Children with Disabilities

6TH EDITION

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24 Attention Deficits and Hyperactivity

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Upon completion of this chapter, the reader will

- Be familiar with the characteristics of attention-deficit/hyperactivity disorder
- Be aware of some of the causes of inattention and hyperactivity
- Understand the components of the diagnostic process
- Know the different approaches to management
- Be aware of the natural history and outcomes for this disorder

Attention-deficit/hyperactivity disorder (ADHD) is one of the most prevalent neurodevelopmental/mental health conditions in childhood. It is characterized by developmentally inappropriate levels of inattention and distractibility and/or hyperactivity and impulsivity that cause impairment in adaptive functioning at home, at school, or in social situations. Treatment improves short-term academic, social, and adaptive functioning (MTA Cooperative Group, 2004a). It is anticipated, though not proven, that comprehensive management can lead to improved long-term outcomes for children with ADHD; however, it is now understood that the condition and its impact tends to persist into adolescence and adulthood in a substantial percentage of individuals (Mick, Faraone, & Biederman, 2004; Wolraich et al., 2005). ADHD has important implications for the individual, as well as his or her family and community (Harpin, 2005; Klassen, Miller, & Fine, 2004).

JASON

Jason, now 7, is in second grade. His teacher reports that he is having great difficulty learning to read. He also is quite disruptive in class, frequently not listening to directions, getting out of his seat, making silly comments, and talking out of turn. Similar problems were reported by his first grade teacher, but these difficulties were attributed to his adjusting to the new school, as he attended a Montessori kindergarten previously. His parents and soccer coach have also noticed problems with his following directions and paying attention. Jason was adopted shortly after birth so there is no family history available. He has, however, always had a "difficult" temperament. He was a colicky baby with poor sleep patterns. As a preschooler, he was demanding and would exhaust all those around him. His parents and teachers feel that he is still quite immature and demanding, as he requires much more attention than other children his age do.

A comprehensive evaluation revealed that Jason has ADHD, combined type, and a specific reading disability, although he is intellectually gifted. Jason is at significant risk for both academic and behavioral difficulties, so a multimodal treatment plan has been put into place. Medication has been dramatically helpful at school and is used on weekends and during school vacations as well for improved functioning in social situations and activities of daily living. His counselor focuses on the development of a consistent behavior management plan at home and school, as well as social skill instruction. At school, he receives resource room teaching for reading and language arts, enrichment programming in math, and weekly meetings with the school counselor for a social skills group.

DIAGNOSIS AND ATTENTION-DEFICIT/ HYPERACTIVITY DISORDER SUBTYPES

ADHD is a neurobehavioral syndrome; there are no currently available medical or psychological tests to make the diagnosis. Instead, the diagnosis depends on ruling in symptoms of ADHD and ruling out other causes of the symptoms. Through the use of interviews and rating scales to systematically collect information from parents, teachers, and (older) children, the clinician must evaluate whether 1) significant ADHD symptoms are present in more than one setting; 2) the symptoms result in functional impairment; and 3) these symptoms are the result of another psychiatric, medical, or social condition (Pelham, Fabbiano, & Massetti, 2005). The current diagnostic criteria consist of two major clusters of symptoms: inattention and hyperactivity/impulsivity (American Psychiatric Association [APA], 2000). These criteria, outlined in the APA's *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR)* are shown in Table 24.1.

Children who display a significant number (at least six) from both symptom clusters are diagnosed with ADHD combined type (ADHD-C), provided the symptoms were evident before age 7, have persisted for at least 6 months, occur across settings, cause impairment, and cannot be better accounted for by another disorder. The selection of 7 years as the age at which symptoms must have been present is controversial because some children who meet all the

Table 24.1. Diagnostic Criteria for Attention-Deficit/Hyperactivity Disorder

A. Inattention/distractibility
   1. Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
   2. Often has difficulty sustaining attention in tasks or play activities
   3. Often does not seem to listen when spoken to directly
   4. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)
   5. Often has difficulty organizing tasks and activates
   6. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
   7. Often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)
   8. Is often easily distracted by extraneous stimuli
   9. Is often forgetful in daily activates

B. Hyperactivity
   1. Often fidgets with hands or feet or squirms in seat
   2. Often leaves seat in classroom or in other situations in which remaining seated is expected
   3. Often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)
   4. Often has difficulty playing or engaging in leisure activities quietly
   5. Is often "on the go" or acts as if "driven by a motor"
   6. Often talks excessively

Impulsivity
   1. Often blurts out answers before the questions have been completed
   2. Often has difficulty awaiting turn
   3. Often interrupts or intrudes on others (e.g., butts into conversations or games)

To make a diagnosis

A. At least 6 symptoms from just Category A (ADHD, Inattentive Subtype), or just Category B (ADHD, Hyperactive-Impulsive Subtype), or at least 6 symptoms from both categories (ADHD, Combined Subtype)
B. Symptoms are chronic (some symptoms were functionally impairing from before the age of 7), are clearly significantly impairing (in social, academic, or occupational functioning), are present across settings
C. Symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia or other Psychotic Disorder, and are not better accounted for by another mental disorder (e.g., Mood, Anxiety, Dissociative, or Personality Disorder).

other criteria for ADHD do not demonstrate functionally impairing symptoms before later elementary or middle school (Voeller, 2004; Weiss, Murray, & Weiss, 2002). ADHD-C is the most commonly diagnosed and studied form of ADHD (Barkley, 1998; Voeller, 2004).

The second most common subtype in children, ADHD predominately inattentive type (ADHD-I), refers to individuals who do not display significant levels of hyperactivity but have significant problems in maintaining attention. There is some evidence to suggest that the specific nature of inattention in this subtype may differ from the inattention shown by those with the combined subtype. A "slow" cognitive tempo is characteristic in ADHD-I. The ratio of girls to boys with this subtype is slightly higher than for the other subtypes, and it is usually identified at a later age. The pattern of psychiatric comorbidity also differs from that of ADHD-C, with fewer disruptive behavior disorders among these individuals and their relatives. Educational impairments are the most prominent difficulty experienced by this group (reviewed in Barkley, 1998; Voeller, 2004).

The third subtype, ADHD-predominantly impulsive/hyperactive type (ADHD-HI), was first identified in *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*; APA, 1994) and refers to children who do not display significant levels of attention problems in the presence of hyperactivity and impulsivity. This subtype is most often diagnosed in young children who have not yet reached an age at which attention problems are impairing. Less is known about the developmental course of this subtype or its response to treatment.

Finally, ADHD-not otherwise specified (ADHD-NOS) can be used for individuals who have significant functional impairment from the symptoms of ADHD, but may not meet strict criteria for the diagnosis based on the number of symptoms present or the age of onset criteria. Any of the subtypes can be used with the phrase "in partial remission" when symptoms are present but have improved such that the individual no longer meets strict criteria.

CLINICAL PRESENTATION

The presenting symptoms of ADHD differ with age. During the preschool years, excessive activity level and impulsivity are typically the most prominent symptoms. This is often accompanied by "intense" temperament and cognitive inflexibility. In combination, these symptoms may lead to impulsive aggression toward peers. Given the high activity level and short attention span of the typical preschooler, only children severely affected with ADHD will differ sufficiently from the developmental norm to fully meet the criteria for the disorder. Children who present in the preschool period should be carefully assessed for language, cognitive, sensory, and autism spectrum disorders, all of which have some similarities in presentation to ADHD (DuPaul et al., 2001).

Upon entering elementary school, problems with listening and compliance, task completion, work accuracy, and socializing are common concerns of parents and teachers (Barkley, 1998). In adolescence, observable hyperactivity may decline significantly (Faraone, Biederman, & Mick, 2006). Concerns often focus around work completion, organization, and following rules. Approximately 65% of children with ADHD diagnosed early in childhood continue to meet the criteria for the disorder in adolescence, whereas an additional group will meet criteria for ADHD-NOS because of a reduced number of symptoms. Occasionally, individuals are not diagnosed with ADHD until adolescence, although they must have had symptoms by history that were impairing in childhood in order to meet current diagnostic criteria. Children who were able to cope during the early grades, typically because of low levels of hyperactivity/impulsivity; strong intellectual skills; social, athletic, or other strengths; and supportive families and school personnel, may present in adolescence. Their attentional/executive systems may finally be overwhelmed by the demands for processing increased volumes of reading and writing, as well as the complex social, time management, organizational, and higher-order thinking and language processing skills required of them (Stein & Baren, 2003).

COMMON COEXISTING CONDITIONS

There are several conditions that commonly coexist with ADHD, typically referred to as coexisting or comorbid conditions. Less frequently, another condition mimics ADHD and is the primary cause of inattentive or hyperactive symptoms rather than a condition that coexists with ADHD (see The Evaluation Process section). Coexisting conditions are important to identify during an evaluation because 1) they will often require additional or different treatment and 2) unless treated, they may prevent adequate treatment of ADHD.

Approximately 30%–50% of individuals with ADHD have an externalizing behavior disorder, such as oppositional defiant disorder (characterized by noncompliance and defiance of authority) or conduct disorder (characterized by more serious antisocial behaviors) (Burke, Loeber, & Birmaher, 2002; Waxmonsky, 2003). Estimates of mood disorders (depression, anxiety, bipolar disorder) in ADHD vary considerably from study to study, ranging from 14%–83%. Childhood bipolar disorder is estimated to occur in as many as 10% of individuals with ADHD (Waxmonsky, 2003). Children with bipolar disorder are likely to be chronically highly irritable, with intermittent explosiveness and signs of disordered thinking (e.g., grandiosity). They tend to have significant aggression and are at risk for additional problems including anxiety and conduct disorders (Waxmonsky, 2003). Anxiety disorders occur in approximately 25% of children with ADHD, and may include separation anxiety, generalized anxiety, phobias, or obsessive-compulsive disorder (OCD) (Varley & Smith, 2003). The prevalence of learning disorders in children with ADHD ranges from 10%–40% depending on which test and criteria are utilized (Kronenberger & Dunn, 2003).

Tic disorders, including transient, chronic, or Tourette syndrome are seen in at least 6% of children with ADHD in a community sample over the course of a year, with transient tics being the most common (approximately 5%) and Tourette syndrome being the least common (less than 1%) (Khalifa & von Knorring, 2005). Similar rates of tic disorders are seen in children with ADHD receiving placebos (Palumbo et al., 2004). Persistent tics are often associated with ADHD and other neuropsychiatric conditions, most notably OCD (Scahill et al., 2005). Tics can occur on a spectrum from mild, which may not even be reported by parents to more severe, in which tics have important physical, emotional, and social impact (Power & Glanzman, 2006). In children with both ADHD and Tourette syndrome, ADHD typically causes greater functional impairment than does the tic disorder itself (Denkla, 2006).

ASSOCIATED IMPAIRMENTS

Individuals with ADHD often have associated impairments that are neither directly described by the core features of ADHD nor indicative of one of the common coexisting diagnoses. Nonetheless, they can be significantly impairing and may require additional interventions. These include deficits in executive, language, social, academic, and adaptive functions as well as problems with sleep patterns and motor coordination.

Although ADHD is defined and diagnosed based on the presence of observed behaviors, neuropsychological investigations suggest that deficits in executive functioning based in the frontal/prefrontal cortex may underlie the characteristic observed behaviors in many children (Weyandt, 2005; Willcutt Doyle, et al., 2005). Executive functions include sustaining and shifting attention, being able to hold information in ultra–short-term memory in order to complete a task (working memory), organizing and prioritizing incoming information, planning ahead, self-monitoring, and inhibiting responses (Martinussen et al., 2005).

Even when criteria for a learning disability are not met, academic underachievement is a concern of many parents of school-age children with ADHD. Difficulty with verbal memory, listening comprehension, and organization of verbal and written output occur in children with ADHD, even in the absence of specific language impairments (McInnes et al., 2003). Although the topic has not been well studied, there appears to be a high rate of pragmatic language difficulties in children with ADHD (Armstrong & Nettleton, 2004). This results in difficulty reading, most often in the form of problems with fluency, comprehension, or engagement and retention of written material (Ghelani et al., 2004; Willicut et al., 2005).

Many children with ADHD have problems with social interactions with peers (Barkley, 2004; Frankel & Feinberg, 2002). They have difficulty "reading" the nuances of social behavior or inhibiting impulsive responses. They may react excessively or overly negatively to the behavior of others, leading some children to enjoy "pushing their buttons" to get a reaction. Some children with ADHD have difficulty initiating or sustaining the verbal turn taking or other reciprocal aspects of peer relations and may find themselves passively or actively ignored and without the deeper friendships that older children begin to develop at school. They may be inflexible or perfectionistic, leading to "bossiness" with peers. Research into the characterization and treatment of social impairment is in its early stages, although it is known that social deficits tend to persist to adulthood (Mannuzza & Klein, 2000).

Research has supported a link between ADHD and sleep disturbances (reviewed in Owens, 2005). The underlying cause of this association is presently unknown. Although stimulant medication can contribute to insomnia, sleep disturbance occurs in children with ADHD prior to medication use as well. They have a greater frequency of problems with sleep initiation, sleep maintenance, decreased rapid eye movement (REM) sleep, increased periodic limb movements, awakening, and decreased daytime alertness (Brown & McMullen, 2001). Although there is not an increased frequency of obstructive sleep apnea in individuals with ADHD, when present, its treatment may improve problems with daytime somnolence, concentration, and behavioral regulation (Bass et al., 2004; Cohen-Zion & Ancoli-Israel, 2004).

Children with ADHD also have an increased incidence of problems with motor coordination that may impair written work in school and participation in athletic activities (Martin et al., 2006; Visser, 2003).

CAUSES OF ATTENTION-DEFICIT/ HYPERACTIVITY DISORDER

Heredity

The most common etiological factor in the development of ADHD is heredity. Siblings of children with ADHD are between five and seven times more likely to be diagnosed with ADHD than children in unaffected families. Each child of a parent with ADHD has a 25% chance of having ADHD (Wilens, Hahsey, et al., 2005). Between 55% and 92% of identical twins will be concordant for ADHD (reviewed in Faraone, Perlis, et al., 2005).

Several genes have been found in preliminary studies to relate to susceptibility to ADHD including those related to the dopamine, norepinephrine, serotonin, acetylcholine, GABA, and glutamate neurotransmitter systems as well as genes associated with neurotransmitter release and neuroimmunology. We all have these genes and there are a few, slightly different forms of each of these genes, called alleles. In molecular genetic studies of families, a specific allele of each of these genes has been found to occur at an unexpectedly high frequency in individuals in the family who have ADHD, whereas different alleles tend to be present in individuals within the family who do not have ADHD. This suggests that specific alleles confer susceptibility to ADHD. The genes thus far identified do not account for the majority of the variation in ADHD symptoms, however, suggesting that other as yet unidentified genes also confer susceptibility (or protection). Those genes that have been found to be associated with ADHD in more than one study sample include the dopamine transporter and the dopamine type 4 and 5 receptors, dopamine beta hydroxylase (an enzyme that is involved in the conversion of **dopamine** to **norepinephrine**), the serotonin transporter, the serotonin 1B receptor subtype, and SNAP-25 [synaptosomal-associated protein, a membrane protein involved in synaptic release of neurotransmitters] (reviewed in Faraone, Perlis, et al., 2005; Glanzman, in press; Kent, 2004).

Dopamine-related genes are candidate genes for investigating the basis for ADHD because a variety of evidence indicates that dopamine is involved in the modulation of attention and behavioral regulation in the frontal cortex and its connections, particularly the striatum. Norepinephrine is another neurotransmitter that plays an important role in orienting attention and regulating alertness in the frontal cortex and in other areas of the cortex and lower brain. Medications that are effective in ameliorating ADHD symptoms have consistently been shown to affect one or both of these neurotransmitters (Glanzman, in press; Solanto, 2002).

Other Etiologic Factors

Other conditions known to affect brain development may result in ADHD symptoms or increase the risk of those genetically at risk for the disorder. These include prenatal exposures to cigarette smoking, lead, alcohol, and possibly cocaine; prematurity; intrauterine growth restriction; brain infections; and inborn errors of metabolism. Sex chromosome abnormalities (e.g., Klinefelter syndrome, Turner syndrome, fragile X syndrome) and other genetic syndromes (e.g., neurofibromatosis type 1, Williams syndrome, Tourette syndrome) are associated with attention problems or overactivity/ impulsivity (reviewed in Accardo, 1999). In children who do not have a family history of ADHD, there is an increased incidence of complications during labor, delivery, and infancy (Sprich-Buckminster et al., 1993). Premature infants with evidence of low cerebral blood flow were found at 12–14 years of age to have an increased risk for ADHD and motor reaction time abnormalities that were associated with alterations in dopamine type 2/3 receptor binding. This suggests that cerebral ischemia may contribute to long-term changes in dopamine neurotransmission that are related to ADHD motor and behavioral symptoms (Lou et al., 2004).

Structural and Functional Differences in the Brain

Multiple lines of evidence suggest that structural and functional differences exist in the brains of individuals with ADHD (reviewed in Durston, 2003; Glanzman, in press). Magnetic resonance imaging (MRI) scans have shown important differences when the volume of specific areas is compared. Five regions have shown consistent differences—the frontal lobes (particularly the right), caudate nucleus and globus pallidus (nuclei in the basal ganglia), corpus callosum (particularly anteriorly), and the posterior inferior cerebellar vermis (lobules 8–10). The frontal lobes of the brain serve as the "executive center," processing incoming stimuli and coordinating appropriate cognitive, emotional, and motor responses. It is thought that the cerebellum and basal ganglia may also be involved because these areas are critical to motor planning, behavioral inhibition, and motivation. These regions are 5%–9% smaller in individuals with ADHD (reviewed in Durston, 2003; Glanzman, in press). The volume reductions appear to affect both gray and white matter (Glanzman, in press; Sowell et al., 2003) and are present from the youngest ages studied (5 years of age) (Castellanos et al., 2002).

Functional MRI (fMRI) is a noninvasive technique that is used to evaluate variations in regional oxygen uptake in the brain, which correlates with cellular activity. FMRI studies support the role of the prefrontal cortex in executive functions, but to date there are only a few small studies in children with ADHD (reviewed in Glanzman, in press). These studies indicate that subjects with ADHD underactivate the prefrontal cortex and caudate nucleus compared with controls during motor inhibition tasks (Rubia et al.,1999; Vaidya et al.,1998), that stimulant medication can increase activation in these areas (Lou et al., 1989), and that the pattern of response to the stimulant may differ between controls and subjects (Vaidya et al., 1998).

Positron emission tomography (PET) and single photon emission tomography (SPECT) scans also provide information about brain function, but these techniques require injection of a radioactive tracer molecule, which has limited its use in children. Multiple studies in children and adults document underperfusion of frontal-striatal regions, although the specific findings within these areas differ between studies (Durston, 2003, Glanzman & Elia, 2006). Several studies document abnormalities in the frontal-striatal dopamine system including alterations in dopamine uptake in the prefrontal cortex and right midbrain in adults and children, respectively (Ernst et al., 1998; Ernst et al., 1999), and a higher level of binding to the dopamine transporter in both adults (Krause et al., 2003) and children (Cheon et al., 2003). Structural and functional imaging scans are presently important research tools, but they have not been shown to be sufficiently sensitive or specific be used diagnostically (American Academy of Pediatrics [AAP], 2000; Glanzman & Elia, 2006).

THE EVALUATION PROCESS

Evaluating a child for ADHD requires focusing on four areas: 1) the symptoms of ADHD, 2) different conditions that might cause the same symptoms, 3) coexisting conditions, and 4) associated medical, psychosocial, or learning issues that may not reach the threshold for a specific diagnosis but may nonetheless influence the treatment plan. A comprehensive history, physical/neurological examination, and academic assessment should be completed. Findings in these examinations may prompt additional investigations.

The history, generally taken from the parents, with the child's participation depending on age, includes current status and concerns, previous treatments and their effects, prenatal and perinatal events, medical history, developmental, psychiatric and behavioral history, educational course, social and family circumstances, and biological family history for ADHD symptoms and associated disorders. Information from teachers, typically in the form of standardized rating scales, should be included to document impairment in the school setting (AAP, 2000).

The medical examination should focus on growth parameters and physical signs of sensory, genetic, chronic medical, and neurologic disorders. In addition, alertness, social interaction, informal communicative ability and insight, and motor skills should be assessed.

Educational testing (including intellectual and achievement measures) will be necessary for many children and should focus on careful assessment for learning disabilities, memory and processing capabilities, and deficits and areas of academic weakness that may not meet criteria for a learning disability but for which additional support may allow the child to make better academic progress. This should include assessments of reading mechanics and comprehension, spelling, mathematical concepts and computation, and writing skills. Some evaluators will include tests of verbal and visual memory and processing efficiency, which can be useful in identifying reasons for intellectual–achievement discrepancies and can inform choices about educational remediation strategies.

Obtaining information about symptoms of ADHD and related conditions, comparing the level of symptoms with age- and gender-matched peers, and assessing the level of functional impairment is frequently facilitated by the use of standardized interview formats and rating scales for parents and teachers. In addition, rating scales designed for teachers allow the required collection of information from more than one setting. Commonly used scales to specifically assess ADHD symptoms include the ADHD-IV Rating Scale (DuPaul, Power, Anastopoulos, et al., 1998), the Conners' Rating Scales–Revised (CSR-R; Conners, 1997), the SNAP-IV Rating Scale (SNAP-IV; Swanson, n.d.), and the Vanderbilt ADHD Diagnostic Rating Scales (Vanderbilt Children's Hospital, n.d.). (For a review of these measures, see AAP, 2000; Pelham et al., 2005.)

Structured diagnostic interviews are most often used in psychiatric and research settings, as they are quite time consuming and require specialized training for their standardized administration. Commonly used structured diagnostic interviews include the DICA-R (Diagnostic Interview for Children and Adolescents, Revised) (Reich, 2000), and the Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS; Kaufman, J., Birmaher, B., Brent, D., et al., 1996). (For a review of these measures, see American Academy of Child and Adolescent Psychiatry, 1997; Pelham et al., 2005.)

Because comprehensive information is required, several professionals are typically involved (e.g., physician, psychologist, teacher). The primary person responsible for formulating the diagnosis and communicating the findings and recommendations to the family must be experienced with the range of coexisting conditions. This person is typically a physician (e.g., pediatrician, neurodevelopmental or behavioral pediatrician, neurologist, psychiatrist) or a psychologist. Additional professionals may be asked to provide input such as speech-language pathologists and occupational therapists. Although such a complex evaluation can be coordinated through a primary care setting, there are also a number of barriers related to knowledge, time, resources, and medical/mental health insurance coverage that limit access to a thorough evaluation for many children (Rushton, Fant, & Clark, 2004).

TREATMENT OF ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

Most treatment plans for ADHD include education about the disorder, as well as one or more of the following: behavioral and family counseling, educational interventions, and medication. Often a combination of treatments is used because of the multiple aspects of the child's life that are affected by ADHD.

Education About the Disorder and Emotional Support

Parents and older children need to learn as much as possible about ADHD so that they can be effective decision makers and advocates. The clinician can provide some information directly but should also guide the family toward other sources of information such as national support and advocacy organizations, books, videos, Internet sites, and parent support groups. Growing up with ADHD and parenting a child with ADHD are significant challenges. Although providing emotional support alone is not likely to result in significant improvements, without emotional support parents and children may not be able to perform the difficult work needed to address the problems.

Behavioral Counseling and Social Skill Intervention

Behavior therapy is the type of counseling intervention with the best documented efficacy (AAP, 2001). The premise of behavioral therapy is that the likelihood of a specific behavior occurring is determined by what takes place prior to the behavior (the antecedents) and immediately after the behavior (the consequences). (See Chapter 35). Changing the antecedents often involves altering the environment. Seating a child away from distracting stimuli, breaking long tasks into smaller components, and making eye contact when giving instructions are examples of ways in which antecedents can be altered to increase the chances of success for an inattentive child.

Behavior therapy can be done in individual or group sessions and forms the basis for most parent training and classroom management programs. Studies have consistently found that these interventions result in at least short-term improvements in the behavior of children with ADHD (Chronis et al., 2004). A study of a very intensive behavioral intervention that also included social skill building and emotional support found some persistent benefit 15 months after the intervention ended (MTA Cooperative Group, 2004b). Factors that may interfere with effective parent training include parental depression, parental ADHD, and high levels of marital discord (Chronis et al., 2004).

Behavior therapy should be differentiated from other forms of therapy that have little documented efficacy in the treatment of children with ADHD. Individual psychotherapy or play therapy may be helpful for children with coexisting mood, anxiety, or self-esteem problems, but it is not effective in treating the core symptoms of ADHD (Barkley, 2004). Similarly, cognitive or cognitive-behavioral therapy (CBT) that attempts to change behavior by helping individuals change self-defeating thought and behavior patterns has been found to have little, if any, effect in children with ADHD (Barkley, 2004). However, there are some small studies of CBT in adults with ADHD (some of whom also took medication) that suggest that CBT may have some benefit in this group (Safren et al., 2004; Stevenson et al., 2002). Family therapy may be necessary when parents cannot agree on an intervention plan or other family stressors interfere with implementation of a treatment plan.

Interpersonal difficulties such as peer victimization and/or social isolation are common in individuals with ADHD (Frankel & Feinberg, 2002). As a result, social skill interventions may be recommended as part of a comprehensive treatment plan. Social skill groups are often conducted in school or other group settings and teach by modeling, practicing, and reinforcing prosocial behaviors. When social skills interventions for children with ADHD are evaluated as a single intervention, the results have generally been disappointing (Abikoff et al., 2004; Barkley, 2004). The social skills interventions that seem to be the most effective are conducted in naturalistic settings (i.e., at a camp or school rather than in a clinic) and are combined with behavioral parent training (Chronis et al., 2004).

Educational Intervention

Appropriate school programs are extremely important for children with ADHD, many of whom have coexisting learning difficulties. Even those children without a specific learning disability may require substantial repetition of an educational task, yet are easily bored and resist it. A well-trained teacher who is interested in providing special help and an educational program suited to the needs of the child are invaluable. The teacher may need to use environmental modifications and behavior management techniques to maintain the child's attention to tasks and decrease unwanted behavior. The child may need the teacher's assistance to develop organizational skills. Classwork or homework assignments may need to be modified to emphasize the child's strengths and help manage the child's learning weaknesses or disabilities. Tutoring outside of school will be helpful in some cases, especially to ensure that basic concepts that serve as building blocks for more advanced work have been learned thoroughly.

When children with ADHD are in need of more assistance than is typically provided in the classroom, they may qualify for **accommodations** within their general classes or in special education settings under either Section 504 of the Rehabilitation Act of 1973 (PL 93-112) or the Individuals with Disabilities Education Improvement Act of 2004 (IDEA 2004; PL 108-446) (see Chapter 34). Accommodations allow the child with ADHD to gain access to the general education environment and may include 1) regular home–school communication; 2) a behavior program to manage mildly disruptive behaviors; 3) a plan to ensure that the student understands and is following through on instructions; 4) modifications of testing time, format, or environment; 5) an extra set of materials at home; and/or 6) technological assistance such as the use of tape recorders and word processors.

Pharmacological Treatment

Stimulant medications are the most effective and most commonly prescribed medications for ADHD. Atomoxetine (Strattera) is the only nonstimulant medication approved by the Food and Drug Administration (FDA) for the treatment of ADHD. Antidepressants, alpha-2-adrenergic agonists, and neuroleptics are sometimes used (although not FDA-approved for the treatment of ADHD) in children who do not respond to stimulants or atomxetine, who experience side effects from these medications, or who have a condition in addition to ADHD that is better treated by one of these medications. Although combinations of these medications are sometimes used, there is little research available concerning the efficacy and safety of combined pharmacological treatment in ADHD.

Stimulant Medications Stimulant medications, including methylphenidate and amphetamines (See Table 24.2) have been used for the treatment of children with disruptive behaviors since 1937 and have been more frequently used and more thoroughly studied than any other psychopharmacologic treatment in children. In the 1990s, 1%–3% of children in the United States received a stimulant medication for treatment of ADHD (Safer & Malever, 2000; Safer & Zito, 1999), and more than 11 million stimulant prescriptions were written per year. Research into the epidemiology of stimulant use suggests that stimulants may be both overprescribed and underprescribed, depending on the community practitioner. For example, one study found that only 12% of children meeting diagnostic criteria for ADHD were prescribed stimulants (Jensen et al., 1999), whereas another found that more than 70% were prescribed stimulants but that more than half of children prescribed stimulants had few parent-reported ADHD symptoms (Angold et al., 2000). During the 1990s, there was a rapid increase in the prevalence of stimulants prescribed to females (Zito et al., 2003), to preschoolers (Zito et al., 2000), and to children receiving more than one psychotropic medication (Safer, Zito, & dosReis, 2003).

Table 24.2. Stimulant medications commonly used to treat attention-deficit/hyperactivity disorder

Brand name	Generic name of active medicine	Usual duration of action (hours)	Dosages available (milligrams)	Comments
Ritalin	D, L-methylphenidate	3–4	Tablets: 5, 10, 20	
Focalin	D-methylphenidate	3–4	Tablets: 2.5, 5, 10	Contains only the active isomer of methylphenidate; usual dose would be the D, L-methylphenidate dose
Focalin XR	D-methylphenidate	12 (20 mg dose)	Capsules: 5, 10, 20	Capsule can be opened and sprinkled
Methylin	D, L-methylphenidate	3–4	Tablets: 2.5, 5, 10 Liquid: 5 mg/5milliter and 10mg/5milliliter	Tablets are grape flavored and chewable
Metadate CD	D, L-methylphenidate	6–8	Capsules: 10, 20, 30, 40, 50, 60	Capsule can be opened and sprinkled 30% of dose immediately released
Ritalin LA	D, L-methylphenidate	6–8	Capsules: 20, 30, 40	Capsule can be opened and sprinkled 50% of dose immediately released
Concerta	D, L-methylphenidate	10–12	Tablet: 18, 27, 36, 54	Must be swallowed whole 22% of dose immediately released
Daytrana	D, L-methylphenidate	Up to 12	Patch: 10, 15, 20, 30	Allows variable duration based on timing of patch removal
Dexedrine	Dextroamphetamine	3–6	Tablet: 5	
Dexedrine Spansules	Dextroamphetamine	6–8	Capsule: 5, 10, 15	
Adderall	Mixed salts of amphetamines	3–6	Tablets: 5, 7.5, 10, 12.5, 15, 20, 30	
Adderall XR	Mixed salts of amphetamines	10–12	Capsule: 5, 10, 15, 20, 25, 30	Capsule can be opened and sprinkled 50% of dose immediately released

Key: XR, extended release; CD, controlled delivery; LA, long acting.

Beneficial Effects Stimulant medications significantly reduce symptoms of ADHD in 70%–90% of those treated (Wigal et al., 1999). They result in a rapid and often dramatic improvement in attention to task and a decrease in impulsivity and hyperactivity. In addition, they improve academic productivity and accuracy, improve parent–child interactions, and decrease aggression (Connor et al.2002; Wigal et al., 1999). The effect of stimulants on academic performance is less strong than that on behavior, with only about half of the children showing significant improvement (Rapport et al., 1994). Although beneficial effects are very clearly demonstrated in short- to intermediate-term studies (up to 5 years of treatment; Charach, Ickowicz, & Schachar, 2004), the long-term efficacy of stimulants is not nearly as well studied. It should also be noted that response to stimulant treatment is not diagnostic of ADHD, as individuals with other psychiatric or developmental disorders, as well as controls, display similar effects when given stimulant medication (Rapaport et al., 1978).

Formulations Methylphenidate and amphetamines come in a variety of formulations, as shown in Table 24.2. The beneficial effects and side effects of these two types of stimulants are nearly identical, although individual children may respond better to one medication than the other (Elia, 2005). Amphetamine-based stimulants are given at approximately half the dose of the methylphenidate-based stimulants to account for differences in the potency of the two medications (Manos, Short, & Findling, 1999). Pemoline (Cylert), which is in a third category of stimulants, is not listed in Table 24.2 because it is rarely used since reports linked it to severe liver failure (Safer, Zito, & Gardner, 2001).

The onset of action of methylphenidate and amphetamine is usually within 30 minutes of taking the dose. Different formulations vary principally in their duration of action, how much of the medication is released immediately, and how the remainder is released (in a later bolus versus continuously). Although Table 24.2 gives the typical duration of action for the various formulations, there is significant variation among individuals. In addition, methylphenidate patch (Daytrana) gives individuals the capacity to vary the duration of action on a daily basis (up to 12 hours) based on the timing of patch removal (see http://www.daytrana.com).

Side Effects The most common adverse effects of stimulants are decreased appetite, headaches, stomachaches, and sleep problems (Elia, 2005). These symptoms are common in children with ADHD off medication as well, so it is important to determine their nature and frequency prior to starting the stimulant. Decreased appetite is reported in 50%–60% of treated children, but it is often mild and limited to school hours (Efron, Jarman, & Barker, 1997). About 10%–15% of children have substantial weight loss. These children may benefit from caloric, vitamin, and mineral supplementation to prevent weight loss and maintain adequate nutrition, but some will simply not tolerate an effective dose in spite of supplementation.

Less common but potentially more problematic side effects include **"rebound"** effects, tics, and social withdrawal. *Rebound* refers to a temporary worsening of symptoms, including irritability, increased activity, and/or mood swings, when the medication wears off. Although it is estimated that 30% of school-age children experience some rebound effects, the effects are significant enough to require altering the medication regimen only in about 10% of cases (Carlson & Kelly, 2003). Some children do become withdrawn on the medication. This may improve with dose adjustment or switching to another medication.

Tics have been reported to occur in approximately 10% of children treated with stimulants (Lipkin, Goldstein, & Adesman, 1994). However, in a community sample of 3,600 children, tics occurred in 22% of preschoolers, 8% of elementary school children, and 3.4% of adolescents (Gadow & Sverd, 2006). Although early reports suggested that stimulants induced or exacerbated tics, more recent research indicates that this is an uncommon occurrence (Gadow & Sverd, 2006; Palumbo et al., 2004). In addition, tics that appear to be stimulant induced or exacerbated usually subside with time, after the dose is reduced, or when treatment is discontinued. In rare cases, tics that appear to have been induced by stimulants do not resolve or may even worsen over time. Given that Tourette syndrome, chronic motor tics, and OCD appear to have an underlying genetic origin, it is possible that those individuals whose tics appear to be induced by stimulants have a genetic predisposition (reviewed in Power & Glanzman, 2006; Saccomani et al., 2005). Although the presence of tics and a personal or family history of Tourette syndrome are listed as contraindications to stimulant use by the pharmaceutical companies that manufacture these medications, given the previously cited research, this seems unnecessarily restrictive. ADHD symptoms may cause much more funetional impairment and thus he the priority for treatment (American Academy of Child and Adolescent Psychiatry, 2002; Denkla, 2006).

Growth velocity slows by approximately 1.2 centimeters per year on average in prepubertal children during at least the first 2 years of continuous treatment with stimulants (MTA Cooperative Group, 2004b). Whether this results in any decrease in ultimate height is less clear. A study of children treated with methylphenidate for at least 6 months during the 1970s found that although these children had decreases in height velocity on the medication, the children treated with stimulants did not have deficits in adult height (Klein & Mannuzza, 1988). However, the average length of treatment in this study was only slightly more that 2 years, which is less than the total duration of stimulant treatment many children with ADHD currently receive. Other recent studies of up to 2 years in duration suggest continued, although minimal, effects on height (Faraone, Biederman, et al., 2005; Wilens, McBurnett, et al., 2005). Thus, stimulants can eause a lag in growth, but short- to intermediate-term treatment does not seem to have a significant effect on adult height. Whether long-term treatment could affect adult height has not been adequately studied.

Other side effects include elevations of pulse or blood pressure and, rarely, activation of mania or psychosis. Typically the elevations of pulse or blood pressure are small and not clinically significant. Significant elevations should prompt an investigation for a potential underlying medical problem that may be exacerbated by the stimulants. Reports of sudden death in children on stimulants raised concerns that stimulants might be at fault, but careful review showed that approximately two thirds of those children had previously undetected cardiac abnormalities. The FDA has recommended that stimulants should generally not be used in individuals with known serious heart disease. This recommendation is on file with the FDA and is listed in the package insert for each stimulant product. The American Heart Association Panel on Psychotropic Medications in Children and Adolescents recommends a careful history for risk factors for sudden death and monitoring of pulse and blood pressure during treatment. In the absence of risk factors, the value of additional cardiac assessment or monitoring is unclear at this time (Wilens et al., 2006).

Potential for Substance Abuse Stimulants are classified as controlled substances by the Drug Enforcement Agency (DEA). They have been used by individuals who want to stay up for long hours, and when injected or taken intranasally stimulants will produce a high. However, children and adolescents taking the medication orally for ADHD do not report euphoria or dependence. Recent research suggests that the relatively slow uptake of methylphenidate into the brain with an oral (as opposed to intravenous) dose prevents oral doses from causing a high (Volkow & Swanson, 2003). The use of slow-release forms, in which the medication is mixed with other substances, makes abuse even less likely to occur. The possibility of diversion (giving or selling medication to others), however, still needs to considered when prescribing these medications. Coaching adolescents about how they will manage questions from peers about their medication or requests to provide it is a wise part of clinical practice for clinicians who prescribe stimulants.

ADHD has been shown to be a risk factor for later substance use disorders, most clearly in the presence of conduct disorder (reviewed in Biederman, 2003). However, multiple studies indicate that the use of stimulant medication does not increase this risk (Wilens et al., 2003) and may, in fact, be protective (Fischer & Barkley, 2003).

Initiating and Monitoring Therapy There is not a direct relationship between an individual's weight and the optimal dose of stimulant medication, so clinicians should have a standard way of assessing medication effectiveness and side effects during a medication trial with a planned titration from lower to higher doses (American Academy of Child and Adolescent Psychiatry, 2002; AAP, 2001). A large, multisite, clinical trial found that children treated with stimulants in the study did better than children treated with these same medications by community physicians (Jensen et al., 2001). Although several factors may have contributed to this finding, a likely factor was the titration protocol used to determine optimal medication dose. Instead of trying a low dose and then increasing until an adequate response was obtained, children in the study were evaluated on at least three different doses, and then the dose that had the best combination of efficacy and side effects was chosen (MTA Cooperative Group, 1999a). Thus, current recommendations are that the initial drug trial assess the child's response to at least two different doses of the medication until the child's behavior is not distinguishable from peers without ADHD, further increases in doses do not result in further behavioral improvement, or the child begins experiencing significant side effects (American Academy of Child and Adolescent Psychiatry, 2002; AAP, 2001). This may be done by obtaining an ADHD teacher rating scale at baseline and increasing the dose on a weekly basis with repeat weekly or twice-weekly rating scales, with the teacher blinded to the child's medication dose. If a child does not respond or has significant side effects on one stimulant, it is reasonable to try a stimulant from the other class (i.e., methylphenidate versus amphetamine) because some children will respond better to one stimulant that to the other (Elia, 2005).

School achievement, behavior, relationships, mood, vital signs, and growth velocity should be monitored at baseline and at regular intervals (every 3–6 months, depending on the frequency of medication or dose changes and the stability of these outcome measures in the past) to ensure continued beneficial responses and the absence of significant adverse effects. No specific blood tests are indicated as part of the monitoring. During childhood, it is important to periodically assess if medication is still required. These evaluations may occur every 1–2 years with the specific timing (e.g., during the summer versus during the school year) dependant on individual circumstances. For children with primarily attention problems, a longer trial may be needed with an evaluation of the medication effect on schoolwork and homework.

As children become adolescents and young adults, additional targets become important that make a longer duration of medication coverage relevant. These include more hours spent doing homework and extracurricular activities, after-school jobs, the requirement for social decision making with increasingly serious implications, and the need for consistent concentration while driving. Driving performance (but not knowledge) has been shown to be impaired in individuals with ADHD, and effective medication treatment has been shown to improve simulated performance (Cox et al., 2004).

Stimulants in Preschoolers Despite relatively few controlled studies of stimulants in preschool-age children, the use of these medications among preschoolers is increasing (Zito et al., 2000). The few controlled, short-term studies of methylphenidate suggested that it does have beneficial effects in preschool-age children with ADHD (Kratochvil et al., 2004). The percentage of preschool children having a beneficial response may be slightly lower than in elementary school–age children, and side effects may be more common (Ghuman et al., 2001; Kratochvil et al., 2004). Although methylphenidate has been studied more frequently than dextroamphetamine (Dexadrine) or mixed salts of amphetamines (Adderall) in preschool children with ADHD, methylphenidate is not FDA approved for children younger than 6 years of age, whereas the amphetamine products are approved for children older than 3 years of age. Nonetheless, methylphenidate was chosen as the medication for a national multisite clinical trial of treatment in preschool-age children with ADHD that is currently under way. Methylphenidate is also available in liquid and chewable tablet preparations and as a patch which will facilitate its use in preschoolers who may be unable to swallow capsules (see Table 24.2).

Nonstimulant Medications Between 10% and 30% of children with ADHD will not benefit from stimulants or will have adverse side effects that preclude their use. Nonstimulant medications may be helpful for these individuals. Such medications fall into three categories: norepinephrine reuptake inhibitors, antidepressants, and alpha-2-adrenergic agonists.

Norepinephrine Reuptake Inhibitors Currently the only nonstimulant that is FDA approved for the treatment of ADHD in children (6 years of age and older) is the norepinephrine reuptake inhibitor atomoxetine (Strattera). At least six randomized clinical trials in children and adults have demonstrated atomoxetine's efficacy in reducing symptoms of inattention and hyperactivity/impulsivity (Michelson et al., 2002). Atomoxetine may take a few days before one begins to see effects and several weeks to reach the maximum effect. The principle advantage over stimulants is that atomoxetine may improve symptoms 24 hours per day. In addition, it is theoretically less likely to exacerbate tics (Allen et al., 2005). Some children will experience fatigue when the medication is first started. Nausea, vomiting, and stomachaches are more likely to occur if the medication is taken on an empty stomach. Taking the medication with high-fat foods minimizes this side effect. Some children experience weight loss during the first few months of treatment. Other side effects include dizziness, irritability, somnolence, and allergic reactions. Small increases in pulse and blood pressure do occur (Michelson et al., 2001). Although there were not reports of hepatotoxicity in the 4,000 individuals who were studied prior to FDA approval, postmarketing surveillance has identified at least two individuals who had increases in liver enzymes on this medication. Both improved after the medication was stopped. There is insufficient evidence at this time to make recommendations about the monitoring of liver function tests on atomoxetine, but parents should be made aware of the need for a physician to review any persistent gastrointestinal complaints or general malaise.

Antidepressants Several types of antidepressants have been found to be effective in children with ADHD. More than 20 placebo-controlled studies of tricyclic antidepressants (TCAs)—including desipramine (Norpramin), imipramine (Tofranil), and nortriptyline (Pamelor)—have demonstrated that they improve ADHD symptoms, although TCAs appear to have a greater impact on parent and teacher ratings of behavior than on neuropsychological measures of cognitive functioning (Banaschewski et al., 2004; Biederman, Spencer, & Wilens, 2004). About two thirds of children with ADHD who do not respond to a stimulant will improve with a TCA (Biederman et al., 1989).

Compared with stimulants, TCAs have advantages that are similar to those of atomoxetine. They have a longer duration of action, low abuse potential, and tend not to exacerbate tics (Singer et al., 1995). However they have many more potentially problematic cardiovascular, neurologic (tingling, incoordination, tremors), and anticholinergic (blurred vision, dry mouth) side effects that limit their use. Drug levels should be checked, as there can be large interindividual differences in metabolism of these medications (Banaschewski et al., 2004). Electrocardiograms (EKGs) must be obtained at baseline and monitored for cardiovascular changes. Overdoses can be lethal, and a few cases of sudden death, presumably from cardiac arrhythmias, have occurred in children taking appropriate doses of desipramine, although causality could not be clearly established (Popper, 2000).

Bupropion (Wellbutrin) is a chemically distinct antidepressant whose precise mechanism of action in ADHD treatment remains unknown, although it is a weak dopamine reuptake inhibitor. It has been shown to improve ADHD symptoms in both children and adults with ADHD (Pliszka, 2003a). Beneficial effects may be detected as early as 3 days after initiation of treatment, but maximum effects may not be seen until 4 weeks of treatment (Conners et al., 1996). On average, the magnitude of the effects is similar to or slightly less than those of stimulants (Conners et al., 1996). Gastrointestinal complaints, drowsiness, and rashes are the most common side effects. Wellbutrin is associated with a slightly increased risk of drug-induced seizures (about 4 per 1,000 patients). Use of high doses, a previous history of seizures, and the presence of an eating disorder seem to increase the risk for seizures. Bupropion may exacerbate tic disorders.

Alpha-2-Adrenergic Agonists Despite relatively limited studies, the alpha-2-adrenergic agents, clonidine (Catapres) and guanfacine (Tenex), are used for the treatment of ADHD. These medications can reduce hyperactivity and impulsivity, but they may not improve attention span (Tourette Syndrome Study Group, 2002). Studies investigating the combination of clonidine with a stimulant suggest that some children may benefit more from the combination than from a stimulant alone (Hazell & Stuart, 2003; Tourette Syndrome Study Group, 2002). In addition, clonidine has been used for stimulant-related sleep difficulties (Banaschewski et al., 2004).

Sedation is the most common side effect of clonidine and has led clinicians to use the less sedating medication, guanfacine, although there are even fewer studies of this medication. Dizziness and hypotension can occur with these medications, and some children become irritable or depressed while taking them. Alpha-2 adrenergic agonists should not be stopped abruptly, as this can result in rebound hypertension.

TREATMENT WITH COEXISTING CONDITIONS

Intellectual Disability

Individuals with intellectual disability can be diagnosed with ADHD if their inattention or hyperactivity and impulsivity are inconsistent with their developmental level and cause additional functional impairments. Studies suggest that stimulants have similar effects in children with ADHD and intellectual disabilities requiring intermittent to limited supports as in children with ADHD and typical intelligence (Handen et al., 1992). Children with intellectual disabilities, however, have a lower response rate (around 50%) and an increased risk for side effects, such as tics and social withdrawal (Handen et al., 1991). Alpha-2-adrenergic agents and atypical antipsychotics such as risperidone (Risperdal) have also been used to treat hyperactivity and disruptive behaviors in individuals with intellectual disabilities (Turgay et al., 2002).

Internalizing Disorders

Children with ADHD may also experience depression or anxiety disorders. The Multimodal Treatment Study of ADHD found that children with anxiety disorders were one of the few groups that responded as well to psychosocial intervention as to medication (MTA Cooperative Group, 1999b). However, stimulants are effective in the treatment of ADHD in combination with anxiety and mood disorders and remain the first-line medication. Thus the Texas Children's Medication Algorithm recommends that if depression symptoms persist after treatment with stimulants, an SSRI should be added to the stimulant (Emslie et al., 2004). However, the finding that SSRIs can increase suicidal ideation in individuals with depression underscores the need for close monitoring of children being treated for depression (March et al., 2004). In addition, there are no studies comparing this approach to the use of a single medication, such as bupropion or the TCAs, which may improve both depression and ADHD symptoms.

Conduct Disorders

The behavior exhibited by children with a conduct disorder consists of a pattern of persistent and repetitive violation of the rights of others or of age-appropriate social norms or rules. Individuals with ADHD and conduct disorder are at a much higher risk of developing substance abuse, of developing antisocial personality disorder, and of being involved in criminal activity than individuals with ADHD alone (Pliszka, 2003b). Individuals with ADHD and conduct disorder respond to stimulants for their ADHD (Pliszka, 2003b); however, they require intensive multimodal intervention that includes medication, behavior therapy, family therapy, and school-based interventions (Frick, 2001). Treatment must be tailored to the individual child's symptoms and may include the use of antidepressants, mood stabilizers, or atypical antipsychotics.

MULTIMODAL TREATMENT

The Multimodal Treatment Study of ADHD is the largest clinical trial of ADHD treatments to date (MTA Cooperative Group, 1999a). This multisite study of 576 children between the ages of 7 and 9 years randomized participants into one of four treatment groups: 1) medication management, 2) intensive behavioral treatment, 3) medication and intensive behavioral treatment, and 4) standard community care. The medication management group received primarily methylphenidate titrated to the best of three doses. The behavioral treatment involved 35 group and individual sessions for parents, a summer program for children, teacher consultation, and 60 days of a part-time behaviorally trained paraprofessional working with the child in school. The combined treatment group received both of these interventions; those in the standard community care group were evaluated and referred back to providers in their own community for treatment.

Outcome was assessed 14 months after the initiation of treatment. For improving the core ADHD symptoms, medication alone was nearly as effective as the combined treatment. Those receiving the combined treatment, however, achieved these outcomes on lower doses of medication than the medication only group. Both the combined and medication only treatments were more effective in improving core ADHD symptoms than behavioral treatment or community care. In terms of academic achievement, anxiety/depressive symptoms, and oppositional/aggressive symptoms, there were small benefits of combined treatment compared with medication alone on some but not all outcome measures (Jensen et al., 2001). Thus, this study and other studies of intensive psychosocial interventions (Abikoff et al., 2004) suggest that behavioral interventions have only small additional benefits for children who respond to stimulant medication. Nonetheless, the study revealed some important points about matching psychosocial interventions to individual patients. For example, children with anxiety disorders at the beginning of treatment responded as well to the psychosocial treatment as they did to medication alone. Moreover, in this group, the combined treatment offered greater advantages over medication alone than were found for the rest of the sample. Families who were on public assistance also had greater benefit from the psychosocial intervention than medication alone. Moreover, despite the greater efficacy of medication treatment, the behavioral intervention was rated as more acceptable to parents (MTA Cooperative Group, 2004a).

COMPLEMENTARY AND ALTERNATIVE THERAPIES

There are numerous nonconventional treatments for ADHD (Arnold, 2001a, 2000b; Baumgaertel, 1999). Among these, the only controlled studies involve dietary interventions. Dietary treatments have taken two general approaches, either elimination of foods thought to cause symptoms or addition of dietary supplements, vitamins, or minerals. Controlled studies comparing diets eliminating certain additives, commonly allergenic foods, or both with disguised diets containing these substances have found that approximately 10%–20% of subjects have significant improvements in rating scale measures of some symptoms. Hyperactivity and irritability are more likely to improve than inattention, and younger children may be more likely to respond than older children (Arnold, 2001a; Bateman et al., 2004). In contrast to elimination of allergens and additives, elimination of sugar has not been found to have an observable effect (Wolraich, Wilson, & White, 1995).

Studies of minerals have documented that children with ADHD may be relatively deficit in iron, zinc, and magnesium (Arnold, 2001a; Konofal et al., 2004). Small open label studies of supplementation with these minerals have demonstrated some improvement in ADHD symptoms (Arnold, 2001a, 2001b). A large, double-blind placebo-controlled study of zinc found improvements in hyperactive and impulsive behaviors but not inattentive behaviors. Approximately 29% of the zinc-treated group versus 20% of the placebo group were judged to be responders, and those with lower zinc levels at baseline were more likely to respond (Bilici et al., 2004). Further study of the role of zinc deficiency in ADHD and the effects of supplementation is warranted, as most of the studies have been done in non-Western cultures in which zinc deficiency is more prevalent (Arnold & DiSilvestro, 2005). Megadoses of vitamins or minerals can have negative health effects and are not indicated or expected.

Essential fatty acids (EFAs) are lower in children with ADHD than in controls, and supplementation has shown positive effects in a number of mental health disorders, (reviewed in Richardson & Puri, 2000). Positive (Richardson & Montgomery, 2005) and negative (Voigt et al., 2001) results have been found in ADHD. Positive studies used eicosapentaenoic (EPA, omega-3), docosahexaenoic (DHA, omega-3), and linoleic acid (LA, omega-6) or gama-linoleic acid (GLA, omega 6) together, whereas negative studies used either DHA or LA/GLA alone, suggesting that a combination may be necessary. Because children may be deficient at certain points in the metabolism of certain EFAs, initial measures followed by individualized treatment may be a more appropriate way to assess the effects of supplementation.

Several techniques that "train the brain" are being investigated as alternative treatments (Hirshberg, Chiu, & Frazier, 2005). Electroencephalogram (EEG) biofeedback is the technique that has been studied most extensively. Studies of the quantity of different types of brain waves produced by groups with ADHD versus controls have shown that subjects with ADHD tend to have a lower level of those waves (alpha and beta) associated with alert, thinking states and a higher level of those waves (theta) associated with drowsiness. EEG biofeedback uses computer technology to train the individual to produce more of the brain wave patterns associated with concentration and to suppress those associated with drowsiness (Gruzelier & Egner, 2005; Hirshberg et al., 2005; Monstra, 2005). There is some evidence for its effectiveness (Monstra, 2005; Rossiter, 2004). EEG biofeedback is safe but time consuming and expensive, and it is not clear which symptoms or children can be predicted to respond. Specific training programs to improve working memory and motor control show promising initial results, and further study is indicated (Klingberg et al., 2005).

OUTCOME

Although overt hyperactivity and impulsivity tend to decline as a clinical problem when youth reach adolescence and young adulthood, inattention often persists. It is estimated that ADHD persists into adulthood in 30% to more than 60% of individuals diagnosed with this disorder as children. In many individuals whose symptoms no longer meet the criteria for ADHD, subclinical difficulty with sustained attention and/or impulsivity may persist (Faraone et al., 2006). In general, adults with ADHD complete less formal schooling, have lower-status jobs and work performance ratings, are more likely to have their driver's licenses suspended and to get into car accidents, have higher rates of antisocial behavior (Barkley, 2002; Mannuzza & Klein, 2000), and have higher rates of additional neuropsychiatric disorders (Biederman et al., 2006).

The presence of conduct disorder is the strongest predictor for adverse outcome, placing children and teens at risk for antisocial personality disorder and substance abuse (Barkley et al., 2004). However, underachievement in educational and occupational level in those with ADHD compared with controls persists even when the adults with antisocial personality disorder are excluded from the sample (Mannuzza et al., 1993). Those whose ADHD symptoms improve during adolescence tend to have a much better outcome than those with persistent symptoms (Biederman, Mick, & Farone, 1998; Greenfield, Hechtman, & Weiss, 1988).

SUMMARY

ADHD is a prevalent neurodevelopmental condition that has a significant impact on the lives of affected children, their families, and the educational and medical/mental health systems. The core features of difficulty sustaining mental effort, hyperactivity, and impulsivity lead to impairment in academic, occupational, social, and adaptive functioning without effective intervention. Coping with ADHD is made more complicated by commonly coexisting conditions, including learning disorders, oppositional defiant disorder, and anxiety disorders. ADHD is highly genetic, but adverse conditions in the pre- and perinatal period can contribute to symptoms. Multiple lines of evidence suggest a biological basis involving frontal cortical-basal ganglia-cerebellar pathways and biogenic amine neurotransmitters, particularly dopamine and norepinephrine. Treatments include counseling, particularly that focusing on behavior management; accommodations in the classroom; addressing coexisting conditions; and medication. Fortunately, the knowledge and resources presently available, and the increases in these areas that are sure to occur over the next generation, offer children growing up with ADHD the opportunity to experience success.

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