAADDS was less useful in identifying probable ADHD in the presence of anxiety or mood disorders. Participants with anxiety or depressive disorders had SR-WRAADDS scores that were higher than those of the normal controls but lower than those of the ADHD participants. Further, participants from these trials with evidence of ADHD had scores similar to those of the ADHD participants. Using a score of 15 successfully identified all those with probable ADHD. However, many participants for whom evidence of ADHD was lacking had scores above this threshold. These findings suggest that the SR-WRAADDS can be used to alert clinicians and researchers to the possibility of comorbid ADHD, but establishing this diagnosis necessitates the acquisition of additional information.

In the preceding discussion, we have regarded the interview-based assessment with informant participation as the gold standard. However, it could be that the participants' self-ratings captured information not available to the interviewer, as others have described.[30] This would account for some of the discrepancy between participant ratings and interviewer ratings. Our experience in conducting interviews and reviewing the self-report ratings was that, not infrequently, the participants' ideas as to how to understand or interpret the terms used to describe ADHD symptoms were rather different from those of the interviewers, a phenomenon commented on by Jobe.[31] Similarly, our experience has been that participants' understanding of items often differed from that of their significant others, and also that with time and repeated assessments, participants' ideas as to the meaning of items tended to come into conformity with those of the interviewers and significant others.

In recent years, Barkley has looked at the importance of what he calls "emotional impulsiveness" and "deficient emotional self-regulation." In a review article,[28] he indicated that when measures of these problems are combined with measures of inattention and hyperactivity/impulsivity, they can be described by 2 factors, with the emotional problems more closely associated with hyperactivity/impulsivity, findings that parallel results reported here.

The CAARS includes a set of items designated "emotional lability" that resembles to some degree several items in the WRAADDS. These emotional items loaded on a factor that included impulsivity but not hyperactivity.[4] Our analysis of the investigator-rated WRAADDS[1]

TABLE 7
Participants within anxiety and depression trials with a history indicating a high probability of ADHD had higher SR-WRAADDS scores

Domain	No history indicating ADHD (N = 77)	History indicates probable ADHD (N = 16)	*P*	Effect size[a]
Attention	2.9 ± 1.2	3.3 ± 0.8	.20	0.41
Hyperactivity/Restlessness	2.8 ± 1.1	3.3 ± 1.1	.14	0.42
Temper	2.5 ± 1.3	2.9 ± 1.6	.30	0.27
Affective Lability	3.1 ± 1.1	3.9 ± 0.2	.004	1.24
Emotional Over-Reactivity	3.2 ± 1.0	3.7 ± 0.6	.06	0.62
Disorganization	2.8 ± 1.3	3.6 ± 0.6	.03	0.78
Impulsivity	2.4 ± 1.3	3.2 ± 1.0	.02	0.73
SR-WRAADDS total	19.6 ± 6.5	23.9 ± 3.7	.01	0.84

All scores are mean ± SD.

[a]Effect size is calculated using Cohen's *d*.

ADHD: attention-deficit/hyperactivity disorder; SD: standard deviation; SR-WRAADDS: Self-Report Wender-Reimherr Adult Attention Deficit Disorder Scale.

found a 2-factor solution, with the first factor including the domains of emotional dysregulation (temper, affective lability, and emotional over-reactivity) as well as hyperactivity/restlessness. The second factor included the domains of attention difficulties and disorganization. Impulsivity was related (fairly equally) to both factors. This solution accounted for 58% of the variance. Based on the German version of the WRAADDS, Rösler et al[32] reported a slightly different 2-factor solution that explained 63% of the variance. Factor 1 was designated by impulsivity, affective lability, hyperactivity/restlessness, and temper; Factor 2 consisted of attention difficulties, disorganization, and emotional over-reactivity. The 2-factor solution that was generated by the SR-WRAADDS as described above was similar to that generated by the WRAADDS as well as that predicted by Barkley. The 3 emotional domains loaded on the same factor as hyperactivity/restlessness, with attention and disorganization loading on a second factor.

Limitations

We identified 4 salient limitations to this investigation. First, racial and ethnic minorities are underrepresented in the participant pool. Second, the most impaired adults with ADHD are almost certainly underrepresented in these data. Adults with ADHD who have serious comorbidities, such as addiction or antisocial personality disorder, are unlikely to volunteer for and/or are intentionally excluded from clinical trials. Third, recruiting the non-ADHD participants as couples may have led to a better functioning group. However, the participants with ADHD are quite likely typical of patients with ADHD who participate in clinical trials and probably typical of patients in private treatment. Fourth, the ADHD clinical sample was compared with only 2 other psychiatric disorders. Although anxiety and depression commonly coexist with ADHD, they are not the only disorders to do so, which permits ongoing uncertainty as to the ability of the SR-WRAADDS to distinguish between disorders, a problem characteristic of other ADHD measures.[33] The high comorbidity of other psychiatric disorders and ADHD[3,26,34] complicates this issue. However, the authors have found that the more complete symptom set constituting the SR-WRAADRS makes it easier, not more difficult, to clarify an individual's diagnosis.

CONCLUSIONS

These analyses demonstrated that the SR-WRAADDS possesses acceptable psychometric properties, including internal consistency and validity. The emotionality domains of the SR-WRAADDS, as well as the interviewer-rated WRAADDS, represent an inherent part of ADHD in adulthood. All 7 SR-WRAADDS domains proved useful in assessing patients' response to ADHD treatment. Researchers and clinicians can use the SR-WRAADDS to produce a more comprehensive picture of symptoms in patients with ADHD. The SR-WRAADDS can be useful as

a screening instrument, for diagnosis when a sample is too large to be interviewed, or to assess potential comorbid ADHD symptoms when the focus is on a different disorder or population. Finally, the scale allowed separation of adults with ADHD into 2 types: ADHD inattentive presentation and ADHD emotional dysregulation presentation. ■

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APPENDIX

Self-Report WRAADDS

Patient Initials: _____ Patient Number: _____ Date: _____

As an adult, do you have, are you, or do you:	None or slightly	Mildly	Moderately	Quite a bit	Very much
1. Overactive, restless, always on the go					
2. Feeling muddled, uneasy, confused, uncertain about life					
3. Concentration problems, difficulty focusing					
4. Tense, on edge, difficulty relaxing					
5. Trouble getting over things, have a hard time letting go, holding grudges					
6. Problems with mind wandering, daydreaming					
7. Hot- or short-tempered, low boiling point					
8. Distractible					
9. Temper outbursts, losing control (loud, abusive, regret actions)					
10. Trouble with stick-to-it-iveness, not finishing things once they are started					
11. Rebellious, have trouble with authority, rules, restrictions					
12. Short periods of being sad, depressed or discouraged					
13. Incautious, dare-devilish, take chances					
14. Feel easily bored, quickly lose interest					
15. Tendency to feel that others are to blame for problems you have had					
16. Difficulty listening, following conversations, others complain that you do not listen					
17. Irritable					
18. Confusion, too many thoughts, too many "channels" in mind all at once					
19. Difficulties organizing time, setting priorities, and working in an organized manner					
20. Moody, up and down, both positive and negative					
21. Feel overwhelmed, "hassled," frustrated					
22. Problems paying attention in lectures, meetings, or programs					
23. Being verbally impulsive—blurt things out, speak without thinking, intrude on others					
24. Tend to annoy, tease others					
25. Rush through things too quickly, make careless mistakes					
26. Impulsive spending, trouble managing money					
27. Get too excited, go too fast, or talk too much					
28. Trouble with authorities, legal problems					
29. Not effective, put in effort, but do not get things done					
30. Get into disagreements, arguments					
31. Feel things very intensely, overly emotional					
32. Feeling bothered, easily annoyed					
33. Fidgety, difficulty sitting still					

As an adult, do you have, are you, or do you:	None or slightly	Mildly	Moderately	Quite a bit	Very much
34. Stubborn, strong-willed, trouble seeing things from someone else's point of view					
35. Forget to do things, miss obligations, often late					
36. Acting without thinking, impulsive					
37. Problems getting started, putting things off, procrastinating					
38. Feeling angry, resentful					
39. Difficulty waking up, slow to get started					
40. Over-react to pressure, blow things out of proportion, become upset easily					
41. Intentionally forget, or delay doing things others want you to do					
42. Under stress even simple responsibilities are too demanding—Pressures or stress causes anxiousness, disorganization or confusion					
43. Minor physical symptoms like headaches, stomach problems, muscle aches and pains					
44. Impatient, or unable to wait, others regard you as impatient					
45. Misplace things like keys, purse, wallet, or things around the house or at work					
46. Problems reading, frequently have to re-read, dislike reading					
Academic problems as an adult:					
47. Problems with numbers, mathematics					
48. Trouble with directions, manuals, instructions					
49. Worried about capacity to learn, going to school, exploring new areas					
50. Trouble applying full ability or mental capacity to work or tasks					
Social adjustment as an adult:					
51. Lack of interest in work, school, or activities					
52. Dislike, feel uneasy or awkward in groups/social activities					
53. Relationship with spouse/significant other stressful, difficult, or distant					
54. Trouble making & keeping friends, few social contacts					
55. Financial difficulty, not enough money for current needs					
56. Friction, difficulty in communication with family members					
57. Upset, distressed, or bothered with work					
58. Feeling inadequate at work or school (or as homemaker), not doing well enough					
59. Few leisure activities, hobbies					
60. Relations with relatives distant or stressed					
61. Work achievement disappointing, feel unsuccessful					

Scoring for the Self-Report WRAADDS:

None or slightly = 0 | Mildly = 1 | Moderately = 2 | Quite a bit = 3 | Very much = 4

For each domain's score, use the highest item's score within the domain. Calculating the ADHD factors is optional.

Scale Name	Domain Score
Attention Difficulties – 6 items 3 ___, 6 ___, 8 ___, 16 ___, 22 ___, 46 ___	_____
Hyperactivity/Restlessness – 3 items 1 ___, 4 ___, 33 ___	_____
Temper – 3 items 7 ___, 9 ___, 17 ___	_____
Affective Lability – 4 items 12 ___, 14 ___, 20 ___, 27 ___	_____
Emotional Over-Reactivity – 4 items 21 ___, 31 ___, 40 ___, 42 ___	_____
Disorganization – 5 items 10 ___, 19 ___, 35 ___, 37 ___, 45 ___	_____
Impulsivity – 5 items 23 ___, 25 ___, 26 ___, 36 ___, 44 ___	_____
ADHD Total[1]	_____
ADHD Inattention Factor[2] **(Attention + Disorganization)**	_____
ADHD Emotional Dysregulation Factor[3] **(Hyperactivity + Temper + Affective Lability + Emotional Over-Reactivity)**	_____
Oppositional Impairment – 9 items 5 ___, 11 ___, 15 ___, 24 ___, 30 ___, 32 ___, 34 ___, 38 ___, 41 ___	_____
NOS – 7 items 2 ___, 13 ___, 18 ___, 28 ___, 29 ___, 39 ___, 43 ___	_____
Academic Impairment – 4 items 47 ___, 48 ___, 49 ___, 50 ___	_____
Social Adjustment – 11 items 51 ___, 52 ___, 53 ___, 54 ___, 55 ___, 56 ___, 57 ___, 58 ___, 59 ___, 60 ___, 61 ___	_____

[1] Sum of first 7 domains
[2] Sum of the 2 identified domains
[3] Sum of the 4 identified domains

Domains Identified for Items of the Self-Report WRAADDS

Question:	Domains of the Utah Criteria
1. Overactive, restless, always on the go	Hyperactive/Restlessness
2. Feeling muddled, uneasy, confused, uncertain about life	NOS
3. Concentration problems, difficulty focusing	Attention Difficulties
4. Tense, on edge, difficulty relaxing	Hyperactive/Restlessness
5. Trouble getting over things, have a hard time letting go, holding grudges	Oppositional Impairment
6. Problems with mind wandering, daydreaming	Attention Difficulties
7. Hot- or short-tempered, low boiling point	Temper
8. Distractible	Attention Difficulties
9. Temper outbursts, losing control (loud, abusive, regret actions)	Temper
10. Trouble with stick-to-it-iveness, not finishing things once they are started	Disorganization
11. Rebellious, have trouble with authority, rules, restrictions	Oppositional Impairment
12. Short periods of being blue, depressed	Affective Lability
13. Incautious, dare-devilish, take chances	NOS
14. Feel easily bored, easily lose interest	Affective Lability
15. Tendency to feel that others are to blame for problems you have had	Oppositional Impairment
16. Difficulty listening, following conversations, others complain that you do not listen	Attention Difficulties
17. Irritable	Temper
18. Confusion, too many thoughts, too many "channels" in mind all at once	NOS
19. Difficulties organizing time, setting priorities, and working in an organized manner.	Disorganization
20. Moody, up and down, both positive and negative	Affective Lability
21. Feel overwhelmed, "hassled," frustrated	Emotional Over-Reactivity
22. Problems paying attention in lectures, meetings, or programs	Attention Difficulties
23. Being verbally impulsive—blurt things out, speak without thinking, intrude on others	Impulsivity
24. Tend to annoy, tease others	Oppositional Impairment
25. Rush through things too quickly, make careless mistakes	Impulsivity
26. Impulsive spending, trouble managing money	Impulsivity
27. Get too excited, go too fast, or talk too much	Affective Lability
28. Trouble with authorities, legal problems	NOS
29. Not effective, put in effort, but do not get things done	NOS
30. Get into disagreements, arguments	Oppositional Impairment
31. Feel things very intensely, overly emotional	Emotional Over-Reactivity

Question:	Domains of the Utah Criteria
32. Feeling bothered, easily annoyed	Oppositional Impairment
33. Fidgety, difficulty sitting still	Hyperactive/Restlessness
34. Stubborn, strong-willed, trouble seeing things from someone else's point of view	Oppositional Impairment
35. Forget to do things, miss obligations, often late	Disorganization
36. Acting without thinking, impulsive	Impulsivity
37. Problems getting started, putting things off, procrastinating	Disorganization
38. Feeling angry, resentful	Oppositional Impairment
39. Difficulty waking up, slow to get started	NOS
40. Over-react to pressure, blow things out of proportion, become upset easily	Emotional Over-Reactivity
41. Intentionally forget, or delay doing things others want you to do	Oppositional Impairment
42. Under stress even simple responsibilities are too demanding—Pressures or stress causes anxiousness, disorganization or confusion	Emotional Over-Reactivity
43. Minor physical symptoms like headaches, stomach problems, muscle aches and pains	NOS
44. Impatient, or unable to wait, others regard you as impatient	Impulsivity
45. Misplace things like keys, purse, wallet, or things around the house or at work	Disorganization
46. Problems reading, frequently have to re-read, dislike reading	Attention Difficulties

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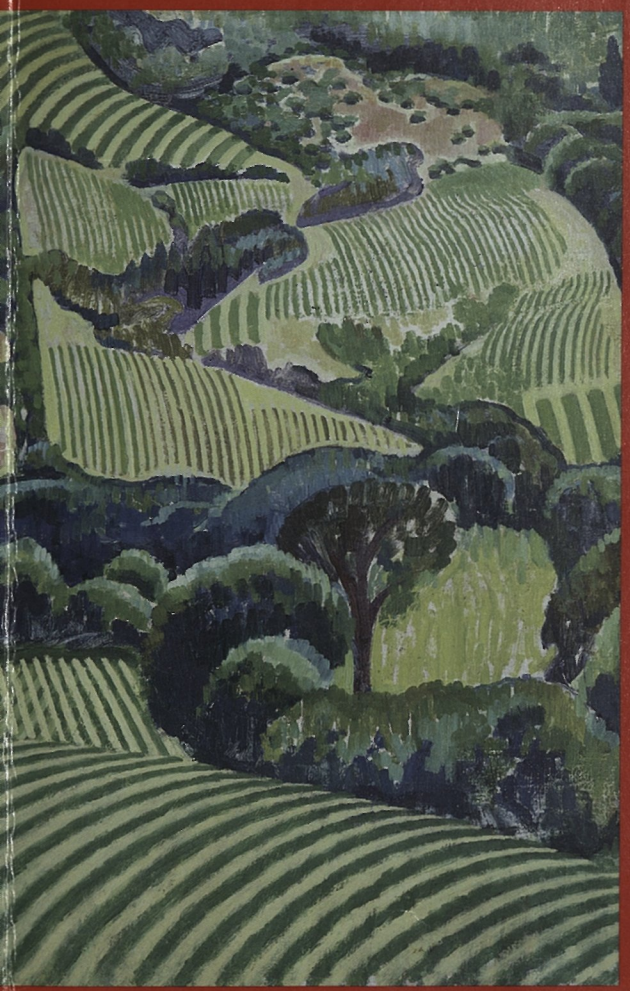

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