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How persistent is ADHD? A controlled 10-year follow-up study of boys with ADHD

Joseph Biederman^{a,*}, Carter R. Petty^a, Maggie Evans^a, Jacqueline Small^a, and Stephen V. Faraone^b

^a Department of Psychiatry, Massachusetts General Hospital and Harvard Medical School

^b Departments of Psychiatry and Neuroscience & Physiology, SUNY Upstate Medical University

Abstract

The main aim of this study was to examine the age-dependent persistence of ADHD in boys transitioning from adolescence into early adulthood attending to different definitions of persistence. We conducted a 10-year follow-up study (mean follow-up time=11 years) of 110 boys with ADHD and 105 non-ADHD controls. Both groups were 6–17 years of age at ascertainment. ADHD was considered persistent at follow-up if subjects met full or subthreshold (more than half of the symptoms required for a full diagnosis) DSM-IV diagnostic criteria, failed to attain functional remission (GAF score ≤ 60), or were receiving treatment for ADHD. While 65% of children with ADHD no longer met full DSM-IV criteria for ADHD at the 10-year follow-up, 78% of subjects met at least one of our definitions of persistence. Persistence as described above was associated with more psychiatric comorbidity, more familiarity with mood disorders, and higher levels of educational and interpersonal impairments than controls. This 10-year longitudinal follow-up study shows that the majority of ADHD boys experience persistent symptoms and functional impairments into early adulthood. Persistence of ADHD is associated with greater psychiatric comorbidity, familiarity and functional impairments.

Keywords

longitudinal; adult; remission; ADHD

Corresponding Author: Joseph Biederman, M.D. Massachusetts General Hospital, Pediatric Psychopharmacology Unit, 55 Fruit Street, YAW 6A-6900, Boston, MA 02114; phone: 617-726-1731; fax: 617-724-3742; jbiederman@partners.org.

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1. Introduction

Despite the existence of several prospective studies of children with ADHD growing up, very few longitudinal studies examined the adult outcome of this disorder and those that did reported inconsistent results (Barkley et al., 1990; Barkley et al., 2008; Mannuzza et al., 1993; Weiss et al., 1985). For example, in independent samples of hyperactive boys grown up, Mannuzza et al. (1998) reported only 4% persistence of ADHD by a mean age of 24.1 years, while Weiss et al. (1985) reported 66% persistence of ADHD by a mean age of 25.1 years. Hill & Schoener (1996) fit a mathematical model to the rates of persistence of ADHD reported in previous studies that had followed ADHD children from childhood to adolescence or adulthood. Their analyses suggested that ADHD is a highly remitting disorder. These findings are difficult to reconcile with emerging epidemiological data that estimates the prevalence of adult ADHD to be up to 5% (Faraone and Biederman, 2005; Fayyad et al., 2007; Kessler et al., 2006). Given that long-term outcome studies are the touchstone for judging the course of a disorder, a better understanding of the true course of ADHD from childhood into adulthood is critical to evaluate whether ADHD is a lifelong disorder for children afflicted with this disorder and help link the pediatric and adult literature on the subject.

In a previous report of our large longitudinal sample of boys with ADHD ascertained from pediatric and psychiatric sources (Biederman et al., 2000), our group examined patterns of persistence and remission at the 4-year follow-up using different definitions of remission. We found that the proportion of subjects experiencing remission varied considerably with the definition used (highest for syndromatic remission, lowest for functional remission). Our prior study also found that persistence of ADHD was associated with higher rates of psychiatric comorbidity and familiarity (Biederman et al., 1996b).

Similar findings were reported by Faraone et al. (2006a) who used a meta-analysis regression model to separately assess the syndromatic and symptomatic persistence of ADHD from the published literature. They found that while the rate of syndromatic persistence (subjects meeting full criteria for ADHD) was quite low (15% at age 25 years), the rate of symptomatic persistence (subjects meeting subthreshold criteria for ADHD) was much higher (65%). These results further supported the idea that estimates of ADHD's persistence are heavily dependent on how one defines persistence. Yet, regardless of definition, these analyses show that ADHD lessens with age, supporting the need for additional studies examining this issue.

To this end the main aim of this study was to reassess the age dependent decline of ADHD at the 10-year follow-up when most of our sample had reached young adult years. In addition, we compared familiarity, psychiatric comorbidity, and measures of functioning (educational, legal, driving, and sexual history) between persistent ADHD, remittent ADHD, and control subjects in order to understand the correlates of persistent ADHD into young adult years. Based on our work and the literature we predicted that ADHD would be persistent at the 10-year follow-up into young adult years, and inattentive symptoms, in particular, would be most persistent. We further hypothesized that persistence of ADHD into young adult years would be associated with higher rates of psychiatric comorbidity, more family history of ADHD, and poorer functioning. This is one of the very few studies examining patterns of persistence and remission in ADHD children grown up.

2. Methods

2.1 Subjects

Detailed study methodology has been previously reported (Biederman et al., 1996a; Biederman et al., 2006). Briefly, subjects were derived from a longitudinal case-control family study of referred youth with and without ADHD. At baseline, we ascertained male Caucasian subjects

aged 6–17 years with (N=140) and without (N=120) DSM-III-R ADHD from pediatric and psychiatric clinics. Potential subjects were excluded if they had been adopted, or if their nuclear family was not available for study. We also excluded potential subjects if they had major sensorimotor handicaps (paralysis, deafness, blindness), inadequate command of the English language, Full Scale IQ less than 80, psychosis, or autism. No other psychiatric disorders were exclusionary for subjects with or without ADHD. Previously, this sample was followed-up one year and four years after the baseline assessment (Biederman et al., 1996a). Psychiatric assessments relied on the Schedule for Affective Disorders and Schizophrenia for School-Age Children Epidemiologic 4th Version (K-SADS-E) (Orvaschel and Puig-Antich, 1987). Diagnoses were based on independent interviews with the mothers (all subjects) and direct interviews with subjects older than twelve years of age. Parents and adult offspring provided written informed consent to participate, and parents also provided consent for offspring under the age of 18. Children and adolescents provided written assent to participate. The human research committee at Massachusetts General Hospital approved this study.

2.2 Follow-up assessment procedures

The present study reports on the 10-year follow-up of this sample (mean follow-up: 11 year; range: 9 to 14 years), where 112 ADHD and 105 control probands were successfully re-ascertained. Participants were re-contacted by telephone and scheduled for a follow-up interview at our research offices. If subjects were unable or unwilling to travel, interviews were conducted by telephone. Interviews were conducted in one session. Psychiatric assessments at the 10-year follow-up relied on the K-SADS-E-IV (Epidemiologic Version) assessing DSM-IV disorders (Orvaschel, 1994) for subjects < 18 years of age and the Structured Clinical Interview for DSM-IV (SCID) (First et al., 1997) (supplemented with modules from the K-SADS-E to assess childhood diagnoses) for subjects 18 years of age and older. We conducted direct interviews with subjects and indirect interviews about subjects with their mothers (i.e., mothers completed the interview about their offspring). Of the 217 subjects interviewed, the proportion that provided direct only, indirect only and both types of reports were 22%, 17%, and 62%, respectively. We combined data from direct and indirect interviews by considering a diagnostic criterion positive if it was endorsed in either interview.

In order to assess family history of psychiatric disorders, first-degree relatives of these probands were also assessed. This sample comprised mothers (N=217, N=112 ADHD, N=105 Controls), fathers (N=216, N=112 ADHD, N=104 Controls), and siblings (N=310, N=161 ADHD, N=149 Controls). The number of family members did not differ between ADHD and Control probands ($\chi^2_{(1)}=0.02$, $p=0.90$). Parents were assessed at baseline only (as they had passed the age of risk for most psychopathology), while the siblings were assessed at baseline (N=243), 1-year follow-up (N=251), 4-year follow-up (N=272), and 10-year follow-up (N=296). Parents received direct interviews and siblings received an indirect interview if they were younger than 12 years of age, and both an indirect and a direct interviews if between 12 and 17 years of age, and a direct interview if 18 years of age and older.

The interviewers were blind to the subject's baseline ascertainment group, the ascertainment site, and all prior assessments. The interviewers had undergraduate degrees in psychology and were extensively trained and supervised. First, they underwent several weeks of classroom style training, learning interview mechanics, diagnostic criteria and coding algorithms. Then, they observed interviews by experienced raters and clinicians. They subsequently conducted at least six practice (non-study) interviews and at least three study interviews while being observed by senior interviewers. The principal investigator (JB) supervised the interviewers throughout the study. We computed kappa coefficients of agreement by having experienced, board certified child and adult psychiatrists and licensed clinical psychologists diagnose subjects from audio taped interviews. Based on 500 assessments from interviews of children

and adults, the median kappa coefficient was .98. Kappa coefficients for individual diagnoses included: ADHD (0.88), conduct disorder (1.0), major depression (1.0), mania (0.95), separation anxiety (1.0), agoraphobia (1.0), panic (.95), substance use disorder (1.0), and tics/Tourette's (0.89).

A committee of board-certified child and adult psychiatrists who were blind to the subject's ADHD status, referral source, and all other data resolved diagnostic uncertainties. Uncertainties arose in a minority of comorbid disorders and never for ADHD. Diagnoses presented for review were considered positive only when the committee determined that diagnostic criteria were met to a clinically meaningful degree. We estimated the reliability of the diagnostic review process by computing kappa coefficients of agreement for clinician reviewers. For these diagnoses, the median reliability between individual clinicians and the review committee assigned diagnoses was 0.87. Kappa coefficients for individual diagnoses included: ADHD (1.0), conduct disorder (1.0), major depression (1.0), bipolar (0.78), separation anxiety (0.89), agoraphobia (0.80), panic (0.77), substance use disorder (1.0), and tics/Tourette's (0.68).

As a measure of overall functioning, we used the Global Assessment of Functioning (GAF) (American Psychiatric Association, 2000), a summary score assigned by the interviewers based on information gathered during the diagnostic structured interview. Socioeconomic status (SES) was measured using the 5-point Hollingshead scale (Hollingshead, 1975), which is scored using the educational and occupational levels of the subject's primary caregivers. Additionally, information about academic functioning, legal problems, treatment history, sexual history, and driving history was collected at the 10-year follow-up assessment. Treatment history, repeated grades, special class, and tutoring were collected in the structured interview. Other academic functioning, legal problems, sexual history, and driving history were collected from paper-and-pencil questionnaires form packets administered directly to subjects and indirectly to mothers.

2.3 Statistical analysis

Consistent with our previous work (Biederman et al., 2000), we defined the following mutually exclusive categories of persistence for the 112 ADHD subjects returning at the 10-year follow-up: a) subjects meeting full DSM-IV criteria for ADHD ("Syndromatic Persistence"), b) subjects meeting subthreshold DSM-IV criteria (more than half of the symptoms required for a full diagnosis, "Symptomatic Persistence"), c) subjects not meeting criteria (a) or (b) but who were functionally impaired with a GAF score ≤ 60 ("Functional Persistence"), and d) subjects not meeting criteria (a), (b), or (c) but who were receiving pharmacotherapy for ADHD ("Medicated") in the month prior to the subject's 10-year follow-up assessment.

To assess age-specific prevalences of syndromatic, symptomatic, and functional persistence, we graphed the different definitions of persistence as a function of age based on symptoms reported currently (last month) at the 10-year follow-up. Specifically, rates of persistence at follow-up were plotted for different developmental groups in order to easily display observed rates: 15–18 years (high school), 19–21 years (early college), 22–24 years (early young adulthood), and 25–30 years (later young adulthood). Definitions of persistence were modeled as a function of age (continuous) using logistic regression.

Sociodemographic characteristics (age, SES, etc.) among Persistent ADHD, Remittent ADHD, and Controls were compared using linear, logistic, or ordinal logistic regression depending on the distributions of the variable. To assess the functional correlates (academic functioning, sexual history, etc.) of persistent ADHD, comparisons were made between subjects with persistent ADHD, remittent ADHD, and Controls using logistic regression. Thirty statistical tests were conducted using the outcome measures. One-year prevalences of comorbid disorders

at the 10-year follow-up were defined as positive if the subject met full criteria currently (last month) or met full criteria and reported an age of offset at the same age or one year prior to the age at assessment (i.e., the disorder was present at any time in the year prior to the assessment). Comparisons of school functioning and legal, driving, and sexual histories were based on lifetime rates. Rates of high school graduation were limited to subjects 18 years of age and older. Positive family history of a disorder was defined as having at least one first-degree relative with a given disorder. All tests were two-tailed with alpha set at 0.05.

3. Results

Of the 140 ADHD and 120 control subjects recruited at baseline, 112 (80%) and 105 (88%), respectively, were re-assessed at the 10-year follow-up. The rate of successful follow-up did not differ between groups ($p=0.11$). The average follow-up time was 11.2 years ($SD=0.9$ years); ages at follow-up ranged from 15 to 31 years (mean=22.2, $SD=3.7$, 90% were 18 years of age or older). There were no significant differences between those successfully followed up and those lost to follow-up on baseline measures of age, GAF score, family intactness, ascertainment source, or psychiatric diagnoses (all $p>0.05$). A significant difference was found in baseline SES, with ADHD and Control subjects lost to follow-up having a lower mean SES compared to subjects successfully re-assessed (ADHD: $t_{(138)}=3.1$, $p<0.01$; Controls: $t_{(118)}=2.1$, $p=0.04$).

3.1 Age-specific prevalence of different definitions of persistence

At the 10-year follow-up, 2 of the 112 ADHD subjects could not be analyzed due to missing diagnostic data. Of the remaining 110 ADHD subjects, 39 (35%) had Syndromatic Persistence, 24 (22%) had Symptomatic Persistence, 16 (15%) had Functional Persistence, 7 (6%) were not symptomatic, syndromatic, or functionally impaired but were medicated for ADHD, and 24 (22%) were fully remitted. Therefore, 78% (86/110) of ADHD subjects showed some evidence of persistence. Using only ADHD subjects who had reached adulthood (at least 18 years of age), 76% (76/100) met one of our definitions of persistence.

Prevalences of the different definitions of persistence by age (categorical) are depicted in Figure 1. Increasing age (continuous) was significantly associated with decreased persistence of overall ADHD symptoms and inattentive symptoms (ADHD syndromatic [$z=3.49$, $p<0.001$], ADHD symptomatic [$z=3.18$, $p=0.001$], ADHD functional [$z=2.86$, $p=0.004$], inattentive syndromatic [$z=4.06$, $p<0.001$], inattentive symptomatic [$z=4.32$, $p<0.001$]), but not for persistence of hyperactive impulsive symptoms (syndromatic [$z=1.12$, $p=0.26$], symptomatic [$z=1.43$, $p=0.15$]). The prevalence estimate of persistence varied considerably depending on the definition used for individual symptomatic clusters. Inattention was substantially more persistent than hyperactivity/impulsivity through age 21 for both syndromatic (Figure 1B) and symptomatic (Figure 1C) persistence. However, for subjects older than 21 years the estimated rate of inattentive persistence was similar to that of hyperactive/impulsive persistence.

3.2 Sociodemographic characteristics

Comparisons were made between ADHD subjects with any form of persistent ADHD (Syndromatic, Symptomatic, Functional persistence and Medicated for ADHD [Persistent ADHD, $N=86$], ADHD subjects with remitted ADHD [Remittent ADHD, $N=24$], and Controls [$N=105$]). Because the Persistent ADHD group was somewhat younger in age (21.2 ± 3.3 years) compared to the Remittent ADHD group (23.3 ± 2.9 years, $t_{(108)}=2.80$, $p=0.006$) and the Controls (22.8 ± 4.0 years, $t_{(189)}=2.92$, $p=0.004$), all subsequent analyses were adjusted for age. The groups did not significantly differ on baseline family socioeconomic status (Persistent ADHD= 1.7 ± 0.9 , Remittent ADHD= 1.8 ± 1.0 , Controls= 1.4 ± 0.7 , $\chi^2_{(2)}=4.79$, $p=0.09$) or rate

of intactness of the family (Persistent ADHD=71%, Remittent ADHD=75%, Controls=83%, $\chi^2_{(2)}=3.90$, $p=0.14$). The Persistent ADHD group was significantly more likely to have an indirect interview (direct=20%, indirect=10%, both=70%) compared to the Remittent ADHD group (direct=54%, indirect=21%, both=25%, $\chi^2_{(2)}=15.99$, $p<0.001$). The Persistent ADHD group was significantly more likely to have received pharmacotherapy for ADHD at some point in their lifetime compared to the Remittent ADHD group (97% versus 79%, $z=2.10$, $p=0.04$). Only 30% (24/79) of the Persistent ADHD group was currently (last month) receiving pharmacotherapy for ADHD (excluding $n=7$ subjects classified as Persistent ADHD by virtue of being on medication).

3.3 One-year rates of psychiatric comorbidity at the 10-year follow-up

As shown in Table 1, Persistent ADHD was significantly associated with higher 1-year rates of oppositional defiant disorder (ODD), conduct disorder/antisocial personality disorder (CD/ASPD), bipolar disorder, multiple (≥ 2) anxiety disorders, psychoactive substance use disorder (PSUD), and smoking at follow-up compared with Controls. Persistent ADHD differed significantly from Remittent ADHD in the rates of ODD, CD/ASPD, and PSUD (Table 1). Controls had a significantly higher rate of PSUD compared to Remittent ADHD subjects.

3.4 Rates of positive family history for a psychiatric disorder

As shown in Table 2, Persistent ADHD was associated with significantly higher rates of positive family history (at least one first-degree relative affected) of ADHD, mood, multiple (≥ 2) anxiety, and antisocial disorders, as well as alcohol/drug dependence compared with Controls. Remittent ADHD subjects also had a significantly higher rate of positive family history of ADHD compared to Controls (Table 2). Persistent ADHD subjects had a significantly higher rate of positive family history of mood disorders compared to Remittent ADHD subjects.

3.5 Functional correlates

As shown in Table 3, Persistent ADHD was associated with significantly higher rates of being placed in a special class and receiving detention compared to Remittent ADHD. However, independent of ADHD persistence, ADHD was associated with significantly higher rates of grade retention and need for extra tutoring when compared with Controls. Persistent ADHD was also associated with higher rates of school suspensions and expulsions compared with controls. Subjects with Persistent ADHD had a significantly lower rate of high school graduation compared with Controls. The Persistent ADHD group also had significantly higher rates of being arrested and being convicted and were more likely to have had sex before age 16 compared with Controls (Table 3).

4. Discussion

Results of this prospective and blind 10-year follow-up study of 110 boys with ADHD and 105 non-ADHD controls revealed that, while 65% of boys with ADHD no longer met full DSM-IV criteria for ADHD at the 10-year follow-up, 78% of subjects met at least one of our definitions of persistence: 35% continued to meet full DSM-IV criteria for ADHD, 22% met subthreshold criteria, 15% were functionally impaired, and 6% while not meeting criteria for ADHD and functioning well, were treated for the disorder. Persistence of ADHD was associated with higher rates of psychiatric comorbidity, familiarity with mood disorders, as well as higher levels of educational and interpersonal impairments than controls. These findings extend into early adulthood previous findings from this sample their adolescent years (Biederman et al., 1996b; Biederman et al., 2000). Both our prior and current work stress that patterns of remission of ADHD are highly sensitive to how persistence and remission are defined.

Our rate of syndromatic remission (65%) by young adult years is in full agreement with the rate of syndromatic remission (65%–70%) estimated by Hill and Schoener (1996) for the same age range. However, our results also indicate that a majority of subjects continue to struggle with a substantial number of ADHD symptoms and high levels of dysfunction at an average age of 22 years. These results are consistent with the pooled analysis of ADHD outcome studies by Faraone et al. (2006a) and confirms the prior work of Barkley et al. (2002; 2008) who concluded that the prognosis of ADHD depends on what definition of persistence one uses. As described by Faraone et al. (2006b; 2006c; 2008; 2007), even subsyndromal forms of ADHD are morbid and associated with significant dysfunction and may benefit from clinical attention.

Our findings documenting symptom decline over time in children with ADHD grown up are consistent with our previous work during the adolescent follow up of this sample (Biederman et al., 2000). However, in contrast to the previous adolescent follow-up showing a more precipitous symptom decline for hyperactivity and impulsivity during adolescent years, by young adult years symptoms of inattention attained the same level of decline as those of hyperactivity/impulsivity indicating that the age dependent decline of ADHD symptoms affects all components of the symptomatic picture in adult years. This convergence of remitted inattentive and hyperactive/impulsive symptoms after age 21 may be related to the transition from educational to occupational environments. That is, individuals with ADHD may choose careers with a low attentional demand and therefore inattentive ADHD symptoms would be less clinically relevant.

While the reasons underlying the symptom reduction with age in some cases of subjects with ADHD remain unclear, several plausible explanations are possible. As Barkley (1997) and Faraone (2000) have argued, symptom decline in ADHD may reflect the developmental insensitivity of the DSM-IV rather than the natural history of ADHD. These researchers have argued that developmental changes may make it difficult to detect DSM-IV ADHD symptoms as children age, as maturation mitigates these symptoms and may make them less conspicuous. For example, although remaining seated is difficult for an elementary school age child, it becomes easier with age as socialization and brain development improve the child's capacity for inhibiting impulses. Likewise, development can lead to changes in the environment. For example, unlike school age children, many adults are not required to sit for several hours each day making the symptoms of hyperactivity less conspicuous. Thus, adults with ADHD may be restless and fidgety, but not overly hyperactive. Although, with age, work may tax the attentional capacity, adults do not need to complete assignments or homework and these symptoms may become less conspicuous. More work is needed to evaluate the expression of ADHD symptoms as they morph across the lifecycle.

The finding that persistence of ADHD was associated with greater psychiatric comorbidity replicates our previous findings during the adolescent follow-up (Biederman et al., 1996b) and indicates that comorbid disorders are also persistent. Considering the morbidity and dysfunction associated with psychiatric comorbidity, these findings should encourage clinicians to carefully monitor children with ADHD and be mindful not only to the residual manifestations of the symptomatic picture of ADHD over time but also to the associated comorbid disorders.

A family history of mood disorders was associated with persistence of ADHD. This finding suggests that previous family studies linking mood disorders with ADHD (Biederman et al., 1991; Faraone and Biederman, 1997; Faraone et al., 1998) may have been driven by persistent cases of ADHD.

The finding that persistence of ADHD was associated with high rates of placement in special classes, detention, and suspension, and lower rates of high school graduation is consistent with

a large literature documenting impaired educational outcomes in subjects with ADHD (Antshel et al., 2007; Barkley et al., 2006; Biederman et al., 2006; Faraone et al., 1996; Faraone et al., 1993; Mannuzza et al., 1993). However, it is important to note that similarly impaired educational deficits were observed in the remitting cases. This finding stresses the critical importance of aggressively addressing ADHD during formative years irrespective of the fact that some cases will remit.

A large majority of subjects with ADHD had some history of pharmacotherapy for ADHD (79% Remittent ADHD, 97% Persistent ADHD). Further research should be conducted to determine what features of pharmacotherapy can predict remittance of ADHD. Despite nearly all subjects with Persistent ADHD receiving pharmacotherapy at some point in their lives, only 30% were currently being treated. Additional work on the effectiveness and adherence to medication should be done to determine why individuals with persistent ADHD cease pharmacotherapy.

Our results must be interpreted in the context of some methodological limitations. Our persistent ADHD group comprised subjects meeting various definitions of persistence, and we lacked sufficient sample sizes to compare these different definitions on comorbidities and functional outcomes. Further research comparing the outcomes associated with these different definitions of persistence could advise as to which definition is most clinically informative. Although the vast majority of our subjects (90%) were older than 18 years, a small proportion of our sample had not yet reached adulthood. However, the rate of persistence was the same when examined only in adult subjects. In addition, we graphed persistence stratified by age to display the developmental range of our sample.

We found that subjects with persistent ADHD were more likely to have had an indirect interview. The reasons for this association are unclear. Mothers whose children had remittent ADHD may have felt less of a need to participate in the follow-up assessment compared to mothers of children with persistent ADHD who were continuing to have negative consequences of the disorder. On the other hand, if a mother's report increases the likelihood of a diagnosis of ADHD, this would suggest either false positives in subjects with indirect reports or false negatives in subjects with only direct reports. Biederman et al. (2007) found that maternal reports of ADHD resulted in meaningful diagnoses of ADHD with high levels of impairment, regardless of endorsement by the youth. Therefore, because remittent ADHD was significantly associated with not having a maternal report, and maternal reports of ADHD tend to be valid, then our estimate of persistence may be low.

Because our subjects were clinically referred these findings may not generalize to community samples. Because our sample was Caucasian, our findings may not generalize to other ethnic groups. Our sample was male, so additional research should be done to determine if females with ADHD have similar patterns of persistence and associated impairments. Because our sample was originally ascertained according to DSM-III-R criteria, it is possible that our results may not generalize to samples ascertained by DSM-IV criteria. However, considering the very high degree of overlap between the two definitions (93% of DSM-III-R cases received a DSM-IV diagnosis (Biederman et al., 1997)) and our use of DSM-IV criteria in our follow-up assessment, any effect on these results should be minimal. Our figure showing the age-specific prevalence of the persistence of ADHD suggests that ADHD may continue to remit after ages 25–30 years. Longer follow-up studies should be conducted to answer this question. Also, because we did not manipulate treatment as an independent variable, we cannot use our study to determine treatment effectiveness (Faraone et al., 1992) nor to describe the untreated course of ADHD. For some variables the data were quite sparse and comparisons were underpowered.

Despite these considerations, this 10-year follow-up shows that many boys with ADHD experience persistent symptoms and functional impairment into early adulthood. These findings support the conclusion that a minority of children with ADHD attain complete remission and further highlight the importance of attending to residual ADHD symptoms in evaluating patterns of persistence of ADHD children growing up. Due to the heterogeneous nature of ADHD and its associated impairments over time, it is recommended that adults with histories of childhood ADHD be re-evaluated to assess evolving symptoms and develop appropriate treatments.

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Figure 1.

Age-specific prevalence of persistence of ADHD at the 10-year follow-up by definition of persistence and symptom type (N=103). The prevalence of persistence varied considerably depending on the definition used. Persistence significantly decreased with age for ADHD and inattentive symptoms but not hyperactive/impulsive symptoms.

Table 1

One-year prevalence of comorbid disorders at 10-year follow-up

Psychiatric disorder	Persistent ADHD (N=86)		Remittent ADHD (N=24)		Controls (N=105)		Test statistic	p-value
	N (%)		N (%)		N (%)			
Oppositional defiant disorder	35 (41) <i>a***b*</i>		2 (9)		7 (7)		$\chi^2_{(2)}=26.07$	<0.001
Conduct disorder/antisocial personality disorder	24 (28) <i>a***b*</i>		0 (0)		5 (5)		Exact	0.01
Major depressive disorder	11 (13)		0 (0)		4 (4)		Exact	0.08
Bipolar disorder	12 (14) <i>a**</i>		0 (0)		2 (2)		Exact	0.002
Multiple (≥ 2) anxiety disorder	10 (12) <i>a*</i>		0 (0)		3 (3)		Exact	0.03
Psychoactive substance use disorder	41 (48) <i>a*b**</i>		2 (8) <i>a*</i>		32 (30)		$\chi^2_{(2)}=10.19$	0.006
Smoking	33 (38) <i>a***</i>		4 (17)		15 (15)		$\chi^2_{(2)}=16.38$	<0.001

a =vs. Controls,*b* =vs. Remittent ADHD;* $p \leq 0.05$,** $p \leq 0.01$,*** $p \leq 0.001$

Table 2

Positive family history of psychiatric disorders

Family history	Persistent ADHD (N=86)		Remittent ADHD (N=24)		Controls (N=105)	Test statistic	p-value
	N (%)		N (%)		N (%)		
ADHD	47 (55) ^{a****}		9 (38) ^{a*}		19 (18)	$\chi^2_{(2)}=25.01$	<0.001
Mood disorder	43 (50) ^{a**p*}		7 (29)		32 (30)	$\chi^2_{(2)}=11.25$	0.004
Multiple (≥ 2) anxiety disorder	53 (62) ^{a**}		15 (62)		42 (40)	$\chi^2_{(2)}=10.19$	0.006
Conduct disorder/antisocial personality disorder	37 (43) ^{a**}		8 (33)		27 (26)	$\chi^2_{(2)}=8.23$	0.02
Alcohol/drug dependence	49 (57) ^{a**}		12 (50)		40 (38)	$\chi^2_{(2)}=8.59$	0.01

^a =vs. Controls,^b =vs. Remittent ADHD;* $p \leq 0.05$,** $p \leq 0.01$,*** $p \leq 0.001$

Table 3

Functional outcomes at the 10-year follow-up

	Persistent ADHD (N=86)		Remittent ADHD (N=24)		Controls (N=105)	Test statistic	p-value
	N (%)		N (%)				
School Functioning							
Repeated grade	39 (45) <i>a***</i>		9 (38) <i>a*</i>		19 (18)	$\chi^2_{(2)}=18.31$	<0.001
Special class	48 (56) <i>a***b*</i>		5 (21) <i>a**</i>		2 (2)	$\chi^2_{(2)}=35.84$	<0.001
Tutoring	83 (97) <i>a***</i>		21 (88) <i>a***</i>		48 (46)	$\chi^2_{(2)}=39.04$	<0.001
Detention [^]	26 (55) <i>a***b*</i>		4 (29)		11 (15)	$\chi^2_{(2)}=19.35$	<0.001
Suspension [^]	28 (57) <i>a***</i>		5 (38)		12 (17)	$\chi^2_{(2)}=17.23$	<0.001
Expulsion [^]	5 (12) <i>a**</i>		2 (14)		0 (0)	Exact	<0.001
Graduated high school ^{^†}	30 (88) <i>a***</i>		14 (100)		55 (100)	Exact	0.02
Legal, Driving, Sexual History							
Ever arrested [^]	18 (34) <i>a***</i>		4 (29)		11 (15)	$\chi^2_{(2)}=9.68$	0.008
Ever convicted [^]	7 (14) <i>a**</i>		1 (7)		1 (1)	$\chi^2_{(2)}=7.56$	0.02
3 or more car accidents [^]	10 (22)		3 (25)		7 (10)	$\chi^2_{(2)}=5.61$	0.06
Intercourse before age 16 ^{^#}	19 (56) <i>a***</i>		1 (12)		9 (17)	$\chi^2_{(2)}=13.46$	0.001

^a =vs. Controls,^b =vs. Remittent ADHD;* $p \leq 0.05$,** $p \leq 0.01$,*** $p \leq 0.001$ [^] Missing data (Persistent ADHD, N=59; Remittent ADHD, N=16; Controls, N=80)[†] Limited to subjects over 18 years of age[#] Limited to subjects who have had intercourse