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Self-ratings of ADHD symptoms in adults II: Reliability, validity, and diagnostic sensitivity

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Background: *The Conners' Adult ADHD Rating Scale (CAARS) was designed to assess the manifestations of ADHD in adults. Prior factor analyses suggested a 4-factor structure for the CAARS, including dimensions related to Inattention/Cognitive Problems, Hyperactivity/Restlessness, Impulsivity/Emotional Liability, and Problems with Self-Concept.*

Method: *The internal consistency, test–retest reliability, concurrent validity, criterion validity, and diagnostic utility for the CAARS were examined.*

Results: *Coefficient alphas ranged from .86 to .92. Median test–retest reliability for the four factors was .89. All four CAARS factors correlated significantly with scores from an established measure used in the evaluation of ADHD in adults. Criterion validity was assessed on the basis of comparisons of matched samples with and without ADHD. Sensitivity and specificity were high, with an overall diagnostic efficiency rate of 85%.*

Conclusion: *The CAARS provides researchers and clinicians with a carefully constructed and psychometrically sound scale for the evaluation of current ADHD symptomatology in adults.*

In response to the need for standardized self-ratings from adults undergoing evaluation for ADHD, the authors developed the Conners' Adult ADHD Rating Scale (CAARS). Intended as a quantitative measure of current ADHD symptomatology that could be completed by a respondent about themselves or about a significant other, the scale was designed to incorporate the manifestations of ADHD in adults based on the scientific literature and the authors' clinical experience. Factor analyses used to select items and determine the structure of the CAARS scale were based on data from a derivation sample consisting of 839 normal adults and from a clinical sample consisting of 167 adults. The development of the scale, normative data, and results of exploratory and confirmatory factor analyses are described in a previous report (Conners, Erhardt, Epstein, Parker, & Sitarenios, submitted). Of relevance to our emerging understanding of the phenomenology of ADHD in adults are the factor analytic results. These reveal that the data provided on the CAARS by both adults in the general population and those referred for an assessment of ADHD resolve into four major dimensions, three of which correspond to the core features of ADHD as seen in children and a fourth constituting an important secondary consequence of ADHD: (1) Inattention/Executive Functioning, (2) Hyperactivity/Restlessness, (3) Impulsivity/Emotional Lability, and (4) Problems with Self-Concept. The purpose of the present report is to describe the results of a series of studies investigating the psychometric properties of the CAARS. Specifically, Study 1 examines the internal consistency of the scale; Study 2 addresses test–retest reliability; Study 3 evaluates the concurrent validity of the CAARS with respect to another reputable adult ADHD measure; and Study 4 examines construct validity by comparing CAARS results from ADHD adults with a matched control sample.

Study 1: Internal Consistency

Method

Participants. The sample consisted of the 839 normal adults (394 males and 444 females, the gender of one participant was not recorded) between the ages of 18 and 81 years who comprised the derivation sample for the CAARS measure. Since 39 of these participants failed to report their age and one participant failed to report gender, all analyses which involved age and sex had a sample size of 799. Males had a mean age of 38.8 years (*sd* = 12.79) and females a mean age of 39.55 (*sd* = 12.49) years. Site administrators from various parts of Canada and the United States agreed to participate in the study. Each site administrator organized administrations of the CAARS for several adults. Informed consent was obtained from all subjects who participated and their confidentiality assured. All adults were administered the CAARS in an environment free from distractions. Most participants were administered the scale on an individual basis. In some cases, the data came from subjects who were administered the CAARS in pairs. One member of the pair completed the self-report form of the CAARS and the other member of the pair, who was familiar with the first, completed an observer version of the CAARS. Only the self-report responses are included in this report. Upon completion of the CAARS, the subjects were thanked for their participation and the administrator debriefed the subjects by restating the nature of the research and how the results would be used.

Results

Table 1 presents the internal reliability coefficients for the CAARS scales, separately for 18–29 year-olds, 30–39 year-olds, 40–49 year-olds, and 50 years-old and older. Coefficient alphas for the four scales ranged from .86 to .92 for both males and females, suggesting that the scales on the CAARS have excellent internal reliability.

Study 2: Test–Retest Reliability

Method

Participants. The cross-validation sample used in the development of the CAARS measure consisted of 167 adults (97 males and 70 females) who had been referred to an outpatient ADHD clinic for an evaluation. The mean age of this clinical sample was 34.3 years of age (*sd* = 11.6). Members of this sample were self-referred or referred by other professionals for symptoms suggestive of ADHD and all received a comprehensive clinical evaluation. A subset of these clinic-referred patients (33 males and 28 females) were asked to complete the CAARS questionnaire on two separate occasions approximately one month apart (mean = 30.6 days).

Results

Using Pearson product moment correlations ($N = 61$), the CAARS scales had the following test–retest correlations: .88 ($p < .05$) for Inattention Problems, .90 ($p < .05$) for

Table 1
Internal reliability coefficients for scales on the Conners' Adult ADHD Rating Scale (CAARS)

CTRS-R Scale	*18-29 yr.*		*30-39 yr.*		*40-49 yr.*		*50+ yr.*	
	Males	*Females*	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
Inattention	.89	.88	.88	.90	.89	.91	.91	.91
Hyperactivity	.89	.90	.91	.92	.90	.89	.91	.91
Impulsivity	.89	.86	.92	.87	.88	.89	.92	.89
Self-concept	.88	.87	.91	.87	.90	.92	.86	.90
N	100	100	102	111	105	139	73	79

Hyperactivity/Restlessness, .80 ($p < .05$) for Impulsivity/Emotional Lability, and .91 ($p < .05$) for Problems with Self-Concept. Further, the mean change in total scores across the two time points for each scale were 1.17 (sd = 3.86) for Inattention Problems, .54 (sd = 3.68) for Hyperactivity/Restlessness, .53 (sd = 4.53) for Impulsivity/Emotional Lability, and .55 (sd = 2.25) for Problems with Self-Concept.

Study 3: Concurrent Validity

Method

Participants. Another subset of the clinic-referred patients (60 males and 41 females) completed the Wender Utah Rating Scale (WURS) at approximately the same time they completed the CAARS questionnaire.

Measures.

Wender Utah Rating Scale (Ward, Wender, & Reimherr, 1993). The WURS is a 61-item retrospective self-report scale with adequate reliability and validity (Rossini & O'Connor, 1995; Stein et al., 1995; Ward et al., 1993). Adults are required to retrospectively recall their own childhood ADHD symptomatology. Patients rate each symptom on a 1-4 Likert-type scale indicating the severity of each symptom. Twenty-five of the 61 items were empirically determined to be the most valid discriminators of ADHD vs. non-ADHD adult patients (Ward et al., 1993). Scores are derived by summing the patient's ratings on these 25 items. Whereas the WURS assesses for ADHD symptoms during childhood, the CAARS asks about current ADHD symptoms. However, the two scales are expected to relate to one another since ADHD is now known to be a developmental disorder that persists across the lifespan (Mannuzza, Klein, Bessler, Malloy, & LaPadula, 1993). In fact, all current conceptualizations of adult ADHD maintain that an individual must have had ADHD symptoms in childhood in order to be considered for an adult ADHD diagnosis (Murphy & Gordon, 1998; Wender, 1995).

Results

The mean WURS total score for the 101 clinic-referred adults was 46.6 (sd = 20.8). This sample mean is more than 2 *SD*s above the mean for normals reported by Ward et al. (1993), suggesting a high degree of childhood ADHD symptomatology in this sample. In addition, the large *SD* indicates that there is not a restricted range of WURS total scores which would limit correlational analyses. Pearson product moment correlations (N = 101) revealed significant correlations between the WURS total score and all four of the CAARS factors: Inattention Problems (r =.37, $p < .001$), Hyperactivity/Restlessness (r = .48, $p < .001$), Impulsivity/Emotional Lability (r =.67, $p < .001$), and Problems with Self-Concept (r = .37, $p < .001$).

Study 4: Criterion Validity

Method

Participants. Two groups of adults were used in the criterion validity study. The first group consisted of 39 adults (23 males and 16 females) who met DSM-IV criteria for ADHD (American Psychiatric Association, 1994). A modified version of the Semistructured Interview for Adult ADHD (Barkley, 1990) was used to determine whether patients met the required number of inattentive and hyperactivity/impulsivity symptoms for a DSM-IV ADHD diagnosis. Twenty-three participants met criteria for ADHD, Predominantly Inattentive type, 5 participants met criteria for ADHD, Predominantly Hyperactive/Impulsive Type, and 11 met ADHD, Combined type criteria. The mean age for males was 36.96 (sd = 10.16) years and for females was 36.25 (sd = 12.09) years. The second group (non-clinical) consisted of 39 normal adults from Study 1 (above) who were randomly selected and matched with the ADHD sample on the basis of age and sex.

Measures.

Semistructured Interview for Adult ADHD (Barkley, 1990). At present, there are no consensus criteria for diagnosing ADHD in adults. Since DSM ADHD criteria for children have been well-validated, these criteria were used for diagnosing the ADHD adults in the present study. The Semistructured Interview for Adult ADHD was developed by Barkley and colleagues (Barkley, 1990) to assess various aspects of adult ADHD including childhood DSM-IIIR symptoms. For the present study, the original symptom list covered in the interview was modified to include all DSM-IV symptoms. These interviews were completed within the context of a diagnostic interview conducted by the first and second authors, both licensed psychologists with considerable experience in assessing and diagnosing ADHD in both children and adults.

Procedure. For participants in the ADHD sample, the CAARS and semistructured interview for adult ADHD were obtained as part of routine clinical assessment.

Results

Table 2 presents means and standard deviations for the CAARS scales for the ADHD and non-clinical groups. The ADHD group scored significantly higher (using *t* tests) than the non-clinical group on the Inattention/Cognitive Problems scale, the Hyperactivity/Restlessness scale, the Impulsivity/Emotional Lability scale, and the Problems with Self-Concept scale. A direct discriminant function analysis was also performed using CAARS scales as predictors of membership in the two groups (ADHD vs. non-clinical). Discriminant function scores were subsequently used to classify the 78 adults into ADHD and non-clinical groups. The results of this classification are presented in Table 3.

Following the definitions and procedures outlined by Kessel and Zimmerman (1993), a variety of diagnostic efficiency statistics were calculated for the CAARS from these classification results: sensitivity was 82%, specificity was 87%, positive predictive power was 87%, negative predictive power was 83%, false positive rate was 13%; false negative rate was 18%, kappa was 0.692; and the overall correct classification rate was 85%.

Discussion

The goals underlying the development of the CAARS measure were twofold: (1) To provide a tool for examining the phenomenology of ADHD in adults in order to better understand the constellation of symptoms that define ADHD as an adult disorder, and (2) To produce a psychometrically sound scale that would be useful in the assessment of ADHD in adults. Results pertaining to the first goal are described and discussed in the companion piece to the present report (Conners et al., submitted). The results reported herein pertain to the second goal and suggest that the CAARS does indeed represent a reliable and valid measure of current ADHD symptoms in adults.

In general, the psychometric properties of this new instrument appear to be excellent. The four scales represented on the CAARS demonstrate both high internal consistency (with alpha coefficients ranging from 0.86 to 0.92) and strong test–retest reliability (0.80 to 0.91) over a period of approximately one month. These reliabilities generally meet or exceed commonly offered standards for tests used to make decisions about individuals (Newcomer & Hammill, 1982; Weiner & Stewart, 1984). Moreover, they compare favorably both with standard scales in common use (e.g., the MMPI) and with some of the existing measures of ADHD in adults (Boatwright, Bracken, Young, Morgan, & Relyea, 1995; McCarney & Anderson, 1996). It thus appears that the reliability of the four CAARS factors is sufficiently robust that the scales can be used separately or in combination for purposes of clinical description and research.

The concurrent validity of the CAARS with the WURS was found to be moderate. Correlations between the factor scores from the CAARS and the total score on the WURS were all statistically significant, ranging from 0.37 to 0.67. Such moderate correlations were expected, given that the WURS is assessing retrospectively recalled symp-

Table 2
Means and standard deviations for the non-clinical (*N* = 39) and ADHD (*N* = 39) groups on the CAARS

CAARS Scale	*Non-Clinical*		*ADHD*		*t*	*P*
	Mean	*SD*	*Mean*	*SD*		
Inattention/ Memory Problems	10.49	(7.92)	25.66	(7.63)	8.62	<.001
Hyperactivity/Restlessness	13.62	(7.75)	21.72	(7.98)	4.55	<.001
Impulsivity/Emot. Lability	12.26	(7.56)	16.92	(6.96)	2.84	<.01
Problems with Self-Concept	6.05	(4.02)	11.15	(4.45)	5.32	<.001

Note: ADHD = Attention Deficit/Hyperactivity Disorder

Table 3
Classification results (ADHD vs. Non-Clinical) for the CAARS

Test	*Diagnosis*		
	ADHD	*Non-Clinical*	*Total*
Present	32	5	37
Absent	7	34	41
Total	39	39	78

Note: ADHD = Attention Deficit/Hyperactivity Disorder

toms from childhood whereas the CAARS measures current symptomatology. From the standpoint of one evaluating an adult for ADHD, a moderate association between the CAARS and WURS is desirable in that one would require measures of the same construct assessed at different time periods to be related but not so strongly as to be redundant. The fairly high correlation (0.67) of the impulsivity factor on the CAARS with the WURS may indicate that this dimension represents a relatively strong continuing influence from childhood through adulthood. However, the retrospective recall nature of the WURS means that although such an interpretation is consistent with a developmental hypothesis, a retrospective recall bias could also account for the finding of agreement in adulthood between these two scales.

Although the results should be considered preliminary, the criterion validity of the CAARS measure also appears to be high. A sample of adults with well-diagnosed ADHD demonstrated significantly more problems on all four factors of the CAARS than a matched normal sample. Additionally, discriminant function analyses revealed the CAARS to have diagnostic sensitivity of 82%, specificity of 87%, and an overall correct classification rate of 85% (for ADHD vs. normal control subjects). Although these results are encouraging with respect to the utility of the CAARS in the assessment of ADHD, caution must be exercised due to the relatively small sample used in the discriminant validity study (39 ADHD adults and 39 matched controls). In addition, optimization procedures such as discriminant functions tend to shrink upon cross-validation. Nevertheless, the findings offer preliminary evidence of the discriminant validity and potential usefulness of the scale in clinical diagnostic work or in setting thresholds for sample definitions in research.

Despite the promise of the CAARS as a measure of current ADHD symptoms in adults, emphasis must be placed on the insufficiency of *any* single scale or test in the assessment and diagnosis of ADHD. Many issues critical to the evaluation of ADHD in adults are simply beyond the purview of rating scales focused on current symptomatology. These include verifying cross-situational current impairment caused by ADHD symptoms, establishing the presence in childhood of chronic and impairing ADHD symptoms, ruling out explanations other than ADHD for the adult's presenting problems (e.g., medical conditions, other psychiatric disorders, stressful or traumatic life events), and assessing for possible comorbid conditions. Thus, self-report ratings should represent only one part of a multi-method (and, preferably, multi-informant) assessment protocol, which will typically cull and integrate data from interviews, questionnaires, objective records (e.g., report cards, educational transcripts, performance evaluations), and psychological testing (DuPaul, Guevremont, & Barkley, 1991; Murphy & Gordon, 1998; Wender, 1995). Determining the amount of independent variance contributed to diagnosis by self-report measures (particularly in comparison to costlier assessment procedures such as interviewing and performance testing) will be an important subject for future investigations.

A number of additional directions for further research involving the CAARS measure appear to be especially promising. One of the most challenging aspects of diagnosing ADHD in adults and children pertains to the non-specificity of the disorder's core symptoms. Significant difficulties with inattention, activity level, disinhibition, or self-regulation may result from a variety of medical and psychiatric conditions and may also occur as part of responses to stressful life events. Thus, additional validity studies examining the ability of the CAARS measure to discriminate clinically distinct groups presenting with overlapping symptoms (e.g., ADHD vs. Mood Disorders vs. Anxiety Disorders) might lend further support to the clinical utility of the scale. Also useful in this regard would be studies investigating the scale's utility in discriminating between groups of ADHD adults with different patterns of comorbidities.

In light of the potential biases afflicting self-report data, those assessing adults for ADHD are commonly encouraged to incorporate data from a spouse, parent, or significant other who knows the subject of the evaluation well (Wender, 1995). In addition to direct interviews,

having such informants complete questionnaires, checklists, and rating scales represents a convenient and cost-effective method of gathering such information. An alternative version of the CAARS has been developed for use by significant others and reports of studies comparing the self-report of adults on the measure with reports from other informants are forthcoming.

As is the case with assessment and diagnosis, our understanding of the optimal methods for treating ADHD in adults is in a formative stage (Murphy & Gordon, 1998; Wilens, Spencer, & Biederman, 1998). The next decade will undoubtedly witness a flurry of research activity investigating the efficacy of various psychosocial and pharmacological approaches to treatment, both alone and in combination. Rating scales have proven to be invaluable tools for assessing the effects of psychoactive drugs for treating ADHD in children (Aman & Pearson, 1999) and will certainly be occupying a similar role in investigations of treatment for adult ADHD. Thus, establishing the degree to which the CAARS measure is sensitive to pharmacological treatment represents a priority for future research.

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