ORIGINAL ARTICLE

Structure and Diagnosis of Adult Attention-Deficit/Hyperactivity Disorder

Analysis of Expanded Symptom Criteria From the Adult ADHD Clinical Diagnostic Scale

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Context: Controversy exists about the appropriate criteria for a diagnosis of adult attention-deficit/hyperactivity disorder (ADHD).

Objective: To examine the structure and symptoms most predictive of *DSM-IV* adult ADHD.

Design: The data are from clinical interviews in enriched subsamples of the National Comorbidity Survey Replication (n=131) and a survey of a large managed health care plan (n=214). The physician-administered Adult ADHD Clinical Diagnostic Scale (ACDS) was used to assess childhood ADHD and expanded symptoms of current adult ADHD. Analyses examined the stability of symptoms from childhood to adulthood, the structure of adult ADHD, and the adult symptoms most predictive of current clinical diagnoses.

Setting: The ACDS was administered telephonically by clinical research interviewers with extensive experience in the diagnosis and treatment of adult ADHD.

Participants: An enriched sample of community respondents.

Main Outcome Measure: Diagnoses of *DSM-IV*/ACDS adult ADHD.

Results: Almost half of the respondents (45.7%) who had childhood ADHD continued to meet the full *DSM-IV* criteria for current adult ADHD, with 94.9% of these patients having current attention-deficit disorder and 34.6% having current hyperactivity disorder. Adult persistence was much greater for inattention than for hyperactivity/impulsivity. Additional respondents met the full criteria for current adult ADHD despite not having met the full childhood criteria. A 3-factor structure of adult symptoms included executive functioning (EF), inattention/hyperactivity, and impulsivity. Stepwise logistic regression found EF problems to be the most consistent and discriminating predictors of adult *DSM-IV*/ACDS ADHD.

Conclusions: These findings document the greater persistence of inattentive than of hyperactive/impulsive childhood symptoms of ADHD in adulthood but also show that inattention is not specific to ADHD because it is strongly associated with other adult mental disorders. In comparison, EF problems are more specific and consistently important predictors of *DSM-IV* adult ADHD despite not being in the *DSM-IV*, suggesting that the number of EF symptoms should be increased in the *DSM-V*/*ICD-11*.

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Although the diagnostic criteria for attention-deficit/hyperactivity disorder (ADHD) were originally developed for children,[1,2] the prevalence, consequences, and responsiveness to treatment of ADHD in adults are now well documented.[3-8] We also know that the clinical profile and manifestations of ADHD evolve with age,[9-11] raising questions about the stability of ADHD symptoms across time and the most appropriate diagnostic criteria for adults. Many studies[12-19] have found that symptoms of hyperactivity and impulsivity (IM) decline with age, although they persist in some cases and sometimes are the presenting concerns in adult ADHD, whereas deficits in attention persist and become more varied in adult cases. These results raise the possibility that the symptoms of adult ADHD might profitably be modified in upcoming *DSM-V* and *ICD-11* revisions.

In response to concerns that the *DSM-IV* criteria are inadequate to characterize adult ADHD, several proposals have been made to expand the *DSM-IV* and *ICD-10* symptoms.[20-23] With few exceptions,[12,24,25] however, empirical studies have not attempted to determine the value of

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newly proposed symptoms. Two recent studies addressed this issue. Barkley and colleagues[12] studied patients evaluated at an ADHD clinic, clinic controls, and a convenience sample of community controls. They compared the predictive validity of *DSM-IV* and theoretically derived non-*DSM* symptoms of adult ADHD in distinguishing between cases and noncases. Of the 7 discriminating items found in that study, only 1 was a *DSM-IV* symptom, and most of the others described deficits in executive functioning (EF). Faraone and colleagues[24] compared adults with and without ADHD on the same items used by Barkley et al[12] and concluded that the algorithm by Barkley et al was an efficient predictor of *DSM-IV* adult ADHD.

The present article describes a study designed to extend the analyses of Barkley et al[12] and Faraone et al[24] beyond their restricted samples by considering 2 national community samples of adults screened for adult ADHD. Enriched (for positive screens) subsamples from these 2 samples were administered the Adult ADHD Clinical Diagnostic Scale (ACDS),[26] a semistructured clinical interview that incorporates a full assessment of *DSM-IV* ADHD and also a variety of additional questions designed to assess non-*DSM* symptoms found in the clinical experience of the scale developers to be typical of patients with adult ADHD. We examined the persistence of ACDS symptoms from childhood to adulthood in these samples, the structure of adult symptoms, and the symptoms most strongly predictive of *DSM-IV* adult ADHD. These results are not designed to prove the validity of the diagnosis of adult ADHD, which is still considered controversial in some quarters, but to ask what the best criteria are for diagnosing it under the assumption that it is a valid diagnosis.

METHODS

THE SAMPLES

The first sample included 131 second-stage respondents from the adult ADHD clinical reappraisal study of the National Comorbidity Survey Replication (NCS-R).[27] As detailed elsewhere,[28] the NCS-R is a face-to-face household survey of 9282 adults in the continental United States. The World Health Organization Composite International Diagnostic Interview (CIDI)[29] was used to assess *DSM-IV* disorders in the NCS-R. The NCS-R ADHD clinical reappraisal study was conducted to validate the CIDI assessment of adult ADHD in a probability sample of NCS-R respondents aged 18 to 44 years that oversampled those positive for adult ADHD on the CIDI. A blinded clinical reappraisal interview was administered to these respondents telephonically by a team of clinical research interviewers experienced in the diagnosis and treatment of adult ADHD. A $25 incentive was offered for participation. Verbal informed consent was obtained before administering the interviews. These recruitment and consent procedures were approved by the human subjects committees of the University of Michigan, Ann Arbor, and Harvard Medical School. The 131 completed interviews were weighted to adjust for oversampling of CIDI cases. A second weight was then multiplied by the first based on a propensity score logistic regression weighting equation[30] to adjust for minor discrepancies between the weighted clinical sample and the total NCS-R sample on a multivariate profile of sociodemographic variables. A more detailed discussion of the clinical study design is reported elsewhere.[16]

The second sample consisted of 214 third-stage respondents from a survey of adult ADHD among subscribers to a large managed health care plan. The initial survey of 20 011 subscribers (first stage) was performed for another purpose[31] but included a screening scale of adult ADHD.[16] A second-stage sample of 668 respondents oversampled the first-stage who screened positive 6 months later to estimate the stability of the screening scale scores. In the third stage, a subsample of second-stage respondents was administered the ACDS to validate the screening scale.[32] A $25 incentive was offered for participation. Verbal informed consent was obtained before administering the interviews. These recruitment and consent procedures were approved and a Health Insurance Portability and Accountability Act waiver was granted by an independent central institutional review board (Quorum Review, Inc, Seattle, Washington). The 214 respondents in this third-stage assessment were weighted to adjust for the oversampling of screened positives by assigning a weight to each respondent such that the sum of weights in each sampling stratum divided by the sample size equaled the proportion of respondents in that sampling stratum in the original sample. A second weight was then multiplied by the first based on a propensity score logistic regression weighting equation[30] that adjusted for minor discrepancies between the weighted sample and the total subscriber population on a multivariate profile of sociodemographic characteristics and information about past medical claims. A more detailed discussion of the design of this study is reported elsewhere.[32] (This earlier article reported a sample size of 154 NCS-R respondents and 218 managed health care plan respondents rather than the 131 and 214, respectively, reported herein. The smaller samples were due to the age restriction of 18-44 years in the NCS-R and missing data in the managed health care sample.)

MEASURES

Version 1.2 of the ACDS,[26] used in both clinical reappraisal surveys reported herein, has been used in a variety of clinical studies of adult ADHD.[33-35] The interview begins with a retrospective assessment of all symptoms of childhood ADHD and then makes an expanded assessment of recent (past 6 months) symptoms of adult ADHD that includes all 9 *DSM-IV* Criterion A symptoms of inattention (AD) and 9 of hyperactivity/IM (HD) plus 14 non-*DSM* symptoms believed to be relevant to adult ADHD based on the clinical experience of the ACDS developers. The latter items assess difficulties with planning and organization, inattention, and mood lability. Most of these additional items are similar to symptoms proposed by Wender[22] in his Utah criteria for the diagnosis of adult ADHD.

A *DSM-IV*/ACDS diagnosis of adult ADHD required respondents to have 6 to 9 *DSM-IV* symptoms of either AD or HD during childhood and during the 6 months before interview (*DSM-IV* Criterion A), at least 2 Criterion A symptoms before age 7 years (Criterion B), some impairment in at least 2 domains of functioning in the past 6 months linked to the ADHD symptoms (Criterion C), and clinically significant impairment in at least 1 domain of functioning in the same period linked to the ADHD symptoms (Criterion D). Impairment was linked to ADHD symptoms overall rather than to specific symptoms, which means that impairment due to a specific symptom was not required to classify a symptom as having occurred. Criterion E (that the symptoms do not occur exclusively during the course of a pervasive developmental disorder or psychotic disorder and are not better accounted for by another mental disorder) was not operationalized, and ADHD not otherwise specified was not diagnosed. None of the 14 non-*DSM* symptom items was used in making diagnoses. The *DSM-IV* requirement of impairment before age 7 years was not operationalized.

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Table 1. Persistence of Retrospectively Reported Childhood *DSM-IV*/ACDS ADHD Into Adulthood (n = 91)[a]

Adult *DSM-IV*/ACDS Symptom Profile	Childhood *DSM-IV*/ACDS Symptom Profile							
	AD Only (n = 42)		HD Only (n = 17)		AD and HD (n = 32)		Any ADHD (n = 91)	
	%	SD	%	SD	%	SD	%	SD
AD only	54.7	49.8	2.0	14.0	6.2	24.1	29.9	45.8
HD only	0.6	7.7	6.8	25.2	2.3	15.0	2.3	15.0
AD and HD	5.6	23.0	3.3	17.9	34.9	47.7	13.5	34.2
Any ADHD	60.8[b]	48.8	12.1	32.6	43.4	49.6	45.7	49.8

Abbreviations: ACDS, Adult ADHD Clinical Diagnostic Scale; AD, inattention; ADHD, attention-deficit/hyperactivity disorder; HD, hyperactivity/impulsivity.

[a] A total of 91 respondents of the 345 in the sample were judged retrospectively to have met the *DSM-IV* criteria for ADHD in childhood. Because these cases were oversampled from a larger initial sample in selecting respondents to be administered the clinical follow-up interview, the data for all 345 respondents were weighted to adjust for the oversampling (not only of cases but also of subthreshold cases). The percentages reported in this table are based on analysis of these weighted data, whereas the sample sizes reported are unweighted. This is why the ratios of observed subsample sizes to the total sample size do not correspond to the reported percentages.

[b] Significantly higher conditional prevalence of adult ADHD in respondents with a childhood history of AD only than of HD only at the .05 level based on a 2-sided test.

The ACDS was administered in the NCS-R clinical reappraisal study by 4 experienced PhD-level clinical interviewers who received 40 hours of training from 2 board-certified psychiatrists who specialize in research on adult ADHD. Each interviewer had to complete 5 practice interviews for which symptom ratings matched those of the trainers before beginning interviews. The ACDS was administered in the managed care sample by 6 PhD-level clinical psychologists or MA-level social workers experienced in administering the ACDS in clinical studies. Weekly calibration meetings were used to prevent drift in both studies. All the clinical interviews in both studies were tape recorded, and a random 20% were reviewed by a supervising psychiatrist. Agreement was greater than 95% of the cases checked in each of the 2 samples.

ANALYSIS METHODS

Data from the 2 samples were pooled for joint analysis to increase the precision of the estimates. Post hoc within-sample analyses showed substantive findings to be consistent across samples. Cross-tabulations were used to examine the persistence of childhood ADHD into adulthood. Principal axis factor analysis was used to examine the structure of ACDS Criterion A symptoms of adult ADHD to determine whether the separation of criteria into distinct AD and HD factors typically found in youth[36-39] also exists in adults. Stepwise logistic regression analysis followed by all-possible-subsets (APS) logistic regression analysis were used to determine the combination of items that best predicted *DSM-IV*/ACDS adult ADHD. The APS analysis is a method used to select a best subset from a larger set of predictors when the latter includes several highly intercorrelated items.[40] In such situations, 2 or more different subsets sometimes have approximately equivalent overall associations with the outcome. Conventional stepwise regression analysis can select a suboptimal subset owing to minor differences in bivariate associations. The APS analysis protects against this problem by generating results for a large number of different models with a fixed number of predictors determined from an earlier stepwise analysis, each time deleting 1 or more items from the selection set so as to discover all subsets that have high and approximately comparable overall associations with the outcome. Once this full range of subsets is known, the researcher can select the 1 subset that contains the predictors most consistently in the different subsets.

Although diagnoses were based on the 18 *DSM-IV* symptoms, there is no logical necessity that any small number of these 18 will be better predictors than will be non-*DSM* items because diagnoses are nonlinear transformations of the sum of the symptom count. Non-*DSM* symptoms might be better indicators of this transformation (ie, 6-9 vs 0-5 of the AD or HD symptoms) than are *DSM* symptoms. This analysis was designed to investigate this possibility to determine whether the most highly diagnostic symptom questions include ones not currently in the *DSM-IV*. Because the data were weighted, the design-based Taylor series method[41] implemented in a SAS macro[42] was used to estimate standard errors and evaluate statistical significance.

RESULTS

PERSISTENCE OF CHILDHOOD ADHD

Of adults retrospectively reporting childhood ADHD (n=91, representing a weighted 7.9% of all respondents; n=49 in the NCS-R and n=42 in the managed health care plan), a weighted 45.7% (n=55, a weighted 3.6% of all respondents; n=33 in the NCS-R and n=22 in the managed health care plan) continued to meet the full criteria at interview. Childhood AD symptoms were much more predictive of adult persistence than were childhood HD symptoms (**Table 1**). Specifically, 60.8% of respondents with childhood AD only (ie, without childhood HD) met the criteria for AD as adults, whereas only 12.1% with childhood HD only (ie, without childhood AD) met the criteria for HD as adults (the difference was significant at $\chi^2_1=6.8$, $P=.01$). Persistence of AD does not differ from that of HD, in comparison, in respondents who had both AD and HD in childhood, with adult AD only in 6.2% of such cases and HD only in 2.3% ($\chi^2_1=0.4$, $P=.44$). In the 32 respondents who had the combined type as children, the adult combined type is most common (34.9%). Current AD is much more common than is current HD in all persistent cases combined, with 94.9% (SD=10.5) having current AD and 34.6% (SD=22.7) having current HD. In addition to the 55 respondents who met the full criteria for ADHD both in childhood and at interview, 35 others (n=11 in the NCS-R and n=24 in the managed health care plan) met the full criteria for ADHD at interview despite not reporting that they met

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Table 2. Prevalence of *DSM-IV* and Other ACDS Criterion A Symptoms of Adult ADHD in Respondents With Narrowly Defined and Other Broadly Defined *DSM-IV*/ACDS Diagnoses of Adult ADHD Compared With Other Respondents and Results of the Rotated (Promax) Principal Axis Factor Analysis[a]

Symptom	*DSM-IV* Symptom[b]	Symptom Prevalence in Respondents With and Without *DSM-IV*/ACDS Adult ADHD, % (SD): Narrowly Defined (n = 55)	Other Broadly Defined (n = 35)	Others (n = 255)
***DSM-IV* Criterion A Symptoms of AD**				
Makes careless mistakes	ADa	33.4 (47.2)	56.8 (49.5)	0.8 (8.9)
Difficulty sustaining attention	ADb	98.0 (14.0)	57.7 (49.4)	6.7 (25.0)
Does not listen	ADc	85.3 (35.4)	56.0 (49.6)	7.9 (27.0)
Difficulty following instructions	ADd	88.4 (32.0)	97.0 (17.1)	18.2 (38.6)
Difficulty organizing tasks	ADe	91.7 (27.6)	61.9 (48.6)	12.7 (33.3)
Dislikes tasks requiring attention	ADf	95.3 (21.2)	96.2 (19.1)	12.7 (33.3)
Loses things	ADg	83.4 (37.2)	57.9 (49.4)	17.3 (37.8)
Easily distracted	ADh	94.3 (23.2)	55.9 (49.7)	12.1 (32.6)
Forgetful in daily activities	ADi	87.6 (33.0)	55.2 (49.7)	9.3 (29.0)
***DSM-IV* Criterion A Symptoms of HD**				
Fidgets	HDa	83.5 (37.1)	91.7 (27.6)	32.8 (46.9)
Difficulty remaining seated	HDb	73.5 (44.1)	47.0 (49.9)	14.1 (34.8)
Restless	HDc	31.8 (46.6)	43.8 (49.6)	14.3 (35.0)
Difficulty playing quietly	HDd	34.7 (47.6)	46.2 (49.9)	9.7 (29.6)
On the go, acts like driven by motor	HDe	34.3 (47.5)	49.6 (50.0)	12.6 (33.2)
Talks excessively	HDf	32.2 (46.7)	48.1 (50.0)	21.4 (41.0)
Blurts out answers	HDg	76.8 (42.2)	50.4 (50.0)	19.6 (39.7)
Difficulty waiting turn	HDh	73.3 (44.2)	54.1 (49.8)	20.0 (40.0)
Interrupts or intrudes	HDi	32.1 (46.7)	87.0 (33.6)	11.1 (31.4)
Symptoms Not in the *DSM-IV*				
Wastes or mismanages time	NA	82.0 (38.4)	54.8 (49.8)	12.0 (32.5)
Trouble planning ahead	NA	75.8 (42.8)	53.2 (49.9)	4.5 (20.7)
Lacks self-discipline	NA	88.8 (31.5)	93.9 (23.9)	9.5 (29.3)
Difficulty prioritizing work	NA	80.5 (39.6)	54.8 (49.8)	5.0 (21.8)
Trouble keeping track of multiple things	NA	89.1 (31.2)	94.2 (23.4)	17.8 (38.3)
Bores easily	NA	96.7 (17.9)	93.2 (25.2)	25.7 (43.7)
Others keep life in order	NA	69.8 (45.9)	13.5 (34.2)	6.6 (24.8)
Cannot work unless under a deadline	NA	95.5 (20.7)	57.6 (49.4)	7.5 (26.3)
Cannot complete tasks on time	NA	80.2 (39.8)	86.1 (34.6)	2.6 (15.9)
Remembers details, not main idea	NA	75.0 (43.3)	50.5 (50.0)	11.7 (32.1)
Mood changes frequently	NA	27.6 (44.7)	82.3 (38.2)	14.8 (35.5)
Easily overwhelmed	NA	27.2 (44.5)	91.8 (27.4)	5.4 (22.6)
Difficulty expressing anger	NA	35.0 (47.7)	47.1 (49.9)	18.9 (39.2)
Sensitive to criticism	NA	35.6 (47.9)	46.5 (49.9)	26.7 (44.2)

(continued)

the full criteria in childhood. All of these cases, however, reported 2 or more symptoms before age 7 years.

PREVALENCE, STRUCTURE, AND BIVARIATE ASSOCIATIONS OF SYMPTOMS WITH DIAGNOSES

All ACDS adult symptoms were more prevalent in respondents with narrowly defined (ie, meeting the full childhood and adult criteria) *DSM-IV*/ACDS adult ADHD (27.2%-98.0%) and in those with other broadly defined (ie, some childhood symptoms before age 7 years and meeting the full adult criteria) adult ADHD (13.5%-97.0%) than in other respondents (0.8%-32.8%) (**Table 2**). Twenty-four of 32 bivariate odds ratios (ORs) between individual symptoms and narrowly defined adult ADHD were statistically significant compared with respondents who met neither narrow nor broad criteria (OR, 6.6-694.6), and 28 bivariate ORs were significant comparing broadly defined (ie, narrowly or other broadly defined) cases with other respondents (OR, 5.1-186.7).

Principal axis factor analysis found 5 unrotated factors with eigenvalues greater than 1.0 (17.4, 2.9, 2.4, 1.6, and 1.3). Promax rotation showed that the last 2 factors were unique (ie, included a high factor loading on only 1 item), leading us to focus on the 3-factor solution. Replication of the factor analysis in the 2 subsamples showed good stability of results. The items in the first factor, which we refer to as *EF*, represent difficulties with planning and organizational skills considered hallmarks of EF. These include 3 *DSM* symptoms of AD ("makes careless mistakes," "difficulty organizing tasks," and "loses things") plus 6 non-*DSM* symptoms involving difficulties in planning, prioritizing, multitasking, remembering details, meeting deadlines, and maintaining self-discipline. The items in the second factor, which we refer to as *inattention-hyperactivity* (IH), include the remaining *DSM* inattention symptoms plus 5 of 9 *DSM* hyperactivity symptoms

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Table 2. Prevalence of *DSM-IV* and Other ACDS Criterion A Symptoms of Adult ADHD in Respondents With Narrowly Defined and Other Broadly Defined *DSM-IV*/ACDS Diagnoses of Adult ADHD Compared With Other Respondents and Results of the Rotated (Promax) Principal Axis Factor Analysis[a] (continued)

	OR (95% CI) of the Symptom Predicting *DSM-IV*/ACDS Adult ADHD[c]				
			Factor Analysis Partial Regression Coefficients (n = 345)		
Symptom	Narrowly Defined vs Others (n = 310)	Broadly Defined vs Others (n = 345)	I	II	III
***DSM-IV* Criterion A Symptoms of AD**					
Makes careless mistakes	60.3 (13.7-265.6)[d]	101.6 (23.2-446.0)[d]	0.61[e]	−0.06	0.10
Difficulty sustaining attention	694.6 (105.2-4586.3)[d]	45.9 (5.0-423.7)[d]	0.26	0.73[e]	−0.11
Does not listen	67.6 (15.5-294.6)[d]	26.8 (4.5-160.0)[d]	0.17	0.69[e]	0.00
Difficulty following instructions	34.2 (7.3-160.6)[d]	59.3 (16.2-217.6)[d]	0.17	0.80[e]	0.06
Difficulty organizing tasks	75.5 (17.5-326.0)[d]	21.6 (3.4-135.6)[d]	0.67[e]	0.35	−0.06
Dislikes tasks requiring attention	138.6 (28.8-667.7)[d]	154.9 (44.6-537.5)[d]	0.52	0.55[e]	−0.07
Loses things	24.1 (5.8-100.7)[d]	11.1 (2.3-54.4)[d]	0.42[e]	0.35	0.13
Easily distracted	119.9 (25.0-574.5)[d]	20.6 (3.0-139.4)[d]	0.21	0.74[e]	−0.03
Forgetful in daily activities	69.1 (13.5-354.2)[d]	23.2 (4.2-128.1)[d]	0.27	0.66[e]	0.01
***DSM-IV* Criterion A Symptoms of HD**					
Fidgets	10.3 (2.5-42.7)[d]	14.8 (4.7-46.0)[d]	−0.19	0.84[e]	0.21
Difficulty remaining seated	16.8 (3.5-81.3)[d]	8.9 (1.8-44.0)[d]	−0.21	0.94[e]	0.12
Restless	2.8 (0.6-12.4)	3.7 (0.8-16.8)	−0.13	0.81[e]	0.18
Difficulty playing quietly	4.9 (0.9-26.2)	6.4 (1.3-32.4)[d]	−0.39	0.89[e]	0.18
On the go, acts like driven by motor	3.6 (0.8-17.6)	5.1 (1.1-23.7)[d]	0.00	0.51[e]	0.24
Talks excessively	1.8 (0.4-7.8)	2.5 (0.6-11.1)	−0.20	0.29	0.73[e]
Blurts out answers	13.5 (3.3-55.4)[d]	6.9 (1.5-32.1)[d]	0.12	0.16	0.69[e]
Difficulty waiting turn	11.0 (2.6-47.0)[d]	6.8 (1.5-31.7)[d]	0.12	0.15	0.63[e]
Interrupts or intrudes	3.8 (0.9-17.0)	12.7 (2.8-57.3)[d]	0.14	0.18	0.72[e]
Symptoms Not in the *DSM-IV*					
Wastes or mismanages time	33.4 (7.6-147.2)[d]	15.3 (2.8-83.8)[d]	0.37	0.35	0.24
Trouble planning ahead	66.9 (8.9-503.4)[d]	37.7 (4.9-287.8)[d]	0.72[e]	0.34	−0.12
Lacks self-discipline	75.5 (15.2-375.0)[d]	102.4 (29.2-359.0)[d]	0.40[e]	0.38	0.32
Difficulty prioritizing work	78.5 (15.2-405.7)[d]	38.3 (6.5-226.7)[d]	0.48[e]	0.43	0.16
Trouble keeping track of multiple things	37.7 (10.1-141.4)[d]	51.8 (16.7-160.6)[d]	0.53[e]	0.29	0.19
Bores easily	83.6 (17.4-402.7)[d]	53.3 (16.5-172.2)[d]	0.05	0.84[e]	0.03
Others keep life in order	32.5 (5.2-202.7)[d]	9.3 (1.5-58.5)[d]	0.00	0.78[e]	−0.29
Cannot work unless under a deadline	261.5 (55.8-1226.5)[d]	38.1 (5.6-260.9)[d]	0.39	0.57[e]	0.03
Cannot complete tasks on time	151.0 (27.7-824.2)[d]	186.7 (43.0-810.0)[d]	0.56[e]	0.34	0.07
Remembers details, not main idea	22.8 (4.8-108.2)[d]	12.4 (2.5-61.9)[d]	0.42[e]	0.33	0.27
Mood changes frequently	2.2 (0.5-8.8)	7.5 (1.8-32.1)[d]	0.00	0.03	0.80[e]
Easily overwhelmed	6.6 (1.5-28.8)[a,d]	28.2 (5.8-137.7)[d]	0.34	0.13	0.39
Difficulty expressing anger	2.3 (0.5-9.8)	3.0 (0.7-12.4)	0.11	0.34	0.18
Sensitive to criticism	1.5 (0.4-6.6)	1.9 (0.5-8.0)	−0.07	0.19	0.64[e]

Abbreviations: ACDS, Adult ADHD Clinical Diagnostic Scale; AD, inattention; ADHD, attention-deficit/hyperactivity disorder; CI, confidence interval; HD, hyperactivity/impulsivity; NA, not applicable; OR, odds ratio.

[a] Prevalence estimates are based on weighted data. See footnote a in Table 1.

[b] Labels indicate the *DSM-IV* symptom criteria for ADHD, distinguishing the symptoms of AD from those of HD.

[c] The ORs in the first column compare narrowly defined cases (n = 55) with respondents who did not meet broadly defined criteria (n = 255), and the ORs in the second column compare broadly defined cases (n = 90; ie, those in the first 2 prevalence columns combined) with respondents who did not meet broadly defined criteria (n = 255). Note that the ORs are calculated based on weighted data, whereas the numbers of narrowly defined and other broadly defined cases are unweighted. This means that hand calculation of ORs for broadly defined vs others using combined prevalence estimates for narrowly defined and other broadly defined cases will be inaccurate owing to the use of unweighted numbers to calculate the combined prevalence.

[d] Significant at the .05 level, 2-sided test.

[e] These entries represent the highest regression coefficients for each item across the 3 factors.

and 3 non-*DSM* symptoms ("bores easily," "others keep life in order," and "cannot work unless under a deadline"). The items in the third factor, which we refer to as *IM*, include all *DSM* IM symptoms in addition to the remaining *DSM* hyperactivity symptoms and 2 non-*DSM* symptoms ("mood changes frequently" and "sensitive to criticism"). Pearson correlations between factors are 0.51 for EF-IH, 0.38 for EF-IM, and 0.39 for IH-IM. Narrowly defined cases have a different symptom profile than do other broadly defined cases (**Table 3**). Specifically, narrowly defined cases have significantly higher proportions of EF (77.6% vs 67.8%, $t = 5.1$, $P < .001$) and IH (76.3% vs 61.5%, $t = 7.5$, $P < .001$) symptoms and a significantly lower proportion of IM symptoms (46.3% vs 61.4%, $t = 4.0$, $P = .001$) than do other broadly defined cases.

APS LOGISTIC REGRESSION ANALYSIS

Stepwise logistic regression was used to predict *DSM-IV*/ACDS adult ADHD from ACDS symptoms. Four symp-

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toms captured all the significant predictive effects. The APS regression analysis selected the 10 four-symptom subsets with the highest predictive associations. Three EF items and 1 IH item emerged in this analysis as most consistently predictive of broadly defined ADHD, and 2 EF and 2 IH items emerged as the most consistently predictive of narrowly defined ADHD. No IM items emerged as consistently predictive. One EF item was in the significant predictive set of both narrowly and broadly defined ADHD: "difficulty prioritizing work" (10 of 10 in narrowly defined ADHD and 8 of 10 in broadly defined ADHD). The other important EF predictor of narrowly defined ADHD was "trouble planning ahead" (3 of 10). The other 2 important EF predictors of broadly defined ADHD were "cannot complete tasks on time" (10 of 10) and "makes careless mistakes" (7 of 10). Only the last of these 4 EF items is in the *DSM-IV*. One IH item was predictive of both narrowly and broadly defined ADHD: "difficulty sustaining attention" (7 of 10 in narrowly defined ADHD and 10 of 10 in broadly defined ADHD). The other item, "cannot work unless under a deadline," was important only in narrowly defined ADHD (8 of 10). Only the first of these 2 IH items is in the *DSM-IV*.

Table 3. Mean Proportions of Adult Executive Functioning, Inattention/Hyperactivity, and Impulsivity Symptoms Reported by Respondents With Narrowly Defined or Broadly Defined *DSM-IV*/ACDS Adult ADHD[a]

	Estimate, % (SD)	
Symptom	Narrowly Defined (n = 55)	Other Broadly Defined (n = 35)
Executive functioning	77.6 (41.7)[b]	67.8 (46.7)
Inattention/hyperactivity	76.3 (42.5)[b]	61.5 (48.7)
Impulsivity	46.3 (49.9)[b]	61.4 (48.7)

Abbreviations: ACDS, Adult ADHD Clinical Diagnostic Scale; ADHD, attention-deficit/hyperactivity disorder.

[a] Executive functioning, inattention/hyperactivity, and impulsivity symptoms are defined by the factor loadings denoted by footnote[e] in Table 2. Proportions were calculated by dividing the number of endorsed symptoms for each respondent by the number of symptoms in the dimension. For example, given that there are 9 executive functioning symptoms, a respondent who endorsed 3 of these symptoms would be defined as having a proportion of 33.3% (3 of 9). Narrowly defined cases were defined as meeting the full childhood and adult criteria, whereas broadly defined cases were defined as having had at least some childhood symptoms before age 7 years and meeting the full adult criteria.

[b] Significant difference between narrowly defined and other broadly defined cases at the .05 level, 2-sided test.

DICHOTOMOUS PREDICTION OF CLINICAL DIAGNOSES

We tested a series of dichotomous scoring rules to predict clinical diagnoses from the predictors described in the previous paragraph. The best rule was to require 3 or 4 of 4 items to predict narrowly defined ADHD and 2 to 4 of 4 items to predict broadly defined ADHD (**Table 4**). The prevalence estimates based on these scoring rules are not significantly different from the ACDS estimates (narrowly defined ADHD: $\chi^2_1=1.2$, $P=.27$; broadly defined ADHD: $\chi^2_1=2.6$, $P=.11$). Individual-level concordance with clinical diagnoses was also very good (narrowly defined ADHD: $\kappa=0.79$, area under the receiver operating characteristic curve [AUC]=0.93; broadly defined ADHD: $\kappa=0.89$, AUC=0.98).[43] Most ACDS cases (88.1% narrowly defined ADHD and 96.7% broadly defined ADHD) were detected using these rules, and most ACDS noncases (98.7% narrowly defined ADHD; 98.5% broadly defined ADHD) were correctly classified as noncases.

Because we wanted to find symptoms specific to adult ADHD, we examined whether the 4 best-predicting symptoms also significantly predicted other *DSM-IV*/CIDI diagnoses in the NCS-R (the only sample in which these other disorders were assessed) after controlling for total ACDS scores. This was performed in a series of prediction equations, each of which included the total ACDS score plus 1 other ACDS symptom to predict other *DSM-IV* disorders. If any especially strong association between individual ACDS symptoms and other disorders existed beyond the general comorbidity with the total ACDS scores, a question might be raised about item confounding. Logistic regression analysis was used to perform this analysis by predicting the 6-month prevalence of any *DSM-IV*/CIDI mood disorder, anxiety disorder, substance use disorder, and behavioral disorder (other than ADHD) from each ACDS item in the 4-item scales controlling for total ACDS scores. Total ACDS scores were significant predictors in every one of these equations, documenting that adult ADHD is significantly comorbid with a wide range of other *DSM-IV* disorders. However, none of the EF symptoms predicted any of these outcomes significantly once total ACDS scores were controlled for. Both AD items, in comparison, were significant in 1 of these equations: "difficulty sustaining attention" predicting anxiety disorders (OR=11.6, 95% confidence interval=2.2-60.4) and "cannot work unless under a deadline" predicting behavioral disorders (13.9, 2.3-83.9).

Based on these results, we explored the possibility of deleting the AD items in the prediction scales and focusing only on the EF items (Table 4). The best scoring rule in these reduced sets was to require both EF items to predict narrowly defined ADHD and 2 to 3 items to predict broadly defined ADHD. These rules generated weighted prevalence estimates similar to the ACDS estimates (narrowly defined ADHD: $\chi^2_1=0.3$, $P=.58$; broadly defined ADHD: $\chi^2_1=0.0$, $P=.98$) and good individual-level concordance with ACDS diagnoses (narrowly defined ADHD: $\kappa=0.70$, AUC=0.83; broadly defined ADHD: $\kappa=0.87$, AUC=0.93). Most ACDS cases (66.9% narrowly defined ADHD and 87.0% broadly defined ADHD) were detected using these rules, and most ACDS noncases (99.2% narrowly defined ADHD and 99.0% broadly defined ADHD) were correctly classified as noncases.

COMMENT

This study has several limitations. First, logistical-financial considerations forced us to base clinical interviews on telephone administration, which could have reduced the validity of clinical assessments. Second, diagnoses

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Table 4. Diagnostic Concordance of the Best Subset of ACDS Items With *DSM-IV*/ACDS Narrowly Defined and Broadly Defined Diagnoses of Adult ADHD Using Several Different Scoring Rules (n = 345)[a]

Scoring Rules/ No.of Items Endorsed[b]	Prevalence, % (SD)			Concordance Estimates, % (SD)					
	DSM-IV/ACDS ADHD	Positive on the Dichotomized Prediction Scale	χ^2	SEN	SPEC	PPV	NPV	κ	AUC
4-Item Scales									
Narrowly defined									
1-4	3.6 (18.6)	24.2 (42.8)	70.0[c]	99.6 (6.3)	78.6 (41.0)	14.9 (35.6)	100.0 (0.0)	0.21 (0.4)	0.89
2-4	3.6 (18.6)	12.0 (32.5)	27.6[c]	96.2 (19.1)	91.2 (28.3)	29.0 (45.4)	99.8 (4.5)	0.41 (0.5)	0.94
3-4	3.6 (18.6)	4.4 (20.5)	1.2	88.1 (32.4)	98.7 (11.3)	72.6 (44.6)	99.5 (7.1)	0.79 (0.4)	0.93
4	3.6 (18.6)	3.0 (17.1)	0.8	66.0 (47.4)	99.4 (7.7)	80.8 (39.4)	98.7 (11.3)	0.72 (0.4)	0.83
Broadly defined									
1-4	7.7 (26.7)	19.8 (39.8)	41.1[c]	99.8 (4.5)	86.8 (33.8)	38.8 (48.7)	100.0 (0.0)	0.50 (0.5)	0.93
2-4	7.7 (26.7)	8.8 (28.3)	2.6	96.7 (17.9)	98.5 (12.2)	84.5 (36.2)	99.7 (5.5)	0.89 (0.3)	0.98
3-4	7.7 (26.7)	5.4 (22.6)	5.9[c]	65.6 (47.5)	99.6 (6.3)	93.2 (25.2)	97.2 (16.5)	0.75 (0.4)	0.83
4	7.7 (26.7)	0.9 (9.4)	22.6[c]	10.6 (30.8)	99.9 (3.2)	90.7 (29.0)	93.0 (25.5)	0.18 (0.4)	0.55
Executive Functioning Subscales									
Narrowly defined									
1-2	3.6 (18.6)	15.6 (36.3)	38.4[c]	89.4 (30.8)	87.1 (33.5)	20.7 (40.5)	99.5 (7.1)	0.30 (0.5)	0.88
2	3.6 (18.6)	3.2 (17.6)	0.3	66.9 (47.1)	99.2 (8.9)	75.8 (42.8)	98.8 (10.9)	0.70 (0.5)	0.83
Broadly defined									
1-3	7.7 (26.7)	14.4 (35.1)	21.7[c]	98.0 (14.0)	92.6 (26.2)	52.6 (49.9)	99.8 (4.5)	0.65 (0.5)	0.95
2-3	7.7 (26.7)	7.6 (26.5)	0.0	87.0 (33.6)	99.0 (9.9)	88.3 (32.1)	98.9 (10.4)	0.87 (0.3)	0.93
3	7.7 (26.7)	0.9 (9.4)	22.5[c]	11.0 (31.3)	99.9 (3.2)	91.0 (28.6)	93.1 (25.3)	0.18 (0.4)	0.55

Abbreviations: ACDS, Adult ADHD Clinical Diagnostic Scale; ADHD, attention-deficit/hyperactivity disorder; AUC, area under the receiver operating characteristic curve; K, Cohen κ; NPV, negative predictive value; PPV, positive predictive value; SEN, sensitivity; SPEC, specificity.

[a] Because screened positive cases and subthreshold cases were oversampled from a larger initial sample in selecting respondents to be administered the clinical follow-up interview, the data for all 345 respondents were weighted to adjust for the oversampling. The percentages reported in this table are based on analysis of these weighted data.

[b] The scoring rules all use unweighted counts of symptoms endorsed to define predicted cases. The entries in this column are for the number of symptoms required to define a predicted case. The 4-item scales in the table have different items for narrowly defined and broadly defined ADHD. The items for narrowly defined ADHD include "difficulty prioritizing work," "trouble planning ahead," "difficulty sustaining attention," and "cannot work unless under a deadline." The items for broadly defined ADHD include "difficulty prioritizing work," "cannot complete tasks on time," "makes careless mistakes," and "difficulty sustaining attention." The executive functioning subscales in the table delete the inattention items from the 4-item scales ("difficulty sustaining attention" in the scales for narrowly defined and broadly defined cases and "cannot work unless under a deadline" in the scale for narrowly defined cases), resulting in only 2 items in the narrowly defined and 3 in the broadly defined subscales.

[c] The prevalence estimate based on the scoring rule applied to the subset of items differs significantly from the *DSM-IV*/ACDS prevalence estimate at the .05 level using a 2-sided test.

were based on self-report even though collateral reports from spouses and others can add important information about adult ADHD.[44] Third, as in most studies of adult ADHD, childhood symptoms were reported retrospectively. These retrospective reports may have been affected by recall bias and the presence or absence of current symptoms.

Another limitation relates to the use of stepwise regression methods to select the most highly predictive symptoms. Stepwise methods can capitalize on chance. Although we used APS analysis to address this problem, caution should, nonetheless, be used in interpreting results before cross-validation. A related limitation is that most non-*DSM* items in the ACDS assessed EF problems. Impulsivity, in comparison, was assessed using a much smaller set of symptoms (only 2 non-*DSM* items and the 3 *DSM-IV* items). The role of IM, consequently, could have been underestimated in this analysis. Consistent with this possibility, the non-*DSM* ACDS symptoms do not include 3 IM symptoms found by Barkley et al[12] to be predictive of adult ADHD ("makes decisions impulsively," "difficulty stopping activities or behavior when he or she should do so," and "more likely to drive a motor vehicle much faster than others"). A final limitation is that interpretation depends on the thresholds established for determining the presence or absence of symptoms, which were not specified in enough detail in the *DSM* system to provide firm guidance for the ACDS assessments.

In the context of these limitations, the estimate that 3.6% of respondents meet the *DSM-IV* criteria for both childhood and adult ADHD and the finding that these cases represent nearly half of all adults who retrospectively reported childhood ADHD are generally consistent with previous studies.[14,45,46] The present results are also consistent with previous studies in finding that symptom profiles change with age, as childhood AD is much more persistent than is childhood HD.[14,15,17,18] We also found that the prevalence of adult ADHD increased substantially when we did not require full criteria for ADHD in childhood and that broadly defined adult ADHD had more adult IM and less EF and IH problems than did narrowly defined adult ADHD. Additional research, ideally in longitudinal samples, is needed to investigate the stability of these specifications. Another topic for future research concerns subthreshold manifestations. We did not explore subthreshold adult symptoms but required either

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6 AD or 6 HD symptoms in adulthood even though the *DSM-V* ADHD and Disruptive Behavior Disorders Work Group is considering the possibility of requiring as few as 3 symptoms for a diagnosis of adult ADHD.

The finding of a distinct adult EF symptom factor is consistent with several other studies[12,20,47] finding EF problems to be cardinal features of adult ADHD. The fact that 3 *DSM-IV* AD items loaded on the EF factor ("difficulty organizing tasks," "makes careless mistakes," and "loses things") is consistent with the suggestion that some inattention may be a manifestation of deficits in working memory, suggesting an underlying effect of difficulty in EF.[12] It is important to note in this regard, however, that the term *EF* is defined in a variety of ways in the literature[48-50] and is used herein in a relatively nontechnical way to refer to observable deficits in the performance of self-regulatory functions in daily life, such as the ability to organize, prioritize, and integrate cognitive functions. This focus on daily functions might not have good correspondence with EF as measured in cognitive performance tests.[51] Ongoing research using such tests might document more subtle distinctions in EF problems that relate to different manifestations of adult ADHD.[47,52]

The finding that symptoms of AD and HD load together on a second factor is inconsistent with AD and HD being conceptualized as distinct in the *DSM-IV*. This finding is also indirectly inconsistent with the finding of separate AD and IH factors in studies of childhood ADHD.[36-39] However, the finding of a single adult IH factor is consistent with the finding of a similar factor in another study of adult ADHD using the Conners Adult ADHD Rating Scale.[20] This replication supports the view of some experts that whereas HD in childhood is primarily motoric, HD in adulthood is more reflective of internal restlessness.[23] The *DSM-IV* acknowledges this by noting that symptoms of HD in adolescence and adulthood "take the form of feelings of restlessness and difficulty engaging in quiet sedentary activities."[53(p79)] In this regard, conceptual models of internal restlessness frequently incorporate traditional symptoms of AD (ie, mind wanders and distracted by sounds and visual stimuli).[23] Furthermore, even in factor analytic studies that find that symptoms of AD and HD load on separate factors, these factors are often highly correlated.[54] The finding that IM symptoms split off from those of HD is also consistent with several previous studies[12,20,54,55] and is especially striking because only a few IM items were included in the ACDS.

The factor analysis results suggest that the higher relative prevalence of AD only than of HD only in adulthood than in childhood is due not merely to age-related changes in symptom expression but also to age-related changes in symptom structure. This finding of a pathoplastic effect of age regarding symptoms of ADHD illustrates the fact that criteria sets sometimes need to be different for segments of the population defined on the basis of sociodemographic characteristics. In the case of adult ADHD, symptoms associated with deficits in EF seem to be key symptoms of this sort that emerge as more important in adulthood than in childhood.

An important finding is that EF problems are consistently important predictors of adult clinical diagnoses of ADHD in respondents who met the full criteria for childhood ADHD and in those who had only some childhood symptoms before age 7 years. Unlike the other highly predictive adult symptoms, all of which involve AD, none of the adult EF symptoms had significant comorbidity with other classes of adult *DSM-IV* disorders after controlling for the general gradient of adult ADHD. This suggests that EF symptoms are those most specifically differentiating adult ADHD from other adult *DSM* disorders. A corollary is that although AD is the aspect of childhood ADHD most likely to persist into adulthood, it would be a mistake to think of AD as the most important discriminating feature of adult ADHD owing to the strong associations of AD with other adult mental disorders.

The most highly predictive EF symptoms in this analysis are not in the *DSM-IV*. Indeed, only 1 of the 4 most predictive symptoms of narrowly defined adult ADHD was a *DSM-IV* symptom, and 2 of the remaining 3 items were EF problems. Three of the 4 most predictive symptoms of broadly defined adult ADHD were EF problems. These findings are broadly consistent with those of Barkley et al[12] and Faraone et al,[24] who found that a variety of non-*DSM* symptoms of EF problems performed better than did *DSM-IV* symptoms in distinguishing patients with adult ADHD from clinical controls. Although some of the most predictive non–*DSM-IV* items in these analyses load on the IH factor ("cannot work unless under a deadline" and "difficulty sustaining attention"), these symptoms also reflect deficits in initiating and sustaining work effort, which are typically considered self-regulatory components of EF.[49]

These results are consistent with the suggestion that diagnostic criteria for adult ADHD in future *DSM* and *ICD* revisions should include more EF items, augmenting evidence that EF problems are evident in virtually all adults with ADHD.[56] Although these findings might be taken to support the view that adult ADHD should be conceptualized as largely a disorder of problems in EF,[48,49] such a view overinterprets the data because AD is strongly persistent from ADHD in childhood to adulthood and because Barkley and Faraone and their coworkers also found that some aspects of IM predict adult ADHD. Nonetheless, the present results highlight the importance of EF. More work is needed to determine whether an expanded version of the most predictive items in the present analysis could be used as a brief screening scale for adult ADHD. Although these items have strong face validity in tapping core symptoms of EF problems, they were applied herein to a relatively small sample. The importance of these items consequently needs to be cross-validated in other samples to determine whether they would perform consistently as well as in the present study in predicting clinical diagnoses of adult ADHD.

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Additional Information: All the NCS-R data are publically available for secondary analysis. Instructions on how to download the public-use data files can be found at http://www.hcp.med.harvard.edu/ncs. The managed care sample database can be obtained for secondary analysis by contacting Nancy Sampson at sampson@hcp.med.harvard.edu.

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