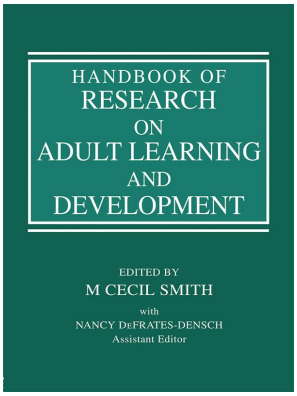

Handbook of Research on Adult Learning and Development

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Attention-Deficit/Hyperactivity Disorder in Adults

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Chapter 23

Attention-Deficit/Hyperactivity Disorder in Adults

Lisa L. Weyandt

It has been estimated that 8% to 10% of American children 3 to 17 years has a learning disability, 3% to 7% has Attention Deficit Hyperactivity Disorder (ADHD), and approximately 4% has both ADHD and a learning disability (American Psychiatric Association, *DSM-IV-TR*, 2000; Blackwell & Tonthat, 2002; Waldman & Perlman, 2004). Vogel and colleagues (1998) reported that the proportion of college students with a specific learning disability varied among universities from .5% to 10%. Recently cross-cultural studies have examined learning disabilities in adults from various countries and results have revealed differences in prevalence, type, manifestation, and treatment of learning disabilities in the adult population (e.g., Chapman, Tunmer, & Allen, 2003; Magajna, Kavkler, & Ortar-Krizaj, 2003; Vogel & Holt, 2003).

According to the definition put forth by the federal government in the Individuals with Disability Act (IDEA 1997, Public Law 105-17), the term "learning disability" means a "disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to think, listen, write, spell, or to do mathematical calculations." The term does not include learning problems due to hearing, vision, physical, motor, or emotional disorders. In other words, learning disabilities interfere with the cognitive processes necessary for learning and they are neurologically based. On December 3rd, 2004 IDEA was amended and signed into law, and although substantial changes were made with respect to procedures for identifying learning disabilities, the definition of specific learning disability was maintained from IDEA 1997. In contrast to the federal definition of learning disability, the essential feature of ADHD is a persistent pattern of inattention and/or hyperactivity-impulsivity that is developmentally more frequent and more severe than is expected. These symptoms can interfere with an individual's ability to concentrate, attend, and complete assignments, ultimately affecting one's learning. ADHD symptoms have an early childhood onset, are pervasive, and cause impairment at home, school, or place of employment (American Psychiatric Association, *DSM-IV-TR*, 2000). Therefore, by definition, ADHD is not a learning disability, but it is a disorder that often impacts one's learning. Research indicates that individuals with ADHD frequently have a coexisting learning disability (i.e., 25% to 50%, Pennington, Willcutt, & Rhee, 2005) and the most common type is reading disability. Brook and Boaz (2005) recently reported that 94% of a group of adolescents with ADHD attending a high school devoted to special education had been diagnosed with a coexisting learning disability. An abundant amount of information is available concerning learning disabilities and it is well recognized that learning disabilities are chronic conditions that continue throughout childhood and into adulthood (e.g., Osmon, Braun, & Plambeck, 2005; Pennington, Willcutt, & Rhee, 2005; Shaywitz & Shaywitz, 2005; Vogel & Holt, 2003). It is only recent that ADHD has been recognized as a valid disorder in adults although this diagnosis is not

without controversy. The purpose of this chapter is to summarize the research literature concerning ADHD in adults and to consider the practical implications of these findings for adults living with ADHD.

Attention-Deficit/Hyperactivity Disorder

Existence and Prevalence

Some regard ADHD is a controversial disorder in childhood and have questioned the validity of ADHD in adulthood. Indeed, the National Institutes of Health (NIH) released a consensus statement concerning the diagnosis and treatment of ADHD and indicated that "despite the progress in assessment, diagnosis and treatment of children and adults with ADHD, the disorder has remained controversial...the controversy raises questions concerning the literal existence of the disorder" (National Institutes of Health 2000, p. 182). The NIH consensus statement following thorough review of the scientific evidence concluded that ADHD is a valid disorder and this perspective is endorsed by the American Academy of Pediatrics, the American Medical Association, the American Psychiatric Association, the American Psychological Association, the National Association of School Psychologists, the U.S. Surgeon General and others. In 2002, a consortium of international scientists addressed the assertion that ADHD is a fraud by reviewing the scientific evidence to the contrary and issued the International Consensus Statement on ADHD (2002). In addition, Faraone et al. (2000) sought to determine whether ADHD is a valid disorder in *adulthood* using the validity criteria of Robins and Guze (1970), and they reviewed clinical, family, psychopharmacologic, neurobiological, and adult ADHD outcome studies. Faraone et al. concluded that adult ADHD is indeed a valid disorder, although the authors emphasized that additional studies are needed to understand the specific nature of ADHD in adulthood.

ADHD is estimated to affect 3% to 10% of children and adolescents and 3% to 4% of adults (Biederman, Mick, & Faraone, 2000; Wender, Wolf, & Wasserstien, 2001). Prevalence rates vary depending on factors such as age of the individuals investigated, gender, raters (e.g., parents, teachers) and diagnostic criteria employed. The disorder occurs worldwide, and prevalence estimates are similar to the USA in many countries while some studies report substantially higher estimates (Faraone, Sergeant, Gillberg, & Biederman, 2003; Weyandt, 2006). For example, in India, Bhatia, Nigam, Bohra, and Malik, (1991) reported that 29.2% of adolescents ages 11 and 12 displayed significant ADHD symptoms. Recently, a study of 600 Ukrainian children reported an overall prevalence rate of 19.8% for ADHD with the highest subtype ratings for ADHD hyperactive-impulsive type (8.5%) followed by the inattentive type (7.2%), and combined type (4.2%) based on parent and teacher ratings (Gadow et al., 2000). Pineda and colleagues (1999) reported 19.8% of boys and 12.3% of girls ages 6 to 11 (among a sample of 540 children) living in Manizales, Columbia met *DSM-IV* (1994) criteria based on parental ratings alone. Prevalence rates in other countries such as Japan, Canada, China, Italy, Thailand, Australia, and New Zealand have been similar to U.S. estimates (Benjasuwantep, Ruangdaraganon, & Visudhiphan, 2002; Faraone et al., 2003; Graetz et al., 2001; Kanbayashi, Nakata, Fujii, Kita, & Wada, 1994; Luk, Leung, & Lee, 1988; Mugnaini et al., in press; Schaughency, McGee, Raja, Feehan, & Silva, 1994; Szatmari, 1992). Brownell and Yogendran (2001) investigated physicians' diagnosis rates for ADHD in the province of Manitoba and found an overall rate of 1.52%.

Once considered a disorder of childhood, research, however, suggests that the ADHD symptoms often persist throughout adolescence and into adulthood. For example,

Weyandt, Rice, and Linterman (1995) found a substantial percentage of college students reported significant levels of ADHD symptoms (7%). This percentage decreased, however, when both childhood symptoms and current symptoms were considered (2.5%), as is required by *DSM-IV-TR* criteria. DuPaul et al. (2001) examined the prevalence of ADHD symptoms in college students from three countries (Italy, New Zealand, and the United States) and found the prevalence rates varied from 0% (Italian females) to 8.1% (New Zealand males). Recently, a NIMH-funded survey tracking the prevalence of attention deficit/hyperactivity symptoms in adults found that approximately 4.4% of adults ages 18–44 experience significant ADHD symptoms (Kessler et al., 2006). Symptom prevalence varies substantially from diagnostic rates, however, and studies that have followed-up adults who had been diagnosed with ADHD during childhood have produced variable results. Specifically, the studies have reported that 5% to 70% or more of children with ADHD continue to have symptoms in adulthood (Barkley, Fischer, Smallish, & Fletcher, 2002; Biederman et al., 1993; Claude & Firestone, 1995; Hechtman & Weiss, 1983; Mannuzza, Klein, & Moulton, 2002). As Barkley et al. (2002), noted, follow-up studies often rely on self-report and this method may underestimate the persistence of ADHD into adulthood. For example, Barkley et al. (2002) followed children who had been diagnosed with ADHD into adulthood and found that only 5% of the sample of 147 still met the criteria for ADHD when relying on self-report. However, when parent reports were also considered, the figures rose to 66% of cases met the criteria for ADHD.

Although the exact percentage of adults with ADHD is unknown, it has been estimated that 1% to 5% of adults have ADHD, and the expression of ADHD symptoms changes over time (Barkley, 1998; Biederman et al., 2000; Faraone et al., 2003; Goldstein, 2002; Hill & Schoener, 1996; Shekim, Asarnow, Hess, Zaucha, & Wheeler, 1990; Barkley, 1998; Spencer, Biederman, Wilens, & Faraone, 1994). Specifically, research suggests that symptoms of hyperactivity and impulsivity decline with age while inattention symptoms appear to persist into adulthood (Mick, Faraone, & Biederman, 2004). For example, according to the *DSM-IV-TR* diagnostic criteria (2000), hyperactivity in adolescents and adults "may be limited to subjective feelings of restlessness" (criterion 2.c). Indeed, Weyandt et al. (2003) recently found that college students with ADHD reported significantly higher levels of internal restlessness than students without the disorder, and other studies have reported that college students with a history of ADHD in childhood report more intrusive thoughts and task-unrelated thoughts than control subjects (e.g., Hines & Shaw, 1993; Shaw & Giambra, 1993). Although speculative, one might hypothesize that high levels of internal restlessness and intrusive thoughts are associated with compromised attention skills and academic performance. Kessler et al. (2005) recently studied factors that predict whether ADHD persists into adulthood and found only two factors that predicted persistence: severity of ADHD in childhood and treatment during childhood. It is also important to note that *DSM* diagnostic criteria are not age-referenced and are limited in number with regard to hyperactivity and impulsivity relative to inattention (i.e., nine for inattention, six for hyperactivity, and three for impulsivity) which has lead researchers such as Spencer, Biederman, Wilens, and Faraone (2002) to suggest that the current criteria for ADHD may minimize, or underestimate, the actual rate of persistence of ADHD into adulthood.

With regard to gender, the American Psychiatric Association (2000) indicates that boys are more likely to be diagnosed with ADHD than girls, with ratios ranging from 2:1 to 9:1 depending on the subtype of ADHD. Other studies have provided male-female ratios of 3:1 in the general population, and 6:1 in children referred to clinics (Gaub & Carlson, 1997; Gershon, 2002). In general, research has supported that girls with ADHD

tend to be less hyperactive, have fewer acting out problems, are less likely to have a learning disability, and are more likely than boys to have ADHD predominately inattentive type (Biederman & Spencer, 2002). Boys tend to be more hyperactive, have more aggression and acting out problems, and fewer attention and anxiety problems than girls with ADHD (Levy, Hay, Bennett, & McStephen, 2005; Newcorn et al., 2001). Recently, however, research by Joseph Biederman and colleagues at Massachusetts General Hospital, Boston, found that ADHD combined type was predominant in both boys and girls, and girls had the same relative risk for adverse outcomes as boys with ADHD even in adulthood (e.g., Biederman et al., 2004; Biederman & Faraone, 2004). Biederman et al. (2004) studied 219 adults with ADHD and concluded that higher rates of depression, anxiety, substance use disorders, and antisocial personality disorders were associated with ADHD in *both* genders. Learning disabilities (e.g., reading, math) appear to be equally prevalent in males and females with ADHD, although they are more common among males than females in the general population. Quinn (2005), however, has argued that ADHD is often a "hidden disorder" in females and has advocated for gender-sensitive diagnostic and treatment approaches for females with ADHD. Research has also found different patterns of cortical activity in adolescent males and females based on EEG recordings (Hermens, Kohn, Clarke, Gordon, & Williams, 2005) although the clinical relevance of these findings is unclear. What is clear is that ADHD affects both male and female adults, and they are at greater risk for a variety of difficulties including interpersonal problems and psychiatric comorbidity.

In summary, research indicates that ADHD symptoms appear in children, adolescents, and adults from various countries throughout the world. A variety of factors contribute to the inconsistent prevalence rates among studies. An important distinction is whether rates reflect the prevalence of ADHD symptoms or actual diagnosed cases of ADHD.

Outcome Studies and Comorbidity

A number of prospective follow-up and longitudinal studies have reported that children with ADHD are at risk for a wide range of pathology in adolescence and adulthood. For example, Lily Hechtman and colleagues conducted several follow-up studies in the 1970s and 1980s and reported that adolescents and young adults with ADHD had poorer social skills, lower self-esteem, completed fewer years of education, were involved in more automobile accidents, had more geographical moves, and greater academic and conduct problems compared to control subjects (e.g., Hechtman, Weiss & Perlman, 1980; Hechtman & Weiss, 1983; Weiss et al., 1979). Eakin et al. (2004) recently found that married adults with ADHD reported more family dysfunction and poorer overall marital adjustment than control families. In addition, Hechtman and Weiss (1986) conducted a 15-year prospective follow-up study and found greater alcohol use and antisocial behavior in those with ADHD compared to control subjects. Mannuzza and colleagues (1989) followed 103 adolescent and adult males who had been diagnosed as hyperactive as children and compared the arrest records to a control group. Results revealed that significantly more males with a history of hyperactivity had been arrested, convicted, and incarcerated compared to control subjects. Further analyses indicated, however, that it was not the persistence of ADHD that was associated with arrest history but rather the presence of antisocial/conduct disorder in adolescence and adulthood. In a later study, Mannuzza, Klein, Bessler, Malloy, & LaPadula (1993) followed 91 males with a history of childhood ADHD and found that 18% had antisocial personality disorder and 16% had drug abuse disorders. These figures were significantly higher than those of the

control group compared (2% and 4%, respectively). More recently, Mannuzza, Klein, and Moulton (2002) conducted a 12-year follow-up study and found 29% of the children with pervasive ADHD had antisocial personality disorder. In addition, Mannuzza et al. found the ADHD group failed a significantly greater number of academic subjects, and completed less formal schooling than the control group.

Similar to Mannuzza et al. (1989), Barkley, Fischer, Smallish, and Fletcher (2004) found that adults with a history of childhood ADHD committed a variety of antisocial acts such as property theft, disorderly conduct, assault, carrying a concealed weapon, and illegal drug possession compared to control subjects. In addition, adults with ADHD had been arrested more frequently, primarily for drug possession, use, and sale of drugs. Kollins, McClernon, and Fuemmeler (2005) found that self-reported ADHD symptoms were significantly associated with risk of smoking and several studies have found that adults with ADHD are more likely to smoke cigarettes compared to control subjects (e.g., Wilens & Dodson, 2004). Lambert and Hartsough (1998) found 42% of adults with ADHD smoked cigarettes compared to 26% of controls and 35% of the subjects with ADHD smoked daily compared to 16% of age-matched control subjects. Biederman et al. (2006) recently suggested that cigarette smoking might serve as gateway to alcohol and illicit drugs among adolescents with ADHD. Specifically, Biederman et al. found that adolescents with ADHD who smoked were significantly more likely to subsequently use and abuse alcohol and illicit substances compared to adolescents with ADHD who did not smoke cigarettes.

Recently, Fischer, Barkley, Smallish, and Fletcher (2005) followed a large sample (147) of children with ADHD into early adulthood (average age 20 years) and found that they continued to have problems with executive functions, that is, inattention, disinhibition, and slowed reaction time compared to control subjects. In a related study, Barkley, Murphy, DuPaul, and Bush (2002) found that adults with ADHD and executive function deficits had received significantly more traffic citations, speeding citations, license suspensions, and had been involved in more vehicular crashes compared to adults without ADHD. Howell, Huessy, & Hassuk (1985) conducted a 15-year longitudinal study of 369 children who exhibited behaviors associated with ADHD and found that, in adulthood, they were more likely to have dropped out of school, been rejected for military service, to have used marijuana daily, and to be employed as manual laborers.

In addition to antisocial behaviors, research indicates that adults with ADHD are at risk for psychiatric comorbidity. For example, Mannuzza et al. (1993) compared adult psychiatric status of those who had been diagnosed with ADHD in childhood compared to those without the disorder and found that 16% of subjects with ADHD had drug abuse disorders (compared to 4% of control subjects). In addition, 50% had a history of conduct disorder by adolescence and as adults, were seven times more likely to have antisocial personality disorder. Other studies have also reported that adults with ADHD are more likely to use and abuse alcohol and illicit drugs. For example, Lambert and Hartsough (1998) reported that 21% of adults with ADHD were cocaine dependent compared to 10% of age-matched control subjects. Carroll and Rounsaville (1993) found that 35% of nearly 300 individuals seeking treatment for cocaine dependence had ADHD. Preliminary studies also suggest that cocaine dependence may be more difficult to treat in adults with ADHD, as individuals with ADHD are less likely to complete treatment than those without the disorder (Levin et al., 2004). Saules, Pomerleau, and Schubiner (2003) have suggested that severity of ADHD symptoms is associated with a greater likelihood of using and becoming addicted to cocaine among adults with ADHD.

With regard to alcohol and other substances, studies have found that 20%–50% of adults with ADHD have a comorbid substance use disorder (Johann, Bobbe, Putzhamer, & Wodarz, 2003; Schubiner, 2005). Murphy, Barkley, and Bush (2002) compared adults with two different subtypes of ADHD (ADHD combined type, ADHD predominantly inattentive type) and control subjects and found that both groups of adults with ADHD had a greater risk of alcohol use and dependence as well as marijuana use and dependence. Johann et al. (2003) found that adults with ADHD and coexisting alcoholism had an earlier onset of alcohol dependence, a higher frequency of suicide ideation, and a higher daily and monthly use of alcohol compared to control subjects and adults with alcoholism but not ADHD. Studies also indicate that individuals with ADHD and alcoholism (and other substance use disorders) are at greater risk for failing to complete treatment and relapse (Levin, Evans, & Kleber, 1999; White et al., 2004). Schubiner et al. (2000) studied the prevalence of ADHD and conduct disorder among adults in chemical dependency centers and found 24% of the participants met *DSM-IV* criteria for ADHD (28% of men, 19% of women). Thirty-four of the 48 adults with ADHD in this study also had conduct disorder. Given the high rate of co-occurrence of conduct disorder with ADHD, several researchers have argued that conduct disorder, not ADHD, increases the risk of substance disorders in adults with ADHD (e.g., Flory, Milich, Lynam, Leukefeld, & Clayton, 2003; Lynskey & Hall, 2001). Barkley et al. (2004) noted that adults with ADHD have a greater likelihood of using substances (and other antisocial behavior), but those with co-existing conduct disorder appear to engage in a greater variety of more frequent use of substances.

With regard to comorbid psychiatric conditions, the findings have been mixed. For example, Mannuzza et al. (1993) did not find a higher incidence of mood or anxiety disorders among the adults with a history of ADHD. Biederman and colleagues (1993), however, studied 84 adults with childhood-onset ADHD and found significantly higher rates of major depression and anxiety disorders compared to control subjects. McGough et al. (2005) reported that 87% of adults with ADHD had at least one psychiatric disorder and 56% had two or more psychiatric disorders, including anxiety and mood disorders. Kennemer and Goldstein (2005) reported that major depression was the most common psychiatric condition for adults with ADHD who were treated in an inpatient setting. Nierenberg et al. (2005) studied adults with bipolar disorder and found that 14.7% of the males and 5.8% of the females had coexisting ADHD. In addition, Biederman et al. (1993) found a significantly greater percentage of adults with ADHD had been divorced or separated, were of lower socioeconomic status, had antisocial personality disorder, had a lower full-scale IQ, and while in school had experienced higher rates of learning disabilities, placement in special education, and repeated grades.

Some have questioned whether use of stimulant medication for ADHD in childhood increases the likelihood of drug use and abuse in adolescence and adulthood. Several long-term studies have investigated this issue and have found that for most individuals the use of medication on a regular basis is not associated with an increased risk of drug involvement and in many cases is actually associated with a *decreased* risk (Chilcoat & Breslau, 1999; Huss & Lehmkuhl, 2002; Weiss & Hechtman, 1993). Barkley, Fischer, Smallish, and Fletcher (2003) followed children with ADHD for 13 years and during adolescence and young adulthood were interviewed about their length of stimulant medication treatment and their drug use. Results revealed that stimulant-treated children had no greater risk for experimenting with drugs during adolescence or frequency of drug use in adulthood. Biederman (2003) also found that stimulant medication treatment appeared to serve a protective role against substance use disorder in adults as substance use disorder

rates were 3 to 4 times higher in adults with untreated ADHD. Recently, Katusic et al. (2005) reported that 21.8% of young adult males treated for ADHD had substance use disorder compared to 36.4% of untreated males with ADHD. Among treated females, however, 15.2% had substance use disorder compared to 10.3% of untreated females with ADHD.

Etiologic Theories

One factor that contributes to the controversy surrounding ADHD in adulthood is that the precise etiology of ADHD is unknown. Findings from genetic, neurochemical, neuroimaging, and neuropsychological studies, however, collectively support a neurobiological basis for the disorder. For example, twin and adoption studies have demonstrated that genetic factors are important in the expression of ADHD, and monozygotic twins are significantly more likely than dizygotic twins to meet the criteria for ADHD (78% and 35%, respectively) (Sherman, Iacono, & McGue, 1997; Willcutt, Pennington, & DeFries, 2000). Familial studies have also found that individuals with ADHD are more likely to have siblings or parents with ADHD relative to families with no history of ADHD (Biederman et al., 1993). Wilens et al. (2005a) recently reported that children of parents with ADHD and substance use disorder were at greater risk for ADHD compared to children of parents with ADHD only or, substance use disorder only or neither diagnosis.

Neuroanatomical, neurochemical, and neuroimaging studies collectively have supported a physiological basis for ADHD although some findings have been inconsistent. Several studies, for example, have reported differences in size and symmetry of anatomical brain structures (e.g., corpus callosum, cerebellum, striatum) when comparing individuals with and without ADHD, while other studies have not replicated these findings (e.g., Castellanos et al., 2002; Giedd et al., 1994; Hynd et al., 1991; Mostofsky, Reiss, Lockhart, & Denckla, 1998). Numerous neurotransmitter, neurometabolite, cerebral blood flow, and glucose metabolism studies have also reported differences between those with and without ADHD although the factors responsible for these differences remain unclear (e.g., Schulz et al., 2005; Teicher et al., 2000; Volkow, Wang, Fowler, & Ding, 2005; Weyandt, 2006; Yeo et al., 2003; Zametkin et al., 1990).

It is critical to note that anatomical and neuroimaging findings are correlational in nature and do not reveal the underlying cause of the morphological or functional differences between those with and without ADHD. Studies that have investigated neuropsychological functioning in adults with ADHD have focused primarily on intelligence and executive function tasks. Although some studies have reported differences in IQ (e.g., Biederman et al., 1993) in adults with and without ADHD, other studies have not found these differences (Katz et al., 1998; Weyandt, Mitzlaff, & Thomas, 2002). Several studies have also reported differences between adults with and without ADHD on executive function tasks (e.g., Bekker et al., 2005; Fischer, Barkley, Fletcher, Smallish, 2005; Weyandt, Rice, Linterman, Mitzlaff, & Emert, 1998) but others have not (e.g., Schoechlin & Engel, 2005). It is plausible that executive function deficits influence IQ test performance and it is equally plausible that intellectual capacity influences performance on executive function tasks. Murphy, Barkley, and Bush (2001) have argued that that ADHD shares a portion (i.e., 10%) of the variance with IQ and executive function performance is negatively correlated with ADHD symptom severity. Furthermore, Murphy et al. argued that executive function performance is positively correlated with IQ and they found that performance differences attenuated on several neuropsychological tasks when IQ was controlled for in subjects with and without ADHD. Given these

findings, Murphy et al. suggested that future studies should report and control for IQ group differences.

In general, research indicates that neuropsychological tasks do not reliably discriminate among adults with and without ADHD (Schoechlin & Engel, 2005; Weyandt, 2005a). Indeed, as Weyandt (2005b) noted, impairments in certain types of executive function deficits may be characteristic of individuals with ADHD but executive function deficits are not unique to individuals with ADHD. Several neurobiological theories have been advanced to explain the underlying pathophysiology of ADHD and most converge on abnormalities of frontal-subcortical networks, i.e., structures involving regions such as the basal ganglia pathways leading to and from prefrontal cortices (e.g., Schulz et al., 2005). Although the precise etiology of the structural and functional abnormalities implicated in ADHD is unknown, it is likely due to interactions between genetic, physiological, and environmental factors that ultimately affect brain development and neuronal functioning. For example, evidence suggests that ADHD may be due in part to polymorphisms in dopamine genes that modulate neurotransmission in subcortical and cortical regions (Madras, Miller, & Fischman, 2005). It is also plausible that prenatal factors such as exposure to teratogens and other risk factors result in morphological and functional abnormalities within the frontal-subcortical region (Lou, 1996; Rodriguez & Bohlin, 2005). These morphological and functional abnormalities may contribute to the dysregulation of cognitive and behavioral systems that mediate the core behaviors deficient in ADHD, such as attention, self-regulation, motor behavior, and executive functions. Future genetic and neurophysiological studies are needed to fully understand the complex underpinnings of ADHD.

Treatment

Various types of treatments are available for adults with ADHD including pharmacotherapy and non-pharmacotherapy approaches. Compared to the child literature, relatively few well-designed medication studies have been conducted with adults with ADHD. For example, in 2002, over 200 controlled studies evaluating the effectiveness of stimulants (methylphenidate) in children and adolescents had been conducted in contrast to six controlled studies with adults (Biederman & Spencer, 2002). Of those that have been conducted, results support the effectives of medication in the treatment of ADHD. Several types of medication have been studied in the treatment of adult ADHD including stimulants, non-stimulants, and antidepressants. Commonly used stimulants, non-stimulants, and antidepressants are presented in Table 23.1.

Stimulant Medications

Stimulants are the most commonly used medication to treat ADHD, and, according to Zito et al. (2000), 80% of children treated with stimulants are treated with methylphenidate. Faraone, Spencer, Montano and Biederman (2004b) reported that 84% among a sample of approximately 900 adults with ADHD were treated with stimulants. Although the precise mode of action of stimulants in still uncertain, studies using neuroimaging techniques have revealed that methylphenidate results in an increase of the neurotransmitter dopamine by blocking the mechanism by which dopamine is removed from the point of cellular communication (e.g., Rosa-Neto et al., 2005; Volkow, Fowler, Wang, Ding, & Gatley, 2002; Volkow, Wang, Fowler, & Ding, 2005). Matochik and colleagues (1993) also found that stimulants (methylphenidate) increase glucose metabolism throughout

Table 23.1 Commonly Used Stimulants, Non-stimulants, and Antidepressants

	Generic Name	*Trade Name*
Stimulant Medications		
	Methylphenidate	Ritalin, Concerta, Metadate, Methylin
	Dextroamphetamine Dexmethylphenidate	DexedrineFocalin
	Amphetamine Salts	Adderall
Non-Stimulant Medications		
	Atomoxetine	Strattera
Antidepressant Medications		
Tricyclics	Imipramine	Tofranil
	Desipramine	Norpramin
	Nortriptyline	Pamelor
SSRIs	Sertraline	Zoloft
	Fluoxetine	Prozac
	Paroxetine	Paxil
	Fluvoxamine	Luvox
Other	Bupropion	Wellbutrin

the brain, not in restricted regions as expected. Rosa-Neto et al. (2005) reported that stimulants (methylphenidate) evoked specific changes in the striatal region of the brain and increased dopaminergic transmission in this area.

Although relatively few studies have been published concerning the use of stimulant medications with adults with ADHD, those that have generally support the effectiveness of stimulants with this population. For example, Wood, Reimherr, Wender, and Johnson (1976) were among the first to study the effects of methylphenidate on 15 adults with ADHD and found that 8 adults showed a "good" response to the medication. In a later study, Wender, Reimherr, Wood, and Ward (1985) found that 57% of adults treated with methylphenidate showed a significant reduction in ADHD symptoms compared to 11% who receive a placebo. Mattes, Boswell, and Oliver (1984) reported a lower response rate (25%) in adults with ADHD who were treated with methylphenidate for a three-week period. More recently, Kooij, Burger, Boonstra, et al. (2004) studied the effectiveness of methylphenidate (versus placebo) in the treatment of 45 adults with ADHD. Results revealed that 38% of those treated with methylphenidate compared to 7% placebo showed a significant favorable response based on outcome measures; however, 82% of adults treated with methylphenidate reported adverse side effects such as loss of appetite, sleeping problems, headaches, dizziness, and abdominal complaints. Bouffard et al. (2003) described methylphenidate as having minimal side effects in adults with ADHD and found significant improvements on adult rating scales, neuropsychological measures, and anxiety and depression scales. Overall, the researchers reported a 63% to73% response rate to methylphenidate, which is higher than the Kooij et al. study (2004). Wilens, Spencer, and Biederman (2002) noted that variability in response rates across studies might be related to diagnostic criteria, doses of medication, co-morbidity rates, and methods of assessing medication effectiveness.

Stimulant medications have also been associated with improved neuropsychological functioning. For example, Riordan et al. (1999) studied the neuropsychological functioning of adults with ADHD before and after approximately one-month treatment with methylphenidate. Results revealed significant improvements in various measures including sustained attention, distractibility, problem solving and memory. Lastly, Dorrego and colleagues (2002) compared the effectiveness of methylphenidate and lithium in treating ADHD in adults and reported that the medications produced similar rates of improvement on measures of aggressiveness, anxiety, depression, irritability, and antisocial behavior. A greater number of side effects were associated with the lithium treatment compared to methylphenidate. Biederman and Spencer (2002) reported that responses to methylphenidate were less robust in adults with ADHD compared to improvements found in children and adolescents. However, in a recent meta-analysis of the efficacy of methylphenidate for treating adult ADHD, Faraone and colleagues (2004a) concluded the degree of efficacy was similar to the child literature.

Cylert and Adderall. A handful of studies have explored the effectiveness of other stimulants including Cylert (pemoline) and Adderall in the treatment of adult ADHD. For example, Wood, Reimherr, Wender, and Johnson (1976) and Wender, Reimherr, and Wood (1981) found that pemoline was significantly more effective than placebo at reducing ADHD symptoms in adults. Cylert is no longer considered a first line of treatment for ADHD, however, due to concerns about liver toxicity (Horrigan, 2001). Adderall is a mixture of amphetamine salts (75% D-amphetamine, 25% L-amphetamine), and research supports its effectiveness in treating ADHD in children and adolescents (Manos, Short, & Findling, 1999; McGough, Pataki, & Suddath, 2005)—particularly those who show no response or an adverse response to methylphenidate (Pliszka, Browne, Olvera, & Wynne 2000). With regard to the use of Adderall with adults, Spencer, Biederman, Wilens, et al. (2001) found that 70% of adults with ADHD showed a 30% or greater reduction in ADHD symptoms following a 7-week treatment with Adderall. Horrigan and Barnhill (2000) used Adderall to treat 24 adults with ADHD and found that 54% showed significant improvement on ADHD rating scales after a 16-week period. Thirty-eight percent, however, were regarded as poor responders and acute anxiety symptoms occurred in the majority of the adults who had co-existing anxiety disorders. Additional questions have been raised about the safety of Adderall following the sudden death in 12 boys (ages 7–16) who had been taking the medication. As a result of the deaths, the Canadian drug regulatory agency suspended the sale of Adderall in the Canadian market in February of 2005. The United States FDA investigated the cases, did not remove Adderall from the market, and issued a statement that patients (and parents of patients) taking Adderall should discuss any concerns with the prescribing physician.

Illegal Use of Stimulants. Although thousands of studies attest to the safety and effectiveness of stimulants in treating ADHD in children and adolescents, stimulants do have the potential for abuse with adolescents and adults. For example, Low and Gendaszek (2002) surveyed undergraduate students at a small college in Maine, and found that 35% of the students sampled reported illicit use of stimulants. Common reasons for using stimulants illegally included a) to improve intellectual performance (23%), b) to be more efficient on academic assignments (22%), and c) for recreational purposes, i.e., in combinations with alcohol (19%) (known as "pharming"; Kadison, 2005). Studies have found that male college students tend to report greater illicit use of stimulants than female college students. However, Teter and colleagues (2003) found only 3% of college students from the

University of Michigan reported illicit use of stimulants and males and females did not differ in their use. Hall, Irwin, Bowman, Frankenberger, and Jewett (2005) conducted a study in the Midwest, and found that 17% of male college students and 11% of female college students reported illicit use of stimulant medication. McCabe and colleagues (2005) surveyed more than 10,000 college students from 119 colleges across the United States and found that 6.9% of students reported illicit use of stimulants. Illicit use of stimulants varied tremendously across universities, however, with the highest use among students who attended universities in the Northeast region of the United States. Upadhyaya et al. (2005) surveyed college students regarding current ADHD symptoms and drug use and found 25% of those prescribed medication for ADHD reported using for recreational purposes and 29% reported giving it or selling it to someone else at least once.

Although methylphenidate can be and is sometimes misused by adolescents and young adults, it is thought to be relatively non-addictive (Volkow et al., 2002). Kollins (2003) reported that the pharmacokinetic properties of methylphenidate are substantially different from other types of stimulants that are often abused (e.g., cocaine) therefore lessening its abuse and addiction potential. Interestingly, Levin et al. (2006) found that adults with ADHD who participated in a methadone treatment program did not misuse methylphenidate when treated with this medication to improve their ADHD symptoms. Wilens, Faraone, Biederman, and Gunawardene (2003a) conducted a meta-analysis to determine whether treatment of ADHD with stimulants increased the risk of substance abuse in adolescence and adulthood. Results revealed a *reduction* in risk for those treated with stimulants for ADHD compared to those with the disorder who did not receive stimulants. Similar findings were reported by Barkley et al. (2003) after following children with ADHD for 13 years during adolescence and young adulthood and interviewing them about their length of stimulant medication treatment and their drug use. Results revealed that stimulant-treated children had no greater risk for experimenting with drugs during adolescence or frequency of drug use in adulthood.

Non-Stimulant Medication

The FDA approved the use of Strattera (atomoxetine) for the treatment of ADHD in children, adolescents, *and* adults in 2002. Strattera is a non-stimulant, non-antidepressant medication that prevents the reuptake of norepinephrine (stimulants target dopamine) at the cellular level causing more of this neurotransmitter to be available at the synapse. Since its approval, a fair amount of studies have supported the effectiveness of Strattera for improving ADHD symptoms in children and adolescents, including both males and females (e.g., Biederman & Spencer, 2002; Kaplan et al., 2004; Kelsey et al., 2004; Simpson & Plosker, 2004; Spencer et al., 2002; Weiss et al., 2005). At least one study has reported that Strattera is equally effective as methylphenidate at treating ADHD in children (Kratochvil et al., 2002). With regard to adults, Simpson and Plosker (2004) and Faraone et al. (2005b) found Strattera significantly reduced ADHD symptoms relative to placebo with very few side effects. Recently, however, concerns have been raised about the possibility that Strattera increases suicidal thoughts in children and adolescents, and in September 2005 the FDA ordered that the manufacturer of Strattera, Eli Lilly, carry a prominent "black box" warning on its label. This is the FDA's most serious alert and was based on Eli Lilly's research with 1,357 children who were taking Strattera compared to children who were not taking the medication. Results revealed that 5 of the 1,357 children reported suicidal thoughts while no children in the control group had reported these thoughts. It is unknown whether Strattera is associated with suicide ideation in adults.

Antidepressant Medication

Antidepressants, including tricyclics and Selective Serotonin Reuptake Inhibitors (SSRIs) are used less often than stimulants to treat ADHD, although a few studies have supported their effectiveness with adults with ADHD (e.g., Maidment, 2003; Wilens et al., 1996). Tricyclic antidepressants sometimes used for individuals with ADHD include imipramine (Tofranil), desipramine (Norpramin), and nortriptyline (Pamelor). These medications are usually reserved for adults with ADHD due to their ability to increase blood pressure and rapid heart rate in some children and adolescents (Popper, 2000). Tricyclic antidepressants are slower acting than stimulants and may take four to six weeks to show effects. Tricyclic antidepressant medication may be useful for individuals with ADHD who do not respond to stimulants or for those who may misuse stimulants. For example, Williams and colleagues (2004) found that 23% of 450 adolescents referred for substance abuse treatment reported non-medical use of methylphenidate and Dexedrine and therefore suggested that antidepressants or other non-stimulant medications be used with substance abusing individuals with ADHD. Tricyclic antidepressants and selective serotonin reuptake inhibitors (SSRIs) have also been used with individuals with ADHD who have coexisting affective disorders such as depression. As Waxmonsky (2005) noted, there has been increasing interest in combining medications, such as stimulants and antidepressants to attenuate treatment effects. Horrigan (2001) reported, however, that the use of tricyclic antidepressants is dwindling perhaps out of concern for the potential for cardiac problems, particularly in those with a history of heart arrythmias. SSRIs can be used in conjunction with stimulants to treat coexisting anxiety disorders or depression and include sertraline (Zoloft), fluoxetine (Prozac), paroxetine (Paxil), and fluvoxamine (Luvox). SSRIs have been found to have fewer side effects and therefore are often better tolerated than tricyclics in adults with ADHD. A third type of antidepressant is bupropion (Wellbutrin), believed to affect multiple neurotransmitter systems, and has been found to be effective at treating ADHD in adults (Daviss et al., 2001; Wender & Reimherr, 1990; Wilens et al., 2001; Wilens et al., 2003b; Wilens et al., 2005b).

It is important to note that research indicates that stimulants are superior to antidepressants at improving ADHD symptoms, and far more research is available concerning the use and safety of stimulants than antidepressants in treating ADHD in adults. Furthermore, the FDA has *not* approved the use of antidepressants for the specific treatment of ADHD in children or adults. In addition to stimulants, antidepressants, and non-stimulants, researchers have explored the role of other medications (e.g., cholinergic agents) in the treatment of ADHD in adults but less information is available concerning the safety and efficacy of these medications. For now, stimulant medications represent the "gold standard treatment for ADHD across the lifespan" (Horrigan, 2001, p. 582). Additional studies are needed, however, to better understand the pharmacology of stimulants and the safety and effectiveness of these medications in the treatment of adult ADHD.

Non-Pharmacological Interventions

A large number of non-pharmacological interventions have been studied in the treatment of ADHD including biofeedback, dietary supplements, dietary restrictions, fatty acids, massage, yoga, exercise, caffeine, music therapy, and sensory integration training to name a few (Weyandt, 2006). A review of these studies is beyond the scope of this chapter and it is important to note that nearly all of these studies have been conducted with children and adolescents, and therefore information is limited with respect

to adults. Moreover, most of the non-pharmacological interventions studies are fraught with methodological problems thereby limiting their usefulness. In general, research indicates that stimulant medications are far superior to alternative approaches in the treatment of ADHD. Biofeedback (i.e., neurofeedback) has received considerable attention recently and a few studies have reported adults with ADHD showed a decrease in symptoms following treatment with biofeedback (Butnik, 2005). Loo and Barkley (2005), however, conducted an extensive review of the literature concerning biofeedback and ADHD and concluded "there is much work to be done to demonstrate EEG biofeedback provides that alternative and that actually changing EEG is the mechanism of change in ADHD symptoms" (p. 73). A handful of studies have examined whether structured-skill building interventions are beneficial to adults with ADHD (Safren, Sprich, Chulvick, & Otto, 2004). For example, adults with ADHD often have issues with disorganization, anger management, financial management, stress management and social skill deficits, and structured skill building programs seek to train and improve the skill level of adults with ADHD in these and other areas. Some programs have used cognitive behavioral and metacognitive approaches to help improve skill deficits of adults with ADHD and the results have been mixed (e.g., Hesslinger et al., 2002; Safren et al., 2005; Wasserstein & Lynn, 2001). Other non-pharmacological interventions targeted for adults with ADHD include psychotherapy (Murphy & Gordon, 1998; Young, 2002), career and vocational counseling (Crawford & Crawford, 2002), marital therapy (Kilcarr, 2002), and life coaching (Ratey, 2002) to name a few. It is important to recognize that non-pharmacological interventions are skill focused, are not uniquely associated with ADHD, and do not address the underlying core symptoms of ADHD.

Assessment of Adult ADHD

The American Academy of Pediatrics (2000) has recommended a multi-method assessment approach be followed in the assessment of ADHD in children and adolescents. A similar multifaceted approach has been recommended for the assessment of ADHD in adults, using multiple assessment measures and multiple informants (Murphy & Gordon, 1998). The process should involve documenting past and current symptoms consistent with *DSM-IV-TR* criteria, establishing that symptoms cause impairment, thorough developmental, social, educational, psychiatric, and medical histories, and use of multiple measures to collect objective data. Methods useful in collecting information about an adult evaluated for ADHD include interviews, behavior rating scales, self-report measures, record review, standardized-normed referenced tests (e.g., intelligence, achievement), and possibly laboratory measures such as continuous performance tasks. Each measure yields a different type of information that is useful in determining whether an individual has ADHD and/or some other problem(s) and requires collaboration among medical personnel, and possibly parents, spouses, employers, or other significant individuals.

Obtaining information from a variety of sources (e.g., adult and spouse/parent/roommate) is critical, as research indicates that diagnoses based on a single informant are likely to be inaccurate (i.e., invalid) (Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000). Although many advocate this multi-method assessment for adults, McGough and Barkley (2004) noted the *DSM-IV-TR* criteria are problematic as they a) have never been validated in adults and b) do not include developmentally appropriate symptoms for adults. Asherson (2005) has argued many cases of adult ADHD may go unrecognized as clinicians may be unfamiliar with symptoms of ADHD in adults.

Implications of Research Findings

Until relatively recently, ADHD was considered a disorder of childhood however, longitudinal and retrospective studies indicate that the majority of individuals continue to have symptoms throughout adolescence and adulthood. ADHD occurs more often in adult males than females but both sexes have a similar relative risk for adult outcomes. Adults with ADHD are at increased risk for antisocial personality disorder as well as depression, anxiety, and substance use disorders. Studies also indicate that adults with ADHD are more likely to have completed fewer years of education, received special educational services, repeated grades, received traffic citations, speeding citations and license suspensions, and been involved in more vehicular crashes compared to adults without ADHD. In addition, adults with ADHD are more likely to experience executive function deficits, family dysfunction and poorer overall marital adjustment. Secnik, Swensen, and Lage (2005) recently reported that employees with ADHD have a higher percentage of comorbidities (e.g., anxiety, asthma, bipolar disorder, substance abuse), higher medical costs, and more absences and unofficial absences compared to employees without the disorder. ADHD in adults is clearly a valid disorder, one that impairs the daily functioning and quality of life of individuals with the disorder. Treatment can significantly improve the symptoms of ADHD, however, and stimulant medication has received the most empirical support. Non-pharmacological interventions are numerous although little information is available concerning the effectiveness of these interventions in the treatment of ADHD. Compared to knowledge concerning ADHD in children and adolescents, a dearth of scientific information is available concerning ADHD in adults. Methodologically rigorous studies are sorely needed to better understand the nature of ADHD in adulthood and to develop ways to effectively improve the symptoms associated with this disorder.

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