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The Structure and Diagnosis of Adult ADHD: An Analysis of Expanded Symptom Criteria from the Adult ADHD Clinical Diagnostic Scale (ACDS)

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Availability of data for secondary analysis

All NCS-R data are publically available for secondary analysis. Instructions on how to download the public use data files can be found at 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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Abstract

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

OBJECTIVES—To examine the structure and symptoms most predictive of DSM-IV adult ADHD.

DESIGN—Data come from clinical interviews in enriched sub-samples of the National Comorbidity Survey Replication (NCS-R) (n = 131) and a survey of a large managed healthcare plan (n = 214). The clinician-administered Adult ADHD Clinical Diagnostic Scale (ACDS) was used to assess childhood ADHD and expanded symptoms of current adult ADHD. Analyses examined 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 diagnosis and treatment of adult ADHD.

PARTICIPANTS—An enriched sample of community respondents

MAIN OUTCOME MEASURES—DSM-IV/ACDS diagnoses of adult ADHD

RESULTS—Almost half (45.7%) of respondents who had childhood ADHD continued to meet full DSM-IV criteria for current adult ADHD, with 94.9% of these cases having current attention-deficit disorder and 34.6% current hyperactivity disorder. Adult persistence was much greater for inattention than hyperactivity-impulsivity. Additional respondents met full criteria for current adult ADHD despite not having met full childhood criteria. A three-factor structure of adult symptoms included executive functioning, inattention-hyperactivity, and impulsivity. Stepwise logistic regression found executive functioning 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 hyperactive/impulsive childhood symptoms of ADHD in adulthood, but also show that inattention in not specific to ADHD, as it is strongly associated with other adult mental disorders. Executive functioning problems, in comparison, are more specific and consistently important predictors of DSM-IV adult ADHD despite not being in DSM-IV, suggesting that the number of executive functioning symptoms should be increased in DSM-V/ICD-11.

Although diagnostic criteria for attention-deficit/hyperactivity disorder (ADHD) were originally developed for children,[1, 2] the prevalence, consequences, and responsiveness to treatment of ADHD among 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 over time and the most appropriate diagnostic criteria for adults. Many studies have found that symptoms of hyperactivity and impulsivity decline with age, although they persist in some cases and sometimes are the presenting complaints of adult ADHD, while deficits in attention persist and become more varied among adult cases.[12–19] 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 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] though, empirical studies have not attempted to determine the value of 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 non-cases. Of the seven discriminating items found in that study, only one was a DSM-IV symptom, while most others described deficits in executive functioning. Faraone and colleagues et al.[24] compared ADHD and non-ADHD adults on the same items used by Barkley et al. and concluded that the Barkley algorithm was an efficient predictor of DSM-IV adult ADHD.

The current report describes a study designed to extend the Barkley and Faraone analyses beyond their restricted samples by considering two national community samples of adults that were screened for adult ADHD. Enriched (for positive screens) sub-samples from these two samples were administered the Adult ADHD Clinical Diagnostic Scale (ACDS),[26] a semi-structured clinical interview that incorporates a full assessment of DSM-IV ADHD and also a number 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 examine 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.

METHOD

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 was a face-to-face household survey of 9,282 adults in the continental US. The WHO 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 carried out to validate the CIDI assessment of adult ADHD in a probability sample of NCS-R respondents ages 18–44 that over-sampled 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 diagnosis and treatment of adult ADHD. A $25 incentive was offered for participation. Verbal informed consent was obtained before administering interviews. These recruitment and consent procedures were approved by the Human Subjects committees of the University of Michigan and Harvard Medical School. The 131 completed interviews were weighted to adjust for over-sampling 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 socio-demographic variables. A more detailed discussion of 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 healthcare plan. The initial survey of 20,011 subscribers (first stage) was carried out for another purpose,[31] but included a screening scale of adult ADHD.[16] A second-stage sample of 668 respondents over-sampled the first-stage screened positives six months later to estimate stability of screening scale scores. In the third stage, a sub-sample 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 HIPPA waiver granted by an independent central Institutional Review Board. The 214 respondents in this third-stage assessment were weighted to adjust for the over-sampling 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 socio-demographic characteristics and information about past medical claims. A more detailed discussion of the design of this study is reported elsewhere.[32] (That earlier paper reported a sample size of 154 NCS-R respondents and 218 managed healthcare plan respondents rather than the 131 and 214 reported here. The smaller samples were are due to the 18–44 age restriction in the NCS-R and missing data in the managed healthcare sample.)

Measures

Version 1.2 of the ACDS,[26] used in both clinical reappraisal surveys reported here, has been used in a number of prior 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 six months) symptoms of adult ADHD that includes all nine DSM-IV Criterion A symptoms of inattention (AD) and nine of hyperactivity/impulsivity (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 in his Utah Criteria for the diagnosis of adult ADHD.[22]

DSM-IV/ACDS diagnoses of adult ADHD required respondents to have 6–9 DSM-IV symptoms of either inattention or hyperactivity-impulsivity both during childhood and during the six months before interview (DSM-IV Criterion A), at least two Criterion A symptoms prior to age seven (Criterion B), some impairment in at least two domains of functioning in the past six months linked to the ADHD symptoms (Criterion C), and clinically significant impairment in at least one domain of functioning in the same time 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 seven was not operationalized.

The ACDS was administered in the NCS-R clinical reappraisal study by four experienced PhD-level clinical interviewers who received 40 hours of training from two board certified psychiatrists who specialize in research on adult ADHD. Each interviewer had to complete five practice interviews for which symptom ratings matched those of the trainers prior to beginning interviews. The ACDS was administered in the managed care sample by six 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 clinical interviews in both studies were tape recorded and a random 20% reviewed by a supervising psychiatrist. Agreement was over 95% of the cases checked in each of the two samples.

Analysis methods

Data from the two samples were pooled for joint analysis to increase precision of estimates. Post hoc within-sample analyses showed substantive findings to be quite consistent across samples. Cross-tabulations were used to examine 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 among youth[36–39] also exists among adults. Stepwise logistic regression analysis followed by all-possible subsets (APS) logistic regression analysis was used to determine the combination of items that best predicted DSM-IV/ACDS adult ADHD. APS is a method used to select a best subset from a larger set of predictors when the latter includes a number of highly inter-correlated items.[40] In situations of this sort, two or more different subsets sometimes have roughly equivalent overall associations with the outcome. Conventional stepwise regression analysis can select a sub-optimal subset due to minor differences in bivariate associations. APS 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 one or more items from the selection set, so as to discover all subsets that have high and roughly comparable overall associations with the outcome. Once this full range of subsets is known, the researcher can select the one subset that contains the predictors most consistently in the different subsets.

Even though 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 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 (i.e., 6–9 vs. 0–5 of the AD symptoms and/or of the HD symptoms) than DSM symptoms. Our analysis was designed to investigate this possibility to determine whether the most highly diagnostic symptom questions include ones not currently in DSM-IV. As the data were weighted, the design-based 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 NCS-R; n = 42 in the managed healthcare plan), a weighted 45.7% (n = 55; a weighted 3.6% of all respondents; n = 33 in NCS-R; n = 22 in the managed healthcare plan) continued to meet full criteria at interview. Childhood inattention symptoms were much more predictive of adult persistence than were childhood hyperactivity/impulsivity symptoms. (Table 1) Specifically, 60.8% of respondents with childhood AD-only (i.e., without childhood HD) met criteria for AD as adults, while only 12.1% with childhood HD-only (i.e., without childhood AD) met criteria for HD as adults (the difference statistically significant at $\chi^2_1 = 6.8$, p = .012). Persistence of AD does not differ from that of HD, in comparison, among 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). Among 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 current HD (standard error in parentheses) in all persistent cases combined, with 94.9% (3.3) having current AD and 34.6% (15.8) current HD. In addition to the 55 respondents who met full criteria for ADHD both in childhood and at interview, 35 others (n = 11 in the NCS-R and n = 24 in the managed healthcare plan) met full criteria for ADHD at interview despite not

reporting that they met full criteria in childhood. All of these cases, though, reported two or more symptoms prior to age seven.

Prevalence, structure, and bivariate associations of symptoms with diagnoses

All ACDS adult symptoms were more prevalent among respondents with narrowly-defined (i.e., meeting full childhood and adult criteria) DSM-IV/ACDS adult ADHD (27.2–98.0%) and those with other broadly-defined (i.e., some childhood symptoms before age seven and full adult criteria) adult ADHD (13.5–97.0%) than other respondents (0.8–32.8%). (Table 2) Twenty-four of 32 bivariate ORs between individual symptoms and narrowly-defined adult ADHD were statistically significant compared to respondents who met neither narrow or broad criteria (6.6–694.6), while 28 bivariate ORs were significant comparing broadly-defined (i.e., narrow or other broadly-defined) cases to other respondents (5.1–186.7).

Principal axis factor analysis found five unrotated factors with eigenvalues greater than 1.0 (17.4, 2.9, 2.4, 1.6, 1.3). Promax rotation showed that the last two factors were unique (i.e., included a high factor loading on only one item), leading us to focus on the three-factor solution. Replication of the factor analysis in the two sub-samples showed good stability of results. The items in the first factor, which we refer to as executive functioning (EF), represent difficulties with planning and organizational skills considered hallmarks of executive functioning. These include three DSM symptoms of inattention (*makes careless mistakes, difficulty organizing tasks, loses things*) plus six non-DSM symptoms involving difficulties in planning, prioritizing, multi-tasking, 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 five of nine DSM hyperactivity symptoms and three non-DSM symptoms (*bores easily, needs others to keep life in order, cannot work unless under deadline*). The items in the third factor, which we refer to as impulsivity (IM), include all DSM impulsivity symptoms in addition to the remaining DSM hyperactivity symptoms and two non-DSM symptoms (*mood changes frequently, sensitive to criticism*). Pearson correlations between factors are . 51 EF-IH, .38 EF-IM, and .39 IH-IM. Narrowly-defined cases have a different symptom profile than other broadly-defined cases. (Table 3) Specifically, narrowly-defined cases have significantly higher proportions of both EF and IH (EF: 77.6% vs. 67.8%, $t = 5.1$, $p < .001$; IH: 76.3% vs. 61.5%, $t = 7.5$, $p < .001$) and a significantly lower proportion of IM (46.3% vs. 61.4%, $t = 4.0$, $p = .001$) symptoms than other broadly-defined cases.

All-possible subsets logistic regression analysis

Stepwise logistic regression was used to predict DSM-IV/ACDS adult ADHD from ACDS symptoms. Four symptoms captured all significant predictive effects. All-possible-subsets regression analysis selected the ten four-symptom subsets with the highest predictive associations. Three EF items and one IH item emerged in this analysis as most consistently predictive of broadly-defined (BD) ADHD, while two EF and two IH items emerged as the most consistently predictive of narrowly-defined (ND) ADHD. No IM items ever emerged as consistently predictive. One EF item was in the significant predictive set of both ND and BD: *difficulty prioritizing work* (10 of 10 in ND; 8 of 10 in BD). The other important EF predictor of ND was *trouble planning ahead* (3 of 10). The other two important EF predictors of BD were *cannot complete tasks in allotted time* (10 of 10) and *makes careless mistakes* (7 of 10). Only the last of these four EF items is in the DSM-IV. One IH item was predictive of both ND and BD: *difficulty sustaining attention* (7 of 10 in ND; 10 of 10 in BD). The other, *cannot work unless a deadline*, was important only in ND (8 of 10). Only the first of these two IH items is in DSM-IV.

Dichotomous prediction of clinical diagnoses

We tested a series of dichotomous scoring rules to predict clinical diagnoses from the predictors described in the last paragraph. The best rule was to require 3–4 out of 4 to predict ND and 2–4 out of 4 to predict BD. (Table 4, Part I) The prevalence estimates based on these scoring rules are not significantly different from the ACDS estimates (ND χ^2_1 = 1.2, p = .27; BD χ^2_1 = 2.6, p = .11). Individual-level concordance with clinical diagnoses was also very good (ND κ = .79 AUC = .93; BD κ =.89 AUC =.98).[43] The vast majority of ACDS cases (ND 88.1%; BD 96.7%) were detected using these rules, while the vast majority of ACDS non-cases (ND 98.7%; BD 98.5%) were correctly classified as non-cases.

As we wanted to find symptoms specific to adult ADHD, we examined whether the four best-predicting symptoms also significantly predicted other DSM-IV/CIDI diagnoses in the NCS-R (the only sample where these other disorders were assessed) after controlling total ACDS scores. This was done in a series of prediction equations each of which included the total ACDS score plus one 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 carry out this analysis by predicting 6-month prevalence of any DSM-IV/CIDI mood disorder, anxiety disorder, substance disorder, and behavioral disorder (other than ADHD) from each ACDS item in the four-item scales controlling total ACDS scores. The 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 executive functioning symptoms predicted any of these outcomes significantly once total ACDS scores were controlled. Both inattention items, in comparison, were significant in one of these equations: *difficulty sustaining attention* predicting anxiety disorders (OR = 11.6, 95% CI = 2.2–60.4) and *cannot work without a deadline* predicting behavioral disorders (OR = 13.9, 95% CI = 2.3–83.9).

Based on these results, we explored the possibility of deleting the inattention items in the prediction scales and focusing only on the executive functioning items. (Table 4, Part II) The best scoring rule in these reduced sets was to require both EF items to predict ND and 2–3 to predict BD. These rules generated weighted prevalence estimates very similar to the ACDS estimates (ND χ^2_1 = 0.3, p = .58; BD χ^2_1 = 0.0, p = .98) and good individual-level concordance with ACDS diagnoses (ND κ = .70 AUC = .83; BD κ = .87 AUC = .93). Most ACDS cases (ND 66.9%; BD 87.0%) were detected using these rules, while the vast majority of ACDS non-cases (ND 99.2%; BD 99.0%) were correctly classified as non-cases.

COMMENT

The 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 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 influenced 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 all-possible-subsets analysis to address this problem, caution should nonetheless be used in interpreting results prior to cross-validation. A related limitation is that most non-DSM items in the ACDS assessed executive functioning problems. Impulsivity, in comparison,

was assessed with a much smaller set of symptoms (only two non-DSM items and the three DSM-IV items). The role of impulsivity consequently could have been under-estimated in our analysis. Consistent with this possibility, the non-DSM ACDS symptoms do not include three impulsivity symptoms found by Barkley et al. to be predictive of adult ADHD (*makes decisions impulsively, difficulty stopping activities or behavior when he/she should do so,* and *more likely to drive a motor vehicle much faster than others*).[12] A final limitation is that interpretation is dependent on the thresholds established for determining presence-absence of symptoms, which were not specified in enough detail in the DSM system to provide firm guidance for the ACDS assessments.

Within the context of these limitations, our estimate that 3.6% of respondents meet DSM-IV criteria for both childhood and adult ADHD and our finding that these cases represent nearly half of all adults who retrospectively reported childhood ADHD are generally consistent with prior studies.[14, 45, 46] Our results are also consistent with prior studies in finding that symptom profiles change with age, as childhood AD is much more persistent than childhood HD.[14, 15, 17, 18] We also found that 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 impulsivity and less executive functioning and inattention-hyperactivity problems than 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 sub-threshold manifestations. We did not explore sub-threshold adult symptoms, but required either six AD or six HD symptoms in adulthood even though the DSM-V ADHD and Disruptive Behaviors Work Group is considering the possibility of requiring as few as three symptoms for a diagnosis of adult ADHD.

Our finding of a distinct adult executive functioning symptom factor is consistent with several other studies finding executive functioning problems to be cardinal features of adult ADHD.[12, 20, 47] The fact that three DSM-IV AD items loaded on the executive functioning factor (*difficulty organizing work, making careless mistakes, and losing things*) is consistent with the suggestion that some inattention may be a manifestation of deficits in working memory, suggesting an underlying influence of difficulty in executive functioning.[12] It is important to note in this regard, though, that the term *executive functioning* is defined in a number of ways in the literature[48–50] and is used here in a relatively nontechnical way to refer to observable deficits in 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 executive functioning as measured in cognitive performance tests.[51] Ongoing research using such tests might in the future document more subtle distinctions in executive functioning problems that relate to different manifestations of adult ADHD.[47, 52]

Our finding that symptoms of inattention and hyperactivity load together on a second factor is inconsistent with inattention and hyperactivity being conceptualized as distinct in the DSM-IV. This finding is also indirectly inconsistent with the finding of separate inattentive and impulsive-hyperactive factors in studies of childhood ADHD.[36–39] However, our finding of a single adult inattention-hyperactivity 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 while hyperactivity in childhood is primarily motoric, hyperactivity in adulthood is more reflective of internal restlessness.[23] DSM-IV acknowledges this by noting that “symptoms of hyperactivity (in adolescence and adulthood) take the form of feelings of restlessness and difficulty engaging in quiet sedentary activities.”[53] It is noteworthy in this regard that conceptual models of internal restlessness frequently incorporate traditional symptoms of inattention (i.e., mind wanders, distracted by sounds and visual stimuli).[23] Furthermore, even in factor analytic

studies that find symptoms of inattention and hyperactivity load on separate factors, these factors are often highly correlated.[54] Our finding that impulsivity symptoms split off from those of hyperactivity is also consistent with several previous studies[12, 20, 54, 55]and is especially striking as only a small number of impulsivity items were included in the ACDS.

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

An especially important finding is that executive functioning problems are consistently important predictors of adult clinical diagnose of ADHD both among respondents who met full criteria for childhood ADHD and among those who only had some childhood symptoms before age seven. Unlike the other highly predictive adult symptoms, all of which involve inattention, none of the adult executive functioning symptoms had significant comorbidity with other classes of adult DSM-IV disorders after controlling for the general gradient of adult ADHD. This suggests that executive functioning symptoms are those most specifically differentiating adult ADHD from other adult DSM disorders. A corollary is that even though inattention is the aspect of childhood ADHD most likely to persist into adulthood, it would be a mistake to think of inattention as the most important discriminating feature of adult ADHD due to the strong associations of inattention with other adult mental disorders.

Importantly, the most highly predictive executive functioning symptoms in our analysis are not in DSM-IV. Indeed, only one of the four most predictive symptoms of narrowly-defined adult ADHD was a DSM-IV symptom, while two of the remaining three items were executive functioning problems. Three of the four most predictive symptoms of broadly-defined adult ADHD were executive functioning problems. These findings are broadly consistent with those of Barkley et al.[12] and Faraone et al.,[24] who found that a number of non-DSM symptoms of executive functioning problems performed better than DSM-IV symptoms in distinguishing patients with adult ADHD from clinical controls. Although some of the most predictive non-DSM-IV items in our analyses load on our inattention-hyperactivity factor (*cannot work unless under deadline* and *difficulty sustaining attention*), these symptoms also reflect deficits in initiating and sustaining work effort, which are typically considered self-regulatory components of executive functioning.[49]

These results are consistent with the suggestion that diagnostic criteria for adult ADHD in future DSM and ICD revisions should include more executive functioning items, augmenting evidence that executive functioning problems are evident in virtually all adults with ADHD.[56] Althuogh these findings might be taken to support the view that adult ADHD should be conceptualized as largely a disorder of problems in executive functioning,[48, 49] such a view over-interprets the data, as inattention is strongly persistent from ADHD in childhood to adulthood and as Barkley and Faraone also found some aspects of impulsivity to predict adult ADHD. Nonetheless, the current results highlight the importance of executive functioning. More work is needed to determine whether an expanded version of the most predictive items in the current analysis could be used as a brief screening scale for adult ADHD. While these items have strong face validity in tapping core symptoms of executive functioning problems, they were applied here 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 current study in predicting clinical diagnoses of adult ADHD.

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Table 1

Persistence of retrospectively reported childhood DSM-IV/ACDS ADHD into adulthood (n = 91)[1]

	Childhood DSM-IV/ACDS symptom profile							
	AD-Only		HD-Only		Both AD and HD		Any ADHD	
Adult DSM-IV/ACDS symptom profile	**%**	**(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)
Both AD and HD	5.6	(23.0)	3.3	(17.9)	34.9	(47.7)	13.5	(34.2)
Any ADHD	60.8*	(48.8)	12.1	(32.6)	43.4	(49.6)	45.7	(49.8)
(n)	(42)		(17)		(32)		(91)	

*Significantly higher conditional prevalence of adult ADHD among respondents with a childhood history AD-Only than HD-Only at the .05 level based on a two-sided test

[1]A total of 91 respondents out of the 345 in the sample were judged retrospectively to have met DSM-IV criteria for ADHD in childhood. As these cases were over-sampled 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 over-sampling (not only of cases but also of sub-threshold 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 sub-sample sizes to the total sample size do not correspond to the reported percentages.

Table 2

Prevalence of DSM-IV and other ACDS Criterion A symptoms of adult ADHD among respondents with narrowly-defined (n = 55) and other broadly-defined (n = 35) DSM-IV/ACDS diagnoses of adult ADHD compared to other respondents (n = 255) and results of the rotated (promax) principal axis factor analysis (n = 345)[1]

		Symptom prevalence among respondents with and without DSM-IV/ACDS adult ADHD						Odds- ratio of the symptom predicting DSM-IV/ACDS adult ADHD[3]						
	DSM-IV Symptom[2]	Narrowly-defined		Other Broadly-defined		Others		Narrowly-defined vs. Others		Broadly-defined vs. Others		Rotated (promax) factor Analysis partial regression coefficients[4]		
		%	(SD)	%	(SD)	%	(SD)	OR	(95% CI)	OR	(95% CI)	I	II	III
I. DSM-IV Criterion A symptoms of Inattention (AD)														
Makes careless mistakes	ADa	33.4	(47.2)	56.8	(49.5)	0.8	(8.9)	60.3*	(13.7–265.6)	101.6*	(23.2–446.0)	**.61**	−.06	.10
Difficulty sustaining attention	ADb	98.0	(14.0)	57.7	(49.4)	6.7	(25.0)	694.6*	(105.2–4586.3)	45.9*	(5.0–423.7)	.26	**.73**	−.11
Does not listen	ADc	85.3	(35.4)	56.0	(49.6)	7.9	(27.0)	67.6*	(15.5–294.6)	26.8*	(4.5–160.0)	.17	**.69**	.00
Difficulty follow instructions	ADd	88.4	(32.0)	97.0	(17.1)	18.2	(38.6)	34.2*	(7.3–160.6)	59.3*	(16.2–217.6)	.17	**.80**	.06
Difficulty organizing tasks	ADe	91.7	(27.6)	61.9	(48.6)	12.7	(33.3)	75.5*	(17.5–326.0)	21.6*	(3.4–135.6)	**.67**	.35	−.06
Dislikes tasks requiring attention	ADf	95.3	(21.2)	96.2	(19.1)	12.7	(33.3)	138.6*	(28.8–667.7)	154.9*	(44.6–537.5)	.52	**.55**	−.07
Loses things	ADg	83.4	(37.2)	57.9	(49.4)	17.3	(37.8)	24.1*	(5.8–100.7)	11.1*	(2.3–54.4)	**.42**	.35	.13
Easily distracted	ADh	94.3	(23.2)	55.9	(49.7)	12.1	(32.6)	119.9*	(25.0–574.5)	20.6*	(3.0–139.4)	.21	**.74**	−.03
Forgetful in daily activities	ADi	87.6	(33.0)	55.2	(49.7)	9.3	(29.0)	69.1*	(13.5–354.2)	23.2*	(4.2–128.1)	.27	**.66**	.01
II. DSM-IV Criterion A symptoms of hyperactivity/impulsivity (HD)														
Fidgets	HDa	83.5	(37.1)	91.7	(27.6)	32.8	(46.9)	10.3*	(2.5–42.7)	14.8*	(4.7–46.0)	−.19	**.84**	.21
Difficulty remaining seated	HDb	73.5	(44.1)	47.0	(49.9)	14.1	(34.8)	16.8*	(3.5–81.3)	8.9*	(1.8–44.0)	−.21	**.94**	.12
Restless	HDc	31.8	(46.6)	43.8	(49.6)	14.3	(35.0)	2.8	(0.6–12.4)	3.7	(0.8–16.8)	−.13	**.81**	.18
Difficulty playing quietly	HDd	34.7	(47.6)	46.2	(49.9)	9.7	(29.6)	4.9	(0.9–26.2)	6.4*	(1.3–32.4)	−.39	**.89**	.18
Driven by motor	HDe	34.3	(47.5)	49.6	(50.0)	12.6	(33.2)	3.6	(0.8–17.6)	5.1*	(1.1–23.7)	.00	**.51**	.24
Talks excessively	HDf	32.2	(46.7)	48.1	(50.0)	21.4	(41.0)	1.8	(0.4–7.8)	2.5	(0.6–11.1)	−.20	.29	**.73**
Blurts out answers	HDg	76.8	(42.2)	50.4	(50.0)	19.6	(39.7)	13.5*	(3.3–55.4)	6.9*	(1.5–32.1)	.12	.16	**.69**
Difficulty waiting turn	HDh	73.3	(44.2)	54.1	(49.8)	20.0	(40.0)	11.0*	(2.6–47.0)	6.8*	(1.5–31.7)	.12	.15	**.63**

	DSM-IV Symptom[2]	Symptom prevalence among respondents with and without DSM-IV/ACDS adult ADHD						Odds- ratio of the symptom predicting DSM-IV/ACDS adult ADHD[3]						
		Narrowly-defined		Other Broadly-defined		Others		Narrowly-defined vs. Others		Broadly-defined vs. Others		Rotated (promax) factor Analysis partial regression coefficients[4]		
		%	(SD)	%	(SD)	%	(SD)	OR	(95% CI)	OR	(95% CI)	I	II	III
Interrupts or intrudes	HDi	32.1	(46.7)	87.0	(33.6)	11.1	(31.4)	3.8	(0.9–17.0)	12.7*	(2.8–57.3)	.14	.18	**.72**
III. Symptoms not in DSM-IV														
Wastes or mismanages time		82.0	(38.4)	54.8	(49.8)	12.0	(32.5)	33.4*	(7.6–147.2)	15.3*	(2.8–83.8)	.37	.35	.24
Trouble planning ahead		75.8	(42.8)	53.2	(49.9)	4.5	(20.7)	66.9*	(8.9–503.4)	37.7*	(4.9–287.8)	**.72**	.34	−.12
Lacks self-discipline		88.8	(31.5)	93.9	(23.9)	9.5	(29.3)	75.5*	(15.2–375.0)	102.4*	(29.2–359.0)	**.40**	.38	.32
Difficulty prioritizing work		80.5	(39.6)	54.8	(49.8)	5.0	(21.8)	78.5*	(15.2–405.7)	38.3*	(6.5–226.7)	**.48**	.43	.16
Trouble keep track multiple things		89.1	(31.2)	94.2	(23.4)	17.8	(38.3)	37.7*	(10.1–141.4)	51.8*	(16.7–160.6)	**.53**	.29	.19
Bores easily		96.7	(17.9)	93.2	(25.2)	25.7	(43.7)	83.6*	(17.4–402.7)	53.3*	(16.5–172.2)	.05	**.84**	.03
Others keep life order		69.8	(45.9)	13.5	(34.2)	6.6	(24.8)	32.5*	(5.2–202.7)	9.3*	(1.5–58.5)	.00	**.78**	−.29
Cannot work unless deadline		95.5	(20.7)	57.6	(49.4)	7.5	(26.3)	261.5*	(55.8–1226.5)	38.1*	(5.6–260.9)	.39	**.57**	.03
Cannot complete tasks in time		80.2	(39.8)	86.1	(34.6)	2.6	(15.9)	151.0*	(27.7–824.2)	186.7*	(43.0–810.0)	**.56**	.34	.07
Remembers details, not main idea		75.0	(43.3)	50.5	(50.0)	11.7	(32.1)	22.8*	(4.8–108.2)	12.4*	(2.5–61.9)	**.42**	.33	.27
Mood changes frequently		27.6	(44.7)	82.3	(38.2)	14.8	(35.5)	2.2	(0.5–8.8)	7.5*	(1.8–32.1)	.00	.03	**.80**
Easily overwhelmed		27.2	(44.5)	91.8	(27.4)	5.4	(22.6)	6.6*	(1.5–28.8)	28.2*	(5.8–137.7)	.34	.13	.39
Difficulty expressing anger		35.0	(47.7)	47.1	(49.9)	18.9	(39.2)	2.3	(0.5–9.8)	3.0	(0.7–12.4)	.11	.34	.18
Sensitive to criticism		35.6	(47.9)	46.5	(49.9)	26.7	(44.2)	1.5	(0.4–6.6)	1.9	(0.5–8.0)	−.07	.19	**.64**
(n)		(55)		(35)		(255)		(310)		(345)		(345)		

*Significant at the .05 level, two-sided test

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

[2]Labels indicate the DSM-IV symptom criteria for ADHD, distinguishing the symptoms of attention-deficit (AD) from those of hyperactivity/impulsivity (HD). Cells without such entries are associated with symptoms that are not in the DSM-IV.

[3]The ORs in the first column compare narrowly-defined cases (n = 55) with respondents who did not meet broadly-defined criteria (n = 255), whereas the ORs in the second column compare broadly-defined cases (n = 90; that is, those in the first two 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 n's 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 due to the use of unweighted n's to calculate combined prevalence.

[4]Bolded entries represent the highest regression coefficients for each item across the three factors

Table 3

Mean proportions of adult executive functioning (EF), inattention- hyperactivity (IH), and impulsivity (IM) symptoms reported by respondents with narrowly-defined or broadly-defined DSM-IV/ACDS adult ADHD[1]

	Narrowly-defined		Other Broadly-defined	
	Est	**(SD)**	**Est**	**(SD)**
Executive functioning (EF)	77.6*	(41.7)	67.8	(46.7)
Inattention-hyperactivity (IH)	76.3*	(42.5)	61.5	(48.7)
Impulsivity (IM)	46.3*	(49.9)	61.4	(48.7)
(n)	(55)		(35)	

*Significant difference between narrowly-defined and other broadly-defined cases at the .05 level, two-sided test

[1]EF, IH, and IM symptoms are defined by the bolded factor loadings in Table 2. Proportions were calculated by dividing the number of endorsed symptoms for each respondent by number of symptoms in the dimension. For example, given that there are 9 EF symptoms, a respondent who endorsed 3 of these symptoms would be defined as having a proportion of 33.3 (3/9). Narrowly-defined cases were defined as meeting full childhood and adult criteria, whereas broadly-defined cases were defined as having had at least some childhood symptoms before age seven and meeting full adult criteria.

Table 4

Diagnostic concordance of 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)[1]

Scoring rules (number of items endorsed) [2]	Prevalence					Concordance										
	DSM-IV/ACDS ADHD		Positive on the dichotomized prediction scale		χ^2	SEN[3]		SPEC[3]		PPV[3]		NPV[3]		K[3]		AUC[3]
	%	(SD)	%	(SD)		Est	(SD)	Est	(SD)	Est	(SD)	Est	(SD)	Est	(SD)	
I. Four-item scales																
A. Narrowly-defined																
1–4	3.6	(18.6)	24.2	(42.8)	70.0*	99.6	(6.3)	78.6	(41.0)	14.9	(35.6)	100.0	(0.0)	.21	(0.4)	.89
2–4	3.6	(18.6)	12.0	(32.5)	27.6*	96.2	(19.1)	91.2	(28.3)	29	(45.4)	99.8	(4.5)	.41	(0.5)	.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)	.79	(0.4)	.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)	.72	(0.4)	.83
B. Broadly-defined																
1–4	7.7	(26.7)	19.8	(39.8)	41.1*	99.8	(4.5)	86.8	(33.8)	38.8	(48.7)	100.0	(0.0)	.50	(0.5)	.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)	.89	(0.3)	.98
3–4	7.7	(26.7)	5.4	(22.6)	5.9*	65.6	(47.5)	99.6	(6.3)	93.2	(25.2)	97.2	(16.5)	.75	(0.4)	.83
4	7.7	(26.7)	0.9	(9.4)	22.6*	10.6	(30.8)	99.9	(3.2)	90.7	(29.0)	93.0	(25.5)	.18	(0.4)	.55
II. Executive functioning sub-scales																
A. Narrowly-defined																
1–2	3.6	(18.6)	15.6	(36.3)	38.4*	89.4	(30.8)	87.1	(33.5)	20.7	(40.5)	99.5	(7.1)	.30	(0.5)	.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)	.70	(0.5)	.83
B. Broadly-defined																
1–3	7.7	(26.7)	14.4	(35.1)	21.7*	98.0	(14.0)	92.6	(26.2)	52.6	(49.9)	99.8	(4.5)	.65	(0.5)	.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)	.87	(0.3)	.93
3	7.7	(26.7)	0.9	(9.4)	22.5*	11.0	(31.3)	99.9	(3.2)	91.0	(28.6)	93.1	(25.3)	.18	(0.4)	.55

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

[1]As screened positive cases and sub-threshold cases were over-sampled 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 over-sampling. The percentages reported in this table are based on analysis of these weighted data.

[2]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 four-item scales in Part I of 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 a deadline*. The items for broadly-defined ADHD include *difficulty prioritizing work*, *cannot complete work in allotted time*, *makes careless mistakes*, and *difficulty sustaining attention*. The executive functioning sub-scales in Part II of the table delete the inattention items from the Part I scales (*difficulty sustaining attention* in the scales for both narrowly-defined and broadly-defined cases and *cannot work unless a deadline* in the scale for narrowly-defined cases), resulting in only 2 items in the narrowly-defined and 3 in the broadly-defined sub-scales.

[3]SEN: sensitivity; SPEC: specificity; PPV: positive predictive value; NPV: negative predictive value; K: Cohen's K; AUC: area under the receiver operating characteristic curve.