Attention-Deficit/Hyperactivity Disorder in Adults: An Overview

Stephen V. Faraone, Joseph Biederman, Thomas Spencer, Tim Wilens, Larry J. Seidman, Eric Mick, and Alysa E. Doyle

To assess the validity of adult attention-deficit/hyperactivity disorder (ADHD), we reviewed clinical, family, psychopharmacologic, neurobiological, and outcome studies. We found multiple reports describing adults with clinical features highly reminiscent of the childhood ADHD. These adults, who are impulsive, inattentive, and restless, have the clinical “look and feel” of ADHD children. As with their childhood counterparts, many adults with ADHD suffer from antisocial, depressive, and anxiety disorders. They also show clinically significant impairments—histories of school failure, occupational problems, and traffic accidents. Studies of biological features show correspondences between child and adult cases of ADHD. Both show familial aggregation and a characteristic profile of neuropsychologic deficits; an emerging neuroimaging literature suggests that abnormalities in the same brain regions underlie both the child and adult forms of the disorder. Although these converging lines of evidence support the validity of ADHD in adults, follow-up studies of ADHD children have yielded ambiguous results. This ambiguity is in part due to differences in how researchers define the persistence of ADHD, a problem that suggests future research focus on how best to diagnose ADHD in adulthood.


Key Words: Attention-deficit/hyperactivity disorder, diagnostic validity, developmental psychopathology

Introduction

Some researchers have asserted that because ADHD usually remits in adulthood (Hill and Schoener 1996), adult ADHD should be rare and of little concern to the practicing clinician. Others have claimed many cases of ADHD persist into adulthood (Barkley 1997; Faraone, in press; Spencer et al 1994b). They stress the diagnostic continuity of ADHD throughout the life span and assert that clinically referred adults have the same syndrome that has been so well validated in pediatric cases. To be clear, this debate addresses the diagnosis of retrospectively diagnosed childhood onset ADHD, when the childhood diagnosis has been made through retrospective accounts and the current presentation shows a continuation of the syndrome into adulthood. Proponents of ADHD as a valid adult diagnosis do not suggest that ADHD arises de novo in adulthood.

Resolving the debate about adult ADHD will benefit both clinicians and researchers. If the diagnostic continuity of child and adult ADHD can be established, clinicians will have a foundation for generalizing the vast pediatric ADHD research literature to adult patients. Because effective treatment plans presuppose accurate diagnoses, clinicians need to know if adults who present with what appears to be childhood onset ADHD truly have the disorder. Diagnostic accuracy is paramount for all disorders, but it is even more important for ADHD, which is frequently accompanied by substance abuse and usually treated with stimulants.

Clarifying diagnostic continuity will also allow a generalization of research results from adults to children. This direction of generalization is especially important for research that may be considered acceptable in adults but premature or unethical in children. Examples include functional imaging with radioactive isotopes and the testing of new drugs. In the latter case, having a valid diagnosis of adult ADHD would allow researchers to show efficacy in adults and then use that information to justify trials in children.

This article addresses the validity of adult ADHD using the validity criteria of Robins and Guze (1970). In their view, the validity of any psychiatric disorder derives not from a single study, but from a pattern of consistent data. For psychiatric disorders, standard validation criteria include clinical correlates, family history, treatment response, laboratory studies, course, and outcome.

Clinical Correlates

The DSM-IV recognizes three subtypes of ADHD: a predominantly inattentive subtype, a predominantly hyper-
active-impulsive subtype, and a combined subtype (American Psychiatric Association 1994). These categories acknowledge clinical heterogeneity and reflect a change in emphasis from earlier definitions that stressed motoric symptoms to the current nosology, which emphasizes deficits in the regulation of cognitive function. These changes have particular relevance to adult ADHD because hyperactive symptoms diminish at a greater rate than do inattentive symptoms (Biederman et al 2000). As in children, some adults with a predominantly inattentive subtype who were previously not diagnosed are now given full diagnostic status. Because this is a relatively new change, much of the extant literature on adult ADHD employed the older definition and reflects what would now be called combined type ADHD.

Studies of adult ADHD have clearly documented the syndrome of inattention, impulsivity, and hyperactivity that are the defining features of the disorder at any age. Downey et al (1997), for example, documented these core features of ADHD among patients attending an adult ADHD clinic. Notably, they found a high correlation between the patients’ rating of ADHD symptoms and those made by independent observers, which suggests that the patients were validly reporting the nature of their symptoms.

In a family study of children with ADHD, Biederman et al (1990) examined the nonreferred adult relatives of ADHD children. Among the relatives meeting criteria for childhood-onset ADHD, more than two thirds reported current levels of ADHD symptoms within the severe range found in clinically referred children. Other studies have documented the defining feature of ADHD in referred adults (Biederman et al 1993; Millstein et al 1997), surveys of college students (Heiligenstein et al 1998, 1999; Heiligenstein and Keeling 1995), participants in treatment protocols (Spencer et al 1995), and surveys of adults (Murphy and Barkley 1996a).

Because there is a general consensus that the defining features of ADHD occur among adults, it is worthwhile to ask if ADHD seen in adults is associated with other features of childhood ADHD which, although not diagnostic, commonly accompany the disorder. We here focus on two such features: the characteristic pattern of psychiatric comorbidity seen in juvenile ADHD and the clinically significant impairments that warrant treatment of ADHD symptoms.

Do ADHD Adults Show Psychiatric Comorbidity?

Both clinical and epidemiologic studies show that, among children, ADHD frequently co-occurs with antisocial, mood, and anxiety disorders (Biederman et al 1991). Similar findings have been seen in studies of adult ADHD. Borland and Heckman (1976) reported high rates of antisocial personality, anxiety, depressive, and substance use disorders among adults with adult ADHD. Morrison et al (1980a, 1980b) showed that, compared with psychiatric control subjects, outpatient ADHD adults had higher rates of antisocial personality disorder.

Biederman et al (1993) studied 84 clinically referred ADHD adults, 140 ADHD children, 43 nonreferred ADHD adult relatives of those ADHD children, and 248 adult relatives of normal control children. The two ADHD adult groups did not differ significantly in rates of comorbid psychiatric disorders. Compared with control subjects, ADHD adults had significantly higher rates of antisocial personality, substance use disorders, anxiety disorders, enuresis, stuttering, and speech and language disorders. In an expanded sample, Biederman et al (1994) used gender-stratified analyses to show that ADHD adults of both genders had significantly higher lifetime rates of major depression, oppositional disorder, drug dependence, agoraphobia, and social phobia.

Subsequent studies have consistently shown ADHD adults to have elevated rates of antisocial and substance use disorders (Downey et al 1997; Heiligenstein et al 1999; Murphy and Barkley 1996b) and anxiety and mood disorders (Downey et al 1997; Heiligenstein et al 1999; Shekim et al 1990), whereas others have not shown such comorbidity (Murphy and Barkley 1996b).

Although high levels of psychiatric comorbidity in ADHD adults mirror findings in ADHD children, these data provide ambiguous support for the validity of adult ADHD. It is possible that comorbid disorders mimic core ADHD symptoms, leading to false positive diagnoses. If so, childhood ADHD may be a precursor to other disorders, not adult ADHD. Nonetheless, two findings speak against this idea. First, the disorders, which co-occur with ADHD, do not routinely lead to ADHD. For example, although depression is seen in many ADHD adults, Alpert et al (1996) found that only 12% of 116 depressed adults met criteria for ADHD. Second, in the studies reviewed above, psychiatric comorbidity was not found in a substantial number of ADHD adults. For example, in the study by Biederman et al (1993), 23% of the adults with ADHD had no adult psychiatric disorder yet met full DSM-III-R criteria for ADHD in childhood and had the characteristic symptoms of inattentiveness, distractibility, and impulsivity associated with ADHD. Compared with normal control adults, the condition of uncomplicated ADHD was also associated with significant impairment, consistent with the status of being a meaningful psychiatric disorder. These impairments were evidenced by poorer functioning on the Global Assessment of Functioning Scale and poorer cognitive performance, as
indicated by histories of school failure and impaired performance on neuropsychologic measures.

Is Adult ADHD Clinically Significant?

If adult ADHD is a clinically significant disorder, then ADHD adults should show functional impairments in multiple domains. Several studies suggest this is so. In an early study, Borland and Heckman (1976) compared ADHD adults with their non-ADHD siblings. The ADHD adults had lower socioeconomic status, more work difficulties, and more frequent job changes. Morrison et al (1980a, 1980b) compared ADHD adults with psychiatric control adults matched for age and gender. The ADHD adults had fewer years of education and lower rates of professional employment. Similarly, other researchers have shown that among patients with substance use disorders, ADHD predicts social maladjustment, immaturity, fewer social assets, lower occupational achievement, and high rates of separation and divorce (Alterman et al 1982; De Oballa and Parsons 1984; Eyre et al 1982; Tarter 1982; Wilens et al 1998). Murphy and Barkley (1996b) compared 172 ADHD adults with 30 non-ADHD adults. The ADHD adults reported more psychologic maladjustment, more speeding violations, and more frequent changes in employment. Compared with the non-ADHD adults, more ADHD adults had had their drivers license suspended, had performed poorly at work, and had quit or been fired from their job. Moreover, the ADHD adults were more likely to have had multiple marriages. Barkley et al (1996a) evaluated the motor vehicle driving knowledge, skills, and negative driving outcomes of older teens and young adults with ADHD. The ADHD young adults showed no deficits in driving knowledge, yet compared with control subjects, they had elevated rates of speeding citations, suspended licenses, crashes, and crashes causing bodily injury. They were more likely to be rated by themselves and others as having poorer driving habits. In addition, a computer-simulated driving test showed the young adults with ADHD to have more crashes, scrapes, and erratic steering.

Given that academic underachievement is a well-known correlate of ADHD in childhood (Hinshaw 1992), ADHD adults ought to have histories reflecting school problems. Several studies have shown this to be so. Biederman et al (1993; 1994) showed that compared with control adults, ADHD adults had significantly higher rates of repeated grades, tutoring, placement in special classes, and reading disability. Similarly, Murphy and Barkley (1996b) showed that ADHD adults had histories marked by poorer educational performance and more frequent school disciplinary actions against them. Notably, in addition to showing an increased likelihood of having a history of school failure, Seidman et al (1998) showed that this could not be accounted for by age, learning disabilities, psychiatric comorbidity, or gender.

Some data suggest that the school problems faced by ADHD children and adolescents continue into the college years. Heiligenstein and Keeling (1995) studied 42 college students with ADHD. Presenting problems included learning disability and academic underachievement. In another college-based study, Heiligenstein et al (1999) showed that ADHD students had lower mean grade point averages, were more likely to have been on academic probation, and had more academic problems.

In summary, the clinical features of ADHD in adults correspond to those seen in ADHD children, but one area of discrepancy between adult and juvenile samples of ADHD is the differing proportion of male to female diagnoses. Juveniles with ADHD are more likely to be boys than girls (Gaub and Carlson 1997), but this gender differential is less pronounced in adult ADHD samples (Gualtieri et al 1985; Mattes et al 1984; Wender et al 1985; Wood et al 1976). One explanation for this discrepancy is that compared with ADHD boys, ADHD girls are less likely to be severely conduct disordered and hence are less likely to be clinically referred (Gaub and Carlson 1997). It is possible that such referral biases are less salient for adults who, unlike children, can refer themselves for treatment.

A second area of discrepancy between child and adult ADHD is in the rates of substance use disorders. Despite the increased rates of substance use disorders in ADHD adults, several studies did not find significantly increased rates of substance use among ADHD adolescents (August et al 1983; Biederman et al 1997; Gittelman et al 1985). This discrepancy is in part due to the natural course of substance use, which increases in adulthood. In fact, one report shows that, although ADHD adults have increased rates of substance use in adulthood, their retrospective reports suggested they did not have increased rates in adolescence (Biederman et al 1995). Another consideration is that many clinically referred ADHD adults had not had treatment during childhood and adolescence. One longitudinal study shows that ADHD subjects who did not receive pharmacologic treatment were at a significantly increased risk for substance use, which suggests that medication status affects the link between ADHD and substance use (Biederman et al 1999).

Family History

Because genes affect one’s susceptibility to ADHD (Faraone and Biederman 1999), family studies provide a method of assessing the validity of adult ADHD. If ADHD persists into adulthood, then the parents of ADHD children
and the children of ADHD adults should show an increased risk for ADHD. Many case-control family studies show that the former prediction is true. The parents of ADHD children are more likely to have ADHD than are the parents of non-ADHD children (Faraone and Biederman 1994).

In contrast to the many family studies of ADHD in childhood, there are only two small family studies of adult ADHD. Both of these produced the same intriguing result: the risk of ADHD among children of ADHD adults was much higher than the risk for ADHD among relatives of children with ADHD (Biederman et al 1995; Manshadi et al 1983). In the study by Manshadi et al (1983), 41% of the siblings of the adult ADHD probands were diagnosed with ADHD compared with no siblings of non-ADHD control subjects. Similarly, Biederman et al (1995) found a 57% prevalence of ADHD among children of ADHD adults, which was much higher than the 15% prevalence of ADHD among siblings of ADHD children.

The high familial loading of adult ADHD suggests that genes (or other familial risk factors) may play a smaller role in the etiology of remitting ADHD than they do for persistent ADHD. This idea has been tested in two ways. A prospective study examined 140 ADHD boys and 120 non-ADHD boys at a baseline assessment and completed a 4-year follow-up study. By midadolescence, 85% of the ADHD boys continued to have the disorder. The prevalence of ADHD was significantly higher among the relatives of persistent ADHD probands compared with relatives of remitted ADHD probands (Biederman et al 1996). Parents of persistent ADHD probands were 20 times more likely to have ADHD than were parents of control subjects, whereas parents of nonpersistent ADHD probands showed only a fivefold increased risk. Similarly, siblings of persistent ADHD probands were 17 times more likely to have ADHD than were siblings of control subjects, whereas siblings of nonpersistent ADHD probands showed only a fourfold increased risk (Faraone et al 2000). A retrospective study compared ADHD adolescents having retrospectively reported childhood onset ADHD with ADHD children. The relatives of adolescent probands had higher rates of ADHD compared with the relatives of child probands (Biederman et al 1998). Taken together, these data suggest that, when ADHD persists into adolescence and adulthood, it is highly familial. This work suggests that future studies attempt to determine if there are clinically meaningful differences in childhood between ADHD patients who continue to be symptomatic in adulthood and those who go into remission.

A potential confound clouds the interpretation of family studies of adult ADHD. The parents of ADHD children are usually aware of the ADHD symptoms in their child. That knowledge may bias them to report ADHD symptoms in themselves. If so, then the rates of ADHD among adult relatives of ADHD children would be spuriously high. To test this idea, Faraone et al (1997) compared the prevalence of symptoms between 26 ADHD adults who had ADHD children and 49 ADHD adults who did not. Because the sensitivity of individual symptoms was nearly identical between groups, the authors concluded that adults with ADHD children are not biased to overreport the symptoms of ADHD in themselves.

### Treatment Response

An overwhelming amount of data from close to 200 controlled clinical trials unequivocally documents the efficacy of stimulant medications in the treatment of children and adolescents with ADHD (Spencer et al 1996). Because approximately 70% of ADHD children show a therapeutic response to stimulant medication, some researchers have looked to studies of stimulant drugs in adult ADHD in the hope that a clear-cut response to stimulant medication would clarify the validity of adult ADHD.

Four initial studies examined a total of 137 adult ADHD patients (Gualtieri et al 1985; Mattes et al 1984; Wender et al 1985; Wood et al 1976). They found an average response rate of 50%, substantially less than the 70% response rate seen for ADHD children. Spencer et al (1995) hypothesized that the lower response rate in adults was due to insufficient dosing. They noted that the mean daily weight-corrected dose of methylphenidate in these studies of adult ADHD patients was 0.6 mg/kg per day, which was much lower than the 1.0 mg/kg per day commonly used in the treatment of ADHD children (Wilens and Biederman 1992). To test this hypothesis, Spencer et al (1995) completed a double-blind, placebo-controlled study of methylphenidate for adult ADHD that achieved an average daily dose of 1.0 mg/kg. The response rate of the stimulant-treated patients (74%) was similar to that seen among ADHD children and was significantly greater than the 4% rate seen for placebo. Methylphenidate has also been shown to be effective for adult cocaine abusers who have ADHD (Levin et al 1998). Equally consistent with the pediatric literature, trials of two other stimulants, the mixed amphetamine compound Adderall (Spencer et al 1999) and magnesium pemoline (Heiligenstein et al 1996; Wilens et al 1999), document a similar separation from placebo in adults with ADHD as has been seen in pediatric studies.

In addition to stimulant drugs, the tricyclic antidepressants also have documented anti-ADHD properties in children (Spencer et al 1994a). Case reports first suggested that the tricyclic antidepressant desipramine (DMI) was efficacious for adults with ADHD (Ratey et al 1992).
Then, in a retrospective study of 25 referred ADHD adults treated with DMI, 68% of patients showed a moderate response at mean doses of 180 mg daily (Wilens et al 1995). These data led Wilens et al (1996) to conduct a randomized, 6-week, placebo-controlled study of DMI at a target daily dose of 200 mg in 41 adult patients with DSM-III-R ADHD. They found significant reductions of ADHD symptoms in DMI-treated patients compared with placebo-treated patients. Using predefined criteria for response, 68% of DMI-treated subjects and no placebo-treated subjects were positive responders. This response rate was identical to that previously documented for pediatric ADHD using an identical design (Biederman et al 1989). Response to DMI was independent of dose, level, gender, or lifetime psychiatric comorbidity with anxiety or depressive disorders. In addition to DMI, another noradrenergic-specific compound, tomoxetine, also separated from placebo in a pilot-controlled study of adults with ADHD (Spencer et al 1998). Taken together, these studies in adults show that medications with documented anti-ADHD activity in pediatric ADHD also work equally well in adults with ADHD, providing further evidence for the syndromic continuity between the juvenile and adult diagnoses.

Laboratory Studies

Although there is no laboratory test of ADHD for either children or adults, laboratory measures provide useful clues about the etiology of adult ADHD and its validity as an outcome of the childhood disorder. This section examines three laboratory approaches that have been applied to adult ADHD: molecular genetics, neuropsychologic assessment, and neuroimaging.

Molecular Genetic Studies

Molecular genetics is providing new laboratory-based methods to examine ADHD. Studies of children have already found evidence for the involvement of several genes in the etiology of ADHD: the D2 dopamine receptor gene, the dopamine-beta-hydroxylase gene, the dopamine transporter (DAT) gene, and the D4 dopamine receptor gene (Faraone and Biederman 1999). The data for the D4 receptor are especially compelling because the gene variant associated with ADHD is known to mediate a blunted response to the neurotransmitter dopamine, which is one of the hypothesized causes of ADHD (Asghari et al 1995). Notably, Faraone et al (1999) showed that this variant of the D4 gene is also associated with ADHD in families ascertained through ADHD adults.

Neuropsychologic Studies

ADHD children and adolescents show impaired performance on tasks assessing vigilance, motoric inhibition, executive functions (such as organization, planning, and complex problem solving), and verbal learning and memory (Barkley et al 1992; Seidman et al 1997). Several studies suggest that these problems are also seen among ADHD adults. Notably, neuropsychologic studies have consistently found ADHD adults to be impaired on measures of vigilance using the continuous performance test (Barkley et al 1996b; Buchsbaum et al 1985; Downey et al 1997; Gansler et al 1998; Gualtieri et al 1985; Holdnack et al 1995; Klee et al 1986; Seidman et al 1998). These studies also have shown ADHD adults to be impaired in other functions known to affect ADHD children. These include perceptual-motor speed as assessed by the digit symbol and coding tests (Buchsbaum et al 1985; Gualtieri et al 1985; Holdnack et al 1995; Klee et al 1986; Silverstein et al 1995); working memory as assessed by digit span tests (Barkley et al 1996b; Holdnack et al 1995; Kovner et al 1998); verbal learning, especially semantic clustering (Downey et al 1997; Holdnack et al 1995; Katz et al 1998; Seidman et al 1998); and response inhibition as assessed by the Stroop Color-Word Test (Katz et al 1998; Lovejoy et al 1999; Taylor and Miller 1997).

For example, Holdnack et al (1995) reported that ADHD adults exhibited significantly slower reaction time to stimuli in the continuous performance task (a measure of vigilance). The ADHD adults also showed slower psychomotor speed and worse scores on the California Verbal Learning Test (CVLT). Downey et al (1997) examined a cohort of patients attending an adult ADHD clinic. These patients were impaired on the CVLT and on several measures of attention. Seidman et al (1998) compared 64 unmedicated ADHD adults with 73 non-ADHD control subjects. Compared with control subjects, adults with ADHD were significantly impaired on measures of vigilance, semantic encoding for CVLT verbal memory, and written arithmetic. Age, learning disabilities, psychiatric comorbidity, and gender could not account for these impairments.

Neuroimaging Studies

It is difficult to compare the results of neuroimaging studies of juvenile and adult ADHD; whereas nearly all the juvenile studies have used structural imaging, all of the adult ADHD studies have used functional imaging. Structural neuroimaging studies of ADHD juveniles suggest that circuitry involving prefrontal cortex, the striatum, cerebellum, and the corpus callosum are altered in ADHD (Castellanos 1997).

The functional neuroimaging studies of adult ADHD
have primarily implicated frontal brain regions. In a positron emission tomography (PET) study of adult ADHD, Zametkin et al (1990) found reduced global and regional glucose metabolism in the premotor cortex and the superior prefrontal cortex. Although these findings were not fully replicated in a similar PET study of adolescents (Zametkin et al 1993), which used siblings of ADHD children as control subjects, they are consistent with brain single photon emission computed tomography (SPECT) imaging in ADHD adolescents (Amen et al 1993).

Ernst et al (1998) used PET with F18-DOPA to compare 17 ADHD adults and 23 healthy control adults. They used the ratio of the isotope concentration of specific regions to that of nonspecific regions to index DOPA decarboxylase activity and dopamine storage processes. Of three composite regions (prefrontal cortex, striatum, and midbrain), only the prefrontal cortex showed significantly lower F18-DOPA ratios in ADHD adults compared with control adults. The medial and left prefrontal areas were the most altered.

Anterior cingulate cortex (ACC), lying on the medial surface of the frontal lobe, has strong connections to dorsolateral prefrontal cortex. Bush et al (1999) used a Stroop task to compare ACC activation in ADHD and non-ADHD adults. In contrast to control subjects, the ADHD adults failed to activate the ACC. Notably, in the prior study by Zametkin et al (1990), cingulate cortex was one of only four (out of 60) regions evaluated that still showed regional hypoactivity after global normalization.

Because the stimulant medications are the treatment of choice for ADHD, several studies of ADHD adults examined changes in brain metabolism due to stimulant administration. They have not, however, produced consistent results (Ernst et al 1994; Matochik et al 1994; Matochik et al 1993). One study has used SPECT to assess dopamine transporter (DAT) activity and dopamine storage processes. Of three composite regions (prefrontal cortex, striatum, and midbrain), only the prefrontal cortex showed significantly lower F18-DOPA ratios in ADHD adults compared with control adults. The medial and left prefrontal areas were the most altered.

In summary, the available data suggest that ADHD adults show frontal dopaminergic hypoactivity. In contrast, studies of adolescents show weaker results. Ernst et al (1998) offered two explanations of the differences between the adolescent and adult data. First, the adolescent samples studied may have been more heterogeneous than the adult samples. Whereas all of the adults had persistent ADHD, some of the adolescent cases might have remitted by adulthood. Thus, frontal dopaminergic hypoactivity may be associated with persistent ADHD only. Alternatively, Ernst et al (1998) speculated that, because of brain maturation, the locus of ADHD’s dopamine abnormality might shift from the midbrain in childhood to the prefrontal cortex in adults.

Course and Outcome

Do ADHD children grow up to become ADHD adults? If adult ADHD is a valid disorder, then follow-up studies of ADHD children should show that they grow up to become ADHD adults and that their persistence of ADHD symptoms exceeds that seen in an appropriate control group. Prospective follow-up studies are not clouded by the ambiguities of retrospective reports. Thus, they are an essential for validating the adult ADHD diagnosis. If prospective studies do not find ADHD persisting into adulthood, then the ADHD diagnoses given to clinically referred adults would be suspect.

The idea that ADHD remits by adulthood was given credibility by Hill and Schoener (1996), who fit a mathematical model to the rates of persistence reported by studies following ADHD children from childhood into adolescence or adulthood. Their model predicted an exponential decline in the rate of ADHD. It suggested that 99% of ADHD children would go into remission by the age of 20. Because the prevalence of ADHD in childhood is between 5 and 10%, their results predict that the prevalence of ADHD in adulthood should range from 5 to 10 per 10,000 adults. Their paper, which concluded that ADHD essentially disappears in adulthood, generated some controversy because of some of its methodological features (Barkley 1997) and for its inconsistency with clinical studies suggesting adult ADHD to have a nonnegligible prevalence.

One problem with Hill and Schoener’s paper is that they only included studies that defined subjects as having persistent ADHD if they met full criteria for the disorder. This method counts as “remitted” former ADHD children who continue to have impairing symptoms despite failing to meet all diagnostic criteria (cases that DSM-IV would code as ADHD in partial remission). Thus, Hill and Schoener studied what Keck et al (1998) called syndromatic persistence (i.e., the maintenance of full diagnostic status). They did not address symptomatic persistence (i.e., the maintenance of partial diagnostic status with impairment).

Although studies of syndromatic persistence are useful for understanding the natural history of a disorder, we also need studies of symptomatic persistence to fully understand the prognosis of a disorder. For example, if follow-up studies of schizophrenia had only reported rates of syndromatic persistence, the prognosis of schizophrenia
Adult ADHD: An Overview

Summary and Future Directions

This article has examined the validity of adult ADHD using the validity criteria of Robins and Guze (1970); clinical correlates, family history, treatment response, laboratory studies, course, and outcome. Table 1 summarizes our review by giving each domain of study a score: ++ means that results strongly support the validity of adult ADHD, + means that results support the validity of adult ADHD, ? means that results are equivocal, − means that results do not support the validity of adult ADHD, and −− means that results strongly argue against the validity of adult ADHD. As the table indicates, no domain was rated −− or −−−, four were rated ++, five were rated +, and two were rated ?. The predominance of positive findings suggests that adult ADHD is a valid disorder, but because all areas are not strongly supportive, more work is needed to clarify this issue.

The clinical correlates of ADHD are similar for children and adults. ADHD adults are impulsive, inattentive, and restless. They have the clinical “look and feel” of ADHD children. Furthermore, like their childhood counterparts, many adults with ADHD suffer from antisocial, depressive, and anxiety disorders and show evidence of clinically significant impairments in histories of school failure, occupational problems, and traffic accidents. Treatment response studies show that the medications used to treat childhood ADHD are equally effective for adult ADHD.

Family studies provide strong support for the validity of adult ADHD. As the table indicates, no domain was rated −− or −−−, four were rated ++, five were rated +, and two were rated ?. The predominance of positive findings suggests that adult ADHD is a valid disorder, but because all areas are not strongly supportive, more work is needed to clarify this issue.

The clinical correlates of ADHD are similar for children and adults. ADHD adults are impulsive, inattentive, and restless. They have the clinical “look and feel” of ADHD children. Furthermore, like their childhood counterparts, many adults with ADHD suffer from antisocial, depressive, and anxiety disorders and show evidence of clinically significant impairments in histories of school failure, occupational problems, and traffic accidents. Treatment response studies show that the medications used to treat childhood ADHD are equally effective for adult ADHD.

Family studies provide strong support for the validity of adult ADHD: adult relatives of ADHD children are at increased risk for ADHD as are the child relatives of ADHD adults. Both childhood and adult ADHD show a characteristic profile of neuropsychologic deficits. Moreover, an emerging neuroimaging literature implicates prefrontal dopaminergic hypoactivity in adult ADHD. Al-

would seem much better than we know it to be from studies of symptomatic persistence.

Two prior studies suggest that studies of syndromatic persistence may underestimate the persistence of ADHD. Fischer (1997) observed 148 hyperactive children for 15 years. At a mean age of 21, self-reports from these subjects found only 3% meeting criteria for DSM-III-R ADHD. When Fischer used a psychometric criterion to define ADHD (symptoms exceeding the 93rd percentile of severity of the control group), 25% met criteria for ADHD. The clinical meaningfulness of the persistent ADHD symptoms was confirmed by parent reports suggesting that 42% of the grown-up ADHD children still met criteria for the disorder.

In a longitudinal study of ADHD boys, Biederman et al (2000) found that by age 19, 38% of children had the full ADHD diagnosis, 72% showed persistence of at least one third of the symptoms required for the diagnosis, and 90% showed evidence of clinically significant impairment. Consistent with these studies, other follow-up studies show that the persistence of ADHD into adulthood ranges from 4% to 80%, depending on the length of follow-up and the definition of persistence (Barkley 1998).

Arguing against the idea that ADHD disappears in adulthood is a report by Murphy and Barkley (1996a), using self-report rating scales to diagnose ADHD in 720 adults applying for drivers licenses. In this sample, 4.7% of adults met DSM-IV criteria for childhood onset ADHD. Similarly, Heiligenstein et al (1998) examined ADHD diagnoses and symptom scores among 448 college students not selected for any psychiatric diagnosis. Of these students, 4% met DSM-IV criteria for ADHD. Notably, these two studies agree with family studies that have examined the prevalence of ADHD among the parents of non-ADHD children. When examined together, these studies show that 7.5% of fathers and 3% of mothers of non-ADHD children have childhood-onset ADHD (Faraone and Biederman 1999).

### Table 1. Summary of Evidence for the Validity of Adult Attention-Deficit/Hyperactivity Disorder (ADHD)

<table>
<thead>
<tr>
<th>Domain</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADHD symptoms</td>
<td>++</td>
<td>Adults show core symptoms of inattention, impulsivity, and hyperactivity, but hyperactivity may diminish with age</td>
</tr>
<tr>
<td>Psychiatric comorbidity</td>
<td>+</td>
<td>Substance use disorder is more common among adults</td>
</tr>
<tr>
<td>Impairment</td>
<td>++</td>
<td>ADHD adults show functional impairments in multiple domains</td>
</tr>
<tr>
<td>Gender difference</td>
<td>+</td>
<td>Greater male prevalence of ADHD is less evident for adults than for children</td>
</tr>
<tr>
<td>Family history of ADHD</td>
<td>+</td>
<td>ADHD appears to be more familial when there is an affected adult in the family</td>
</tr>
<tr>
<td>Treatment response</td>
<td>++</td>
<td>Medications with documented anti-ADHD activity in children work equally well in adults</td>
</tr>
<tr>
<td>Molecular genetics</td>
<td>+</td>
<td>The D4 dopamine receptor gene has been implicated in both child and adult ADHD</td>
</tr>
<tr>
<td>Neuropsychology</td>
<td>++</td>
<td>ADHD children and adults show impaired vigilance, motoric inhibition, executive functions, and verbal learning and memory</td>
</tr>
<tr>
<td>Neuroimaging</td>
<td>?</td>
<td>Not enough comparable data between children and adults</td>
</tr>
<tr>
<td>Course and outcome</td>
<td>?</td>
<td>The persistence of ADHD into adulthood ranges from 4% to 80%, depending on the definition of persistence</td>
</tr>
</tbody>
</table>

++ results strongly support the validity of adult ADHD; + results support the validity of adult ADHD; ?, results are equivocal.
though this is consistent with the putative role of dopamine in the etiology of ADHD (Faraone and Biederman 1998), much more work is needed to determine the evolution of ADHD’s dopamine abnormalities from childhood to adulthood.

These converging lines of evidence from studies of clinical correlates, family history, treatment response, and laboratory measures provide support for the validity of ADHD in adults. Nevertheless, some areas of ambiguity remain. The psychiatric comorbidity of ADHD adults raises questions about false positive diagnoses and divergent validity. Thus, we need follow-up studies of ADHD adults with comorbid disorders to determine if ADHD, the comorbid disorder, or both persist over time. We also need studies using psychiatric control subjects to determine if the clinical or neurobiological features of specific disorders vary between ADHD and non-ADHD adults.

Although false positive diagnoses are an issue for all disorders, the problem may be more acute for adult ADHD, given that many adult ADHD patients are self-diagnosed when the first seek clinical help. This situation occurs because adult ADHD has received much media attention. Thus, adults seeking to justify their life problems with a diagnostic label may be biased to see ADHD symptoms in themselves. Future research could address this issue by comparing self-referred cases of adult ADHD with cases that are diagnosed in adults who seek help without already thinking they have ADHD. Until this issue is resolved, however, clinicians should take extra care in assessing the childhood onset, chronicity, and impairment of ADHD symptoms in self-diagnosed referrals.

Given that follow-up studies of ADHD children have yielded ambiguous results, more work is also needed to evaluate the long-term outcome of ADHD children. These studies should determine the clinical and neurobiological features that differentiate cases of ADHD that persist into adulthood from those who go into remission. Because the ambiguity of follow-up studies is in part due to differences in how researchers have defined the persistence of ADHD, future work should focus on how best to diagnose ADHD in adults. Two diagnostic questions require further attention: 1) should the age at onset criterion of ADHD be modified? and 2) what type and number of symptoms should be required to define an adult as having ADHD?

Although DSM-IV requires ADHD to onset by age 7, recent papers have challenged the validity of this age-at-onset criterion (AOC). Barkley and Biederman (1997) noted that recall of age at onset had low reliability and that there was little empirical evidence for the AOC required by DSM-IV. The most comprehensive assessment of the AOC for ADHD was provided by the DSM-IV field trials (Applegate et al 1997), which showed that many subjects met symptom criteria for ADHD but did not satisfy the AOC. Requiring an AOC of 7 reduced the accuracy of identifying currently impaired cases of ADHD and also reduced agreement with clinician judgments. The authors concluded that further research should evaluate the value of the AOC for ADHD and identified three alternative strategies: 1) drop the AOC; 2) drop the requirement that symptoms at the AOC are impairing, and 3) keep the impairment criterion but raise the AOC. They also noted that a separate AOC rule for the inattentive subtype should be considered.

Unlike the AOC, the demarcation of symptom thresholds for defining ADHD received much empirical support from the DSM-IV Field trials through extensive psychometric studies (Lahey et al 1994). Lahey and colleagues’ careful validation of symptom thresholds in children justifies the use of DSM-IV criteria when documenting the childhood onset of ADHD in adults, but we know little about the validity of DSM-IV symptom thresholds for diagnosing the current status of ADHD in an adult meeting DSM-IV criteria for childhood onset ADHD. The authors of DSM-IV did recognize the existence of clinically meaningful cases of ADHD that do not meet full criteria. These cases are included in the category of ADHD “in partial remission,” reserved for “individuals (especially adolescents and adults) who currently have symptoms but no longer meet full criteria.” Although clinically sensible, this category has not been validated with empirical studies.

Thus, for adult ADHD, the question of appropriate diagnostic criteria is complex. It requires attention to the AOC and to the symptom threshold used to define caseness. These uncertainties in the diagnosis of adult ADHD highlight a more general issue for psychiatry—the developmental sensitivity of DSM-IV (Faraone, in press). DSM-IV accommodates developmental changes in the expression of ADHD in several ways. It cautions diagnosticians that, with maturation, symptoms become less conspicuous. Older children may be restless and fidgety but not overly hyperactive. With age, inattention may predominate as tasks at school require increasing levels of attention (Millstein et al 1997). The DSM only counts symptoms that are inconsistent with the patient’s developmental level. Although few would argue with this latter point, there is little normative data to guide clinicians about the degree to which ADHD symptoms in adults are not consistent with their developmental level.

The diagnosis of ADHD may be especially sensitive to developmental changes because the items that assess ADHD are performance based rather than experiential. Examples of developmentally appropriate performances required by the ADHD criteria are sitting still, waiting one’s turn, listening, not losing things, and so forth. By contrast, the diagnosis of depression is more experiential. We ask if the patient has experienced dysphoria, irritabil-
ity, loss of interest, insomnia, and so forth. The problem with performances that are difficult in childhood is that they are often easy in adulthood. Thus, developmental changes may make it more difficult for ADHD children to meet criteria for ADHD as they get older.

The performance-based diagnosis of ADHD is consistent with neuropsychologic models of ADHD that stress executive function impairment as a fundamental deficit in ADHD at all ages (Barkley and Biederman 1997; Pennington and Ozonoff 1996; Seidman et al. 1998). These deficits include impairments in working memory (verbal and nonverbal), self-regulation (affect, motivation, and arousal), and the ability to analyze behavior and synthesize novel responses. Barkley (1997) has written that a sense of time and flexible access to memory is required to analyze data of past consequences and to synthesize new patterns of behavior. These capacities allow an individual to move from reacting to immediate environmental concerns to pursue future, purposeful goals. Thus, executive function deficits are expected to lead to performance deficits, the nature of which will depend on the environmental challenges faced by the patient. The administrative and multitasking demands faced by adults are qualitatively different from those faced by children, who function in more structured family and school settings. As opposed to tasks in early childhood that predominately require simple responses to focused demands, the demands of adulthood require juggling of competing tasks, independence, organization, and planning. This suggests that future revisions of the DSM test a set of symptoms that are appropriate for the challenges faced by ADHD adults.

These considerations have led Barkley (1998) to suggest that ADHD be recast as a norm-referenced rather than a criterion-referenced diagnosis. From this perspective, we should deal with the diagnosis of ADHD as we do the construct of intelligence. We would not have adults complete the Wechsler Intelligence Scales for Children and then conclude that intelligence increases with age. Instead, we use different test batteries for different age groups and within a single battery; we consider a score high or low in reference to people of the same age. If this idea is correct, then the debate about adult ADHD will not be solved by a new slew of conflicting studies. Research needs to focus not only on the validity of the disorder, but also on the validity of the theoretic assumptions and empiric data that buttress the diagnosis.

References


