Academic and Educational Outcomes of Children With ADHD

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Attention-deficit/hyperactivity disorder (ADHD) is associated with poor grades, poor reading and math standardized test scores, and increased grade retention. ADHD is also associated with increased use of school-based services, increased rates of detention and expulsion, and ultimately with relatively low rates of high school graduation and postsecondary education. Children in community samples who show symptoms of inattention, hyperactivity, and impulsivity with or without formal diagnoses of ADHD also show poor academic and educational outcomes. Pharmacologic treatment and behavior management are associated with reduction of the core symptoms of ADHD and increased academic productivity, but not with improved standardized test scores or ultimate educational attainment. Future research must use conceptually based outcome measures in prospective, longitudinal, and community-based studies to determine which pharmacologic, behavioral, and educational interventions can improve academic and educational outcomes of children with ADHD.

Key words attention-deficit/hyperactivity disorder; behavior management; pharmacologic treatment; school-based services; education; Academic achievement; Educational underachievement; Learning.

Problems in school are a key feature of attention-deficit/hyperactivity disorder (ADHD), often bringing the child with ADHD to clinical attention. It is important to establish the nature, severity, and persistence of these school difficulties in children with ADHD. It is also critical to learn how various treatments affect academic and educational outcomes. These findings inform clinical practice, public health, public education, and public policy. This review of academic and educational outcomes of ADHD is organized around 5 questions: (1) What are the academic and educational characteristics of children with ADHD? (2) Are academic and educational problems transient or persistent? (3) What are the academic characteristics of children with symptoms of ADHD but without formal diagnoses? (4) How do treatments affect academic and educational outcomes? (5) How should we design future research to determine which treatments improve academic and educational outcomes of children with ADHD?

Conceptual Framework

We used the International Classification of Functioning, Disability, and Health (ICF)[1] as the conceptual framework for describing the functional problems associated with ADHD. The World Health Organization developed the ICF to provide a systematic and comprehensive framework and common language for describing and assessing functional implications of health conditions, regardless of the specific disease or disorder. Use of this model facilitates comparisons of health-related states across conditions, studies, interventions, populations, and countries.

In the underlying ICF conceptual framework, health conditions impact function at 3 mutually interacting levels of analysis (Figure 1): body functions and structures, activities of daily living, and social participation. Problems of body functions and structures are called *impairments*, a more specific and narrow meaning for the term than that used in DSM-IV.[2] Problems of activities of daily living are called *limitations*. Problems of social participation are called *restrictions*. Environmental and personal factors can also affect functioning. Treatments may address the health condition directly, may be aimed at one or more domains within the levels of functioning, or may be designed to change the environment. Because of the bidirectional influences

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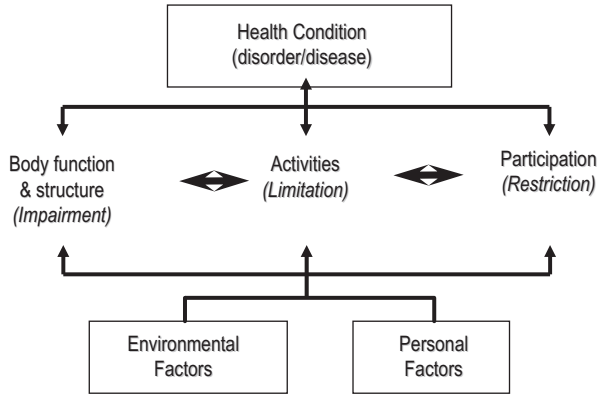

Figure 1. Conceptual model of International Classification of Functioning, Disability, and Health.

within and among these levels of analysis, treatments directed at one problem may indirectly improve problems at other levels.

Figure 2 applies the ICF model to school functioning in children with ADHD using the specific codes and terminology of the classification system. At the level of body functions, ADHD affects several global and specific mental functions: intellectual function; impulse control; sustaining and shifting attention; memory; control of psychomotor functions; emotion regulation; higher level cognition, including organization, time management, cognitive flexibility, insight, judgment, and problem solving; and sequencing complex movements. At the level of activities, ADHD may result in limitations in at least 2 domains relevant to this review (and other domains addressed by other chapters in this volume): (1) learning and applying knowledge, including reading, writing, and calculation; and (2) general tasks and demands, including completing single or multiple tasks, handling one's own behavior, and managing stress and frustration. Here, we will differentiate between *academic underachievement*, which will refer to problems in learning and applying knowledge, including earning poor grades and low standardized test scores, and *academic performance*, which includes completing classwork or homework. At the level of social participation, ADHD can compromise the major life area of education, including creating restrictions in moving in and across educational levels, succeeding in the educational program, and ultimately leaving school to work. Any one of these functional problems may have many contributors, including the health condition and functional problems at other levels of analysis. We will refer to the restrictions in participation as *educational problems*. Environmental factors relevant to outcomes in ADHD include general and special education services and policies.

Evolving Definitions of ADHD

The clinical criteria for ADHD have evolved over the last 25 years. Studies from the 1980s and 1990s often used different inclusion and exclusion criteria than were used in more recent studies. Some studies carefully differentiate between children with what we now label as ADHD-Combined subtype (ADHD-C) and attention deficit disorder or ADHD-predominantly Inattentive subtype (ADHD-I). We will address briefly the outcomes of the subtypes specifically. Many children with ADHD have comorbid conditions, including anxiety, depression, disruptive behavior disorders, tics, and learning problems. The contributions of these co-occurring problems to the functional outcomes of ADHD have not been well established. Therefore, in this review, we will consider the academic and educational outcomes of ADHD without subdividing the population on the basis of coexisting neurobehavioral problems in affected children.

What are the Academic and Educational Characteristics of Children with ADHD?

Children with ADHD show significant academic underachievement, poor academic performance, and educational problems.[3–8] In terms of impairment of body functions, children with ADHD show significant decreases in estimated full-scale IQ compared with controls but score on average within the normal range.[9] In terms of activity limitations, children with ADHD score significantly lower on reading and arithmetic achievement tests than controls.[9] In terms of restrictions in social participation, children with ADHD show increases in repeated grades, use of remedial academic services, and placement in special education classes compared with controls.[9] Children with ADHD are more likely to be expelled, suspended, or repeat a grade compared with controls.[10]

Children with ADHD are 4 to 5 times more likely to use special educational services than children without ADHD.[10,11] Additionally, children with ADHD use more ancillary services, including tutoring, remedial pull-out classes, after-school programs, and special accommodations.

The literature reports conflicting data about whether the academic and educational characteristics of ADHD-I are substantially different from the characteristics

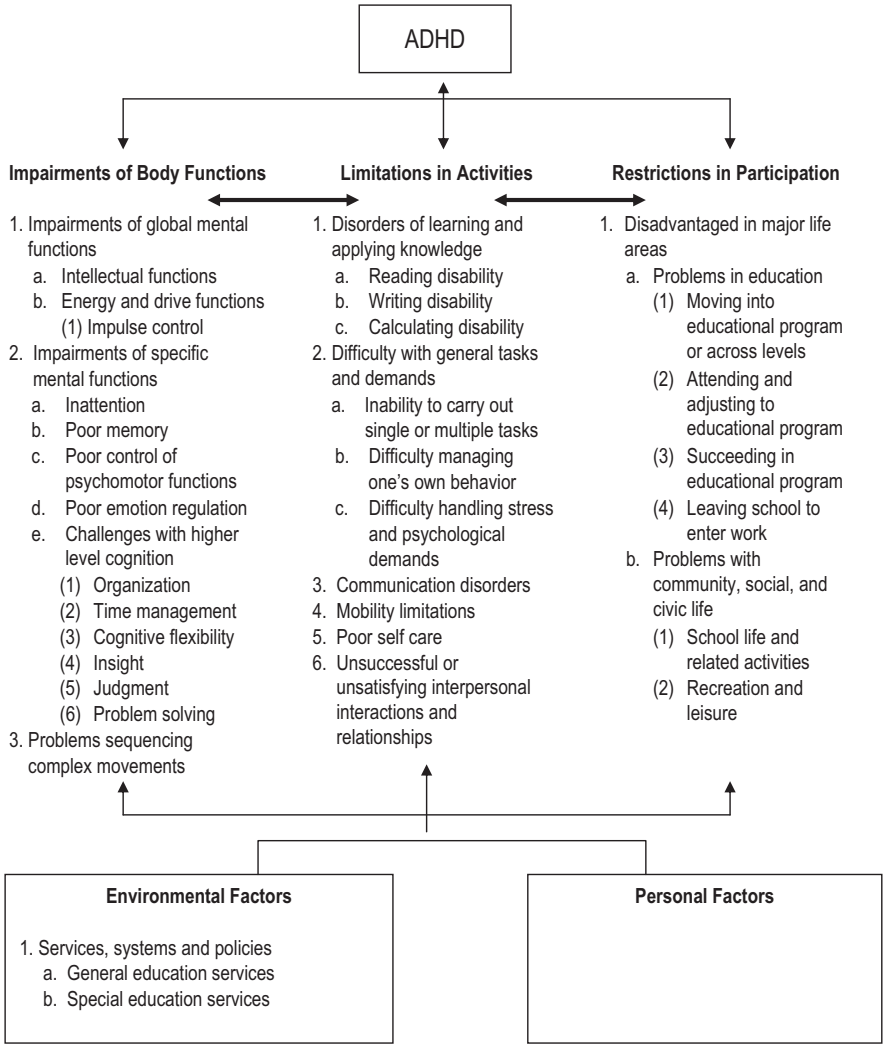

Figure 2. Functional problems associated with attention-deficit/hyperactivity disorder using the International Classification of Functioning, Disability, and Health conceptual model.

of ADHD-C.[12,13] Some studies have not found different outcomes in terms of academic attainment, use of special services, and rates of high school graduation.[14] However, a large survey of elementary school students found children with ADHD-I were more likely to be rated as below average or failing in school compared with the children with ADHD-C and ADHD–predominantly hyperactive-impulsive subtype.[15] A subset of children with ADHD-I are described as having a sluggish cognitive tempo, leading to the assumption that there is a higher prevalence of learning disorders in the ADHD-I than the ADHD-C populations. One study supporting this claim found more children with ADHD-I than children with ADHD-C in classrooms for children with learning disabilities.[16] Comparative long-term outcome studies of the subtypes in terms of academic and educational outcomes have not been conducted.[17]

Are Academic and Educational Problems Transient or Persistent?

Longitudinal studies show that the academic underachievement and poor educational outcomes associated with ADHD are persistent. Academic difficulties for children with ADHD begin early in life. Symptoms are commonly reported in children aged 3 to 6 years,[18] and preschool children with ADHD or symptoms of ADHD are more likely to be behind in basic academic readiness skills.[19,20]

Several longitudinal studies follow school-age children with ADHD into adolescence and young adulthood. Initial symptoms of hyperactivity, distractibility, impulsivity, and aggression tend to decrease in severity over time but remain present and increased in comparison to controls.[21] In terms of activity limitations,

subjects followed into adolescence fail more grades, achieve lower ratings on all school subjects on their report cards, have lower class rankings, and perform more poorly on standardized academic achievement tests than matched normal controls.[22–26] School histories indicate persistent problems in social participation, including more years to complete high school, lower rates of college attendance, and lower rates of college graduation for subjects than controls.[27–30]

The subjects with ADHD in the longitudinal studies generally fall into 1 of 3 main groups as young adults: (1) approximately 25% eventually function comparably to matched normal controls; (2) the majority show continued functional impairment, limitations in learning and applying knowledge, and restricted social participation, particularly poor progress through school; and (3) less than 25% develop significant, severe problems, including psychiatric and/or antisocial disturbance.[31] It is unclear what factors determine the long-term outcomes. Persistent difficulties may be due to ADHD per se or may be due to a combination of ADHD and coexisting conditions, including learning, internalizing, and disruptive behavior disorders. The contribution of environmental factors to outcomes is also unclear.

What are the Academic Characteristics of Children with Symptoms of ADHD but without Formal Diagnoses?

Studies of outcome in children diagnosed with ADHD suffer from a potentially serious logical problem: circularity.[32] The clinical definition of ADHD in the DSM-IV requires the presence of functional impairment, typically defined in terms of behavior and performance at home and school. School problems are almost always present to make the diagnosis and therefore are more likely to be present at follow-up. Another problem in the use of clinic-referred samples is the selection bias in who gets referred to diagnostic clinics. One research strategy to complement the longitudinal studies of clinic-referred samples and avoid these problems is to evaluate children from community-based samples who demonstrate symptoms of ADHD but who have not necessarily been formally diagnosed with ADHD. In general, these studies find that children with symptoms of ADHD and without formal diagnoses also have adverse outcomes.

An early community-based study that charted the natural history of ADHD[33] followed subjects who were diagnosed and treated during childhood and children with symptoms and/or behavior indications who were never diagnosed or treated. Both groups were far more likely to attend special education schools and far less likely to graduate from high school or go to college than the asymptomatic controls. The magnitude of the difference was greater for the children with formal diagnosis than for those with pervasive symptoms.

Another community-based study on the relationship between symptoms of ADHD, scores on academic standardized tests, and grade retention found a linear relationship between the number of behavioral symptoms and academic achievement, even among children whose scores were generally below the clinical threshold for the diagnosis of ADHD.[34] Similar findings have been found in studies from Britain[35] and New Zealand.[36] Taken together, these findings suggest that the symptoms and associated features of ADHD are associated with adverse outcomes.

How do Treatments Affect Academic and Educational Outcomes?

By using the ICF framework, treatments can be evaluated in terms of whether they improve body functions, including intelligence, sustained attention, memory, or executive functions; affect activities, including increasing learning and applying knowledge (such as raising standardized test scores or grades in reading, mathematics, or writing) and improving attending and completing tasks; or enhance participation, including moving across educational levels, succeeding in the educational program, and leaving school for work.

Medical Treatments

Psychopharmacological treatments, particularly with stimulant medications, reduce the core symptoms of ADHD[37] at the level of body functions. In addition, psychopharmacological treatments have been shown to improve children's abilities to handle general tasks and demands; for example, medication has been shown to improve academic productivity as indicated by improvements in the quality of note-taking, scores on quizzes and worksheets, the amount of written-language output, and homework completion.[38] However, stimulants are not associated with normalization of skills in the domain of learning and applying knowledge.[39] For example, stimulant medications have not generally been associated with improvements in reading abilities.[40,41] In longitudinal studies, subjects demonstrated poor outcomes compared with controls whether or not they received medication.[24,25,27,42–44] One caution in interpreting these

findings is that it cannot be determined if outcomes would have been even worse without treatment because studies often lacked a true nontreatment group with ADHD. Another problem was attrition; subjects lost to follow-up may include those with worse outcomes. A third caution is that most children receive medication for only 2 to 3 years,[45] and it remains unclear whether steady treatment over many years would be associated with improved outcomes.

Behavior Management of ADHD

Behavioral interventions for ADHD, including behavioral parent training, behavioral classroom interventions, positive reinforcement and response cost contingencies, are effective in reducing core ADHD symptoms.[17,30,46] However, in head-to-head comparisons behavior management techniques are less effective than psychostimulant medications[37] in reducing core symptoms. It has been shown that behavior management is equivalent or better than medication in improving aspects of functioning, such as parent-child interactions and reduction in oppositional-defiant behavior. However, the problem with this literature is that most behavior management intervention studies evaluate the impact on short-term behavior outcomes, not academic and educational outcomes. The impact of behavioral treatments on long-term academic and educational outcomes must be carefully studied.

Combined Management of ADHD

Given the chronic nature of ADHD and its impact on multiple domains of function, it is likely that multiple treatment approaches are needed. However, the impact of such combined treatments on long-term academic and educational outcomes has not been well studied. Combined treatment (medication and behavioral treatment) in the Multimodal Treatment Study of Children With ADHD was better than behavioral treatment and community care for reading achievement; however, the differences were small and of questionable clinical significance.[37] In addition, children with ADHD and co-occurring anxiety or environmental adversity derived benefit from the combination of medication and behavior management.[47,48] We need studies to determine whether combined treatment has a larger impact on academic and educational outcomes in some subpopulations than others.

In terms of academic achievement and performance, a 2-year study comparing therapy with methylphenidate to therapy with methylphenidate plus multimodal psychosocial treatments found no advantage of combined treatment over medication alone on any academic measures.[49] The multimodal treatment included academic assistance, organizational skills training, individual psychotherapy, social skills training, and, if needed, reading remediation using phonics. In these studies, medication and/or behavior management, whether used alone or in combination, did not improve academic and educational outcomes of ADHD.

Educational Interventions and Services

The impact of remedial educational services on academic and educational outcomes is not known. Most available treatment outcome studies have not been conducted in general education classroom settings[50] and have focused on reducing problematic behavior rather than on improving scholastic status.[51] Even current rates of utilization are difficult to determine because ADHD itself is not an eligibility criterion for special education.[52] Although advocates pursued making ADHD a category of disability under the Individuals with Disabilities Education Act of 1990 (IDEA), this attempt was not successful.[53] Instead, the US Department of Education issued a policy memorandum[54] stating that students with ADHD were eligible for special education services under the Other Health Impairment category if problems of limited alertness negatively affected academic performance. Children with ADHD may qualify for special education services if they are eligible for another IDEA category, such as emotional disturbance or specific learning disability, but the children with ADHD are not disaggregated from students without ADHD in these categories.[55]

Educational services are also provided to students with ADHD who do not meet IDEA eligibility requirements under Section 504 of the Vocational Rehabilitation Act of 1973 if the condition substantially limits a major life activity, such as learning.[53] Services include accommodations and related services in the general education setting, such as preferential seating, modified instructions, reduced classroom and homework assignments, and increased time or environmental modification for test taking. There is wide variability in the knowledge and application of Section 504 services among parents and educators.[53]

For both special education and Section 504 services, the children most likely to obtain services are those with the most severe functional limitations. Therefore, it would be difficult to interpret associations among use of services and outcomes. There are no data regarding effectiveness

of many commonly recommended accommodations, such as preferential seating, on outcomes.

How should We Design Future Research to Determine Which Treatments Improve Academic and Educational Outcomes of Children with ADHD?

The evidence that ADHD is associated with poor academic and education outcomes is overwhelming. However, studies thus far find that treatments are associated with relatively narrow improvements in core symptoms of inattention, hyperactivity, and impulsivity at the level of body functions and attending and completing tasks at the level of activities. We need prospective, controlled, and large-scale studies to investigate whether existing or new treatments will improve reading, writing, and mathematics skills; reduce grade retention; reduce expulsions and detentions; improve graduation rates; and increase completion of postsecondary education. In a literate, information-age society, these improved outcomes are vital to the economic and personal well-being of individuals with ADHD.

Because of the limitations of previous research, we recommend that future research incorporate several features. In terms of the subjects, the study must specify clear inclusion criteria, including diagnostic criteria for ADHD, subtypes, and coexisting conditions. Given the research history to date, we favor community- or school-based samples as opposed to clinic-referred samples to avoid selection bias. Studies should be conducted in general education as well as secondary school settings, given the lack of data from these settings. In terms of the outcome variables, we support use of standardized definitions of functional outcomes following the conceptualization of function provided by the ICF framework. We specifically favor repeated measures of academic achievement. Unfortunately, measures such as grades may vary across school systems. For this reason, the use of achievement tests may be preferable in large-scale studies. In addition, measures relevant to educational promotion, such as college entrance examinations, may provide more standardized information than graduation rates. In local or regional studies, other repeated measures may be possible, including analysis of portfolios. Another sensitive measure that could be collected on a continuous basis is curriculum-based measurement,[56] which involves probes of reading and math performance relative to the instructed curriculum and permits examination of relative trajectories over time as a measure of treatment outcome.

Designing convincing studies on the long-term impact of medication or behavior management on academic and educational outcomes is challenging because it is unethical to withhold standard treatments for long periods of time from an affected sample to create a control group. To circumvent this problem, we suggest large-scale studies that evaluate rates of change in the outcomes as a function of treatment strategy (or intensity) and that use statistical methods such as hierarchical linear modeling.[57] In this approach, individual students are nested in hierarchies that are defined by grade and diagnosis and also by treatment type and intensity. Repeated measures for outcomes, such as reading or math standard scores, are collected over time. The statistical methods estimate the effects of each factor—age and treatment intensity—on the rate of change. This method can demonstrate if the rate of change increases more rapidly in some groups than other groups and more rapidly than would have been predicted on the basis of status at study entry. The hierarchical linear modeling method is also helpful with differentiating rates of progress among children who adhere to treatment recommendations over long periods of time versus those who discontinue treatment after a few months or years.

We also recommend that the research strategy incorporate a 2-tiered approach. First, improvements in instruction/teaching methods, curriculum design, school physical designs, and environmental modifications should be offered to all students. We can call this phase *improved universal design*. Schools often try to change the child with ADHD to fit the school environment. Attempts to ''normalize'' behavior include pulling a child out of the classroom, perhaps applying a remedial strategy, and then putting the child back into the original setting, with the hope that the child will now be successful.[58] This strategy identifies the child as the problem, serves to isolate and potentially stigmatize the child, and precludes the exploration of environment-based solutions.[59] The advantage of universal design is that most children with ADHD are educated in general education settings. Improved universal design in the classroom could potentially benefit all children in the classroom, particularly those with ADHD. Such interventions may not decrease the differences between children with ADHD and their peers without ADHD on some measures, such as standardized test scores. However, more important is whether the children with ADHD reach a higher threshold of achievement, such as improved reading scores or higher rates of high school graduation.

The second tier for research is specific interventions for children with ADHD, layered on top of the basic reforms. These interventions can include teaching methods, new curricula, specific behavior management, and school-based intervention approaches.[60]

We will focus on 6 different options that warrant further investigation in this 2-tiered research design: (1) small class size; (2) reducing distractions; (3) specific academic intervention strategies; (4) increased physical activity; (5) alternative methods of discipline; and (6) systems change.

Small Class Size

A study based in London schools of regular education students found that variations in average class size in the 25- to 35-student range are of little consequence in affecting student progress, probably because of a lack of opportunity for differences in classroom management techniques.[61] However, small classes of approximately 8 to 15 students have been beneficial for younger children and children with special needs.[62] Because children with ADHD are reported to do better with one-on-one instruction, smaller class size makes intuitive sense. Teachers perceive class size to be one of the major barriers to inclusion of ADHD students in regular education.[63] Empiric investigation on reduced class size is therefore warranted for all children, and also for children with ADHD. Small class sizes will probably result in use of innovative educational approaches that are precluded in the current system.

Reducing Distractions

Classrooms are often noisy and distracting environments. Children perform more poorly in noisy situations than do adults, and researchers have reported that the ability to listen in noise is not completely developed until adolescence or adulthood.[64–66] If an acoustic environment can be provided that allows +15 dB signal-to-noise ratio throughout the entire classroom, then all participants can hear well enough to receive the spoken message fully.[64] Accommodations in Section 504 plans often include repeating instructions and providing quiet test-taking areas that are free of distractions. Repetition of instructions alone is not likely to increase the attention of children with ADHD. Thus, methods for reducing noise and other distractions should be studied.

Specific Academic Intervention Strategies

As reviewed by Hoffman and DuPaul,[51] the so-called antecedent-oriented management strategies are good universal design features that hold promise for improving outcomes for children with ADHD. Antecedent interventions include choice making, peer tutoring, and computer-aided instruction, all reviewed below. Such strategies are proactive, support appropriate adaptive behavior, and prevent unwanted, challenging behaviors. These strategies make tasks more stimulating and provide students with opportunities to make choices related to academic work.[67] They may be particularly helpful for children with ADHD who demonstrate avoidance and escape behaviors.

Choice-making strategies allow students to select work from a teacher-developed menu. In a study of choice making with children with emotional and behavioral difficulties in a special education classroom, students demonstrated increased academic engagement and decreased behavior problems.[68] Another study demonstrated decreased disruptive behavior in a general education setting,[69] although more variable academic and behavioral performance occurred in a study of 4 students with ADHD in a general education setting.[51] A related concept is project-based learning, which capitalizes on student interests and provides a dynamic, interactive way to learn.

Studies of Class Wide Peer Tutoring, a widely used form of peer tutoring, have demonstrated enhanced task-related attention and academic accuracy in elementary school students with ADHD,[70,71] as well as positive changes in behavior and academic performance in students without ADHD.[72] Teachers perceive time requirements of specialized interventions as a significant barrier to the inclusion of ADHD students.[63] Peer tutoring reduces the demands on teachers to provide one-on-one instruction. At the same time, it gives students with ADHD the opportunity to practice and refine academic skills, as well as to enhance peer social interactions, promoting self-esteem. Peer tutoring may be particularly effective when students are using disruptive behavior to gain peer attention.[51]

Computer-aided instruction has intuitive appeal as a universal design feature and for children with ADHD because of its interactive format, use of multiple sensory modalities, and ability to provide specific instructional objectives and immediate feedback. Computer-aided instruction has not been well studied in children with ADHD.[51,73] Studies with small numbers of subjects showed promising initial results[74,75] but did not examine the effects on academic achievement. A small study of 3 children with ADHD that used a game-format math program found increases in academic achievement and increased task engagement.[76]

Increased Physical Activity

Given that fidgeting and out-of-seat behavior are common in children with ADHD, increased use of recess and physical exercise might reduce overactivity. A study on the effects of a traditional recess on the subsequent classroom behavior of children with ADHD showed that levels of inappropriate behavior were consistently higher on days when participants did not have recess, compared with days when they did have recess.[77] A meta-analysis of studies on the effects of regular, noncontingent exercise showed reductions in disruptive behavior with greater effects in participants with hyperactivity.[78] Increased physical exercise would be beneficial for long-term health and for behavioral regulation in both children developing typically and children with ADHD.

Alternative Methods of Discipline

Many students receive suspensions or are sent to the principal's office for disruptive behavior. For those children who are avoiding work, these approaches are equivalent to positive reinforcement. Such avoidant or escape behavior could be countered with in-school as opposed to out-of-school suspensions. The use of interventions that teach children how to replace disruptive behaviors with appropriate behaviors is less punitive than suspensions and more effective in promoting academic productivity and success.[17]

Systems Change

Classroom changes are unlikely to create adequate improvements without concomitant changes in the educational system. Three potential areas under the category of systems change are improved education of teachers and educational administrators; enhanced collaborations among family members, school professionals, and health care professionals; and improved tracking of child outcomes. Teacher surveys demonstrate that teachers perceive the need for more training about ADHD.[63] The optimal management of children with ADHD requires close collaboration of their parents, teachers, and health care providers. Currently there is no organized system to support this collaboration.

At the policy level, we need mechanisms to track the outcome of children with ADHD in relation to educational reform and utilization of special services. Federally supported surveys could focus on services and treatments for mental health conditions, including ADHD, and their impact on outcomes. Relevant data for the relationship of interventions and outcomes may also exist at the local and state level. Building on existing local and state databases to include health and mental health statistics could provide valuable information on this issue.

Conclusion

We remain ill informed about how to improve academic and educational outcomes of children with ADHD, despite decades of research on diagnosis, prevalence, and short-term treatment effects. We urge research on this important topic. It may be impossible to conduct long-term randomized, controlled trials with medication or behavior management used as treatment modalities for practical and ethical reasons. However, large-scale studies that use modern statistical methods, such as hierarchical linear modeling, hold promise for teasing apart the impact of various treatments on outcomes. Such methods can take into account the number and types of interventions, duration of treatment, intensity of treatment, and adherence to protocols. Educational interventions for children with ADHD must be studied. We recommend large-scale, prospective studies to evaluate the impact of educational interventions. These studies should be tiered, introducing universal design improvements and specific interventions for ADHD. They must include multiple outcomes, with emphasis on academic skills, high school graduation, and successful completion of postsecondary education. Such studies will be neither cheap nor easy. A broad-based coalition of parents, educators, and health care providers must work together to advocate for an ambitious research agenda and then design, implement, and interpret the resulting research. Changes in local, state, and federal policies might facilitate these efforts by creating meaningful databases and collaborations.

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