Prevalence and Assessment of Attention-Deficit/Hyperactivity Disorder in Primary Care Settings

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ABSTRACT. Research literature relating to the prevalence of attention-deficit/hyperactivity disorder (ADHD) and co-occurring conditions in children from primary care settings and the general population is reviewed as the basis of the American Academy of Pediatrics clinical practice guideline for the assessment and diagnosis of ADHD. Epidemiologic studies revealed prevalence rates generally ranging from 4% to 12% in the general population of 6 to 12 year olds. Similar or slightly lower rates of ADHD were revealed in pediatric primary care settings. Other behavioral, emotional, and learning problems significantly co-occurred with ADHD. Also reviewed were rating scales and medical tests that could be employed in evaluating ADHD. The utility of using both parent- and teacher-completed rating scales that specifically assess symptoms of ADHD in the diagnostic process was supported. Recommendations were made regarding the assessment of children with suspected ADHD in the pediatric primary care setting. Pediatrics 2001;107(3). URL: http://www.pediatrics.org/cgi/content/full/107/3/e43; prevalence, attention-deficit/hyperactivity disorder, primary care.

ABBREVIATIONS. ADHD, attention-deficit/hyperactivity disorder; TRI, Technical Resources International; DSM, Diagnostic and Statistical Manual; DISC, Diagnostic Interview Schedule for Children; EEG, electroencephalogram; ERP, event-related potential.

Attention-deficit/hyperactivity disorder (ADHD) has defining features of inattention, overactivity, and impulsivity.1 It is the most frequently encountered childhood-onset neurodevelopmental disorder in primary care settings. Symptoms frequently co-occur with other emotional, behavioral, and learning problems, including oppositional defiant disorder, conduct disorder, depression, anxiety, and learning disabilities. The cause of ADHD is unknown, and multiple pathways may lead to the phenotypic expression of the disorder.2

Public awareness of ADHD has increased, and the disorder represents a public health concern with significant effects on children’s functioning across multiple areas.3 Referrals to health care professionals for children suspected of having the disorder continue at a high rate, and changes in the health care system in the United States have placed increasing demands on primary care pediatricians to diagnose and manage the disorder. It is now recognized that ADHD is a chronic condition that will persist over the life span.2

The American Academy of Pediatrics Committee on Quality Improvement Subcommittee on Attention-Deficit/Hyperactivity Disorder synthesized a clinical practice guideline for the diagnosis and evaluation of children with ADHD.3 This report will highlight the empirical literature review on which this practice guideline is based. The subcommittee worked with Technical Resources International (TRI), Washington, DC, under the auspices of the Agency for Healthcare Research and Quality, to develop an evidence base addressing questions regarding the prevalence, co-occurring conditions, and diagnostic tests for ADHD. For a full account of the literature review, see the technical review compiled by Green, Wong, Atkins, Taylor, and Feinleib.4

Given the widespread attention ADHD has received, it is important to examine the epidemiology of this disorder and methods to assess it. Because of the paucity of data regarding preschoolers and adolescents with ADHD, the literature review focused on studies involving elementary-school-aged children. Specifically, 4 key questions provided the framework for the development of the technical review.4 They are as follows:

1. What is the prevalence of ADHD and co-occurring behavioral, emotional, and learning disorders in the general population of 6 to 12 year olds in the United States?
2. What is the prevalence of ADHD and co-occurring conditions in 6 to 12 year olds coming to primary care providers in the United States?
3. How accurate and reliable are behavior rating instruments in screening for ADHD?
4. How useful are medical screening tests in diagnosing ADHD?

For the review, 507 articles and 10 published rating scale manuals were compiled from empirical articles; traditional databases (Medline, PsychINFO); references lists in review papers; references from the Practice Parameters for the Assessment and Treatment of...
Children, Adolescents, and Adults with Attention-Deficit/Hyperactivity Disorder; recently published journal articles; citations suggested by members of the American Academy of Pediatrics; and a database of bibliographies on studies involving the Child Behavior Checklist rating scale. A physician and psychologist specializing in ADHD independently rated each article and manual for sound empirical evidence addressing the 4 questions. Criteria used to evaluate the appropriateness of a study are presented in Table 1. Application of the inclusion and exclusion criteria yielded 87 articles and 10 manuals for inclusion in the review.

PREVALENCE OF ADHD

Most studies of ADHD have come from referral populations seen in tertiary care centers. They, therefore, reflect unknown sampling biases and cannot provide estimates of rates of ADHD in unreferred populations. Thus, to address the epidemiology of ADHD, we reviewed the prevalence of ADHD in communities, schools, and primary care settings. Also investigated was the prevalence of co-occurring conditions in the general population and primary care settings.

Prevalence of ADHD and Co-occurring Conditions in the Community Samples

Studies in which diagnostic instruments were administered to 6- to 12-year-olds from representative community samples or school settings were considered. All used Diagnostic and Statistical Manual (DSM) criteria for ADHD, although different editions were used. Three studies used DSM-III, 6 used DSM-III-R, 1 used DSM-IV, and 1 used DSM-IV. See Table 2 for the criteria employed in the various editions. For studies using DSM-III and DSM-III-R criteria to diagnose ADHD, prevalence rates ranged from 4% to 26%. However, 9 of the 10 investigations revealed prevalence rates between 4% and 12% (median: 5.8%). The investigation reporting the outlier prevalence rate of 26% examined the smallest sample of children, and all children in that investigation were from a single, inner-city elementary school. These methodological limitations may have contributed to a spuriously inflated estimate for the prevalence of ADHD in the general population. Across studies, setting (ie, community vs school), gender, and diagnostic nomenclature (DSM-III vs DSM-III-R criteria), all affected the prevalence rates. Specifically, the mean prevalence rates of ADHD were higher in community samples (10.3% for community samples vs 6.9% for school samples), higher among males (9.2% for males vs 3.0% for females), and higher among children who were diagnosed according to DSM-III-R criteria (10.3% for DSM-III-R vs 6.8% for DSM-III criteria).

At the time that the American Academy of Pediatrics practice guideline was synthesized and the technical report was compiled, sufficient research

### TABLE 1. Inclusion Criteria for Studies

<table>
<thead>
<tr>
<th>Factor</th>
<th>Criteria</th>
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</thead>
<tbody>
<tr>
<td>ADHD with criteria from DSM-III, DSM-III-R, and DSM-IV</td>
<td>Co-occurring conditions: learning disabilities, depression, anxiety, conduct disorder, and oppositional defiant disorder</td>
</tr>
<tr>
<td>Combinations of the 5 co-occurring conditions allowed in Questions 1 and 2</td>
<td>None of the 5 co-occurring conditions for Questions 3 and 4 (assessment questions)</td>
</tr>
<tr>
<td>Boys and girls 6 to 12 years old</td>
<td>Non-referred populations (for prevalence estimates)</td>
</tr>
<tr>
<td>Representative population</td>
<td>Absence of moderate to severe mental retardation, pervasive developmental disorders, and severe psychiatric disorders</td>
</tr>
<tr>
<td>North American studies for Questions 1 and 2 (prevalence questions)</td>
<td>Any countries for Questions 3 and 4 (assessment questions)</td>
</tr>
<tr>
<td>Limited settings allowed in Questions 3 and 4 (assessment questions)</td>
<td>Selected behavior checklists and rating scales (parent and teacher reports)</td>
</tr>
<tr>
<td>(Question 1)—community and school surveys; primary care setting (Question 2)—pediatricians and family or general practice physicians</td>
<td>Accuracy for ADHD: sensitivity, specificity, positive predictive value</td>
</tr>
<tr>
<td>(Question 4)</td>
<td>Accuracy for referral population (for broad-band checklists)</td>
</tr>
<tr>
<td>Selected medical and neurologic screening tests: electroencephalography, lead concentration level, thyroid hormone level, imaging tests, continuous performance tests, hearing and vision screening</td>
<td>Effect size for discriminating referred from non-referred samples</td>
</tr>
<tr>
<td>Prevalence of abnormal findings</td>
<td>Data from peer-reviewed published studies</td>
</tr>
<tr>
<td>Literature published 1980 to 1997</td>
<td>English language</td>
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</table>
had not yet accumulated on the prevalence of ADHD using *DSM-IV* criteria. One study that was available, however, was an investigation by Wolraich et al.\(^9\) conducted with 4323 school children ranging from kindergarten to fifth grade. In addition to assessing *DSM-IV* symptoms, Wolraich and colleagues examined the level of impairment in children’s academic and behavior functioning. Consistent with the data provided by others,\(^8,15\) the investigators found an overall prevalence rate of 6.8% when each of the ADHD subtypes (primarily inattentive type, combined type, and primarily hyperactive/impulsive type) was considered. Of interest is the finding that, when *DSM-IV* impairment criteria were not considered, 16% of the sample qualified for a diagnosis, with many more males than females meeting criteria. This finding underscores the importance of incorporating functional impairment when making a diagnosis of ADHD. Without due consideration of the *DSM-IV* functional impairment criterion, the frequency of ADHD diagnosis may be spuriously high. Wolraich and colleagues\(^9\) offered support for the *DSM-IV* diagnostic subtypes of ADHD, with most of the children meeting criteria for either the predominantly inattentive subtype (3.2%) or the combined subtype (2.9%). More studies need to be conducted to determine the distribution of children with ADHD across the subtypes.

Three studies\(^20–22\) examined prevalence rates of ADHD among elementary school children in the general population who had been screened for symptoms of behavior problems. Formal diagnostic instruments were administered only to children who were identified in the initial screening procedure. The average prevalence rate approached 4%.

A high proportion of children with ADHD have other related conditions, and several investigators have assessed co-occurring conditions. In the technical review, Green et al.\(^2\) presented studies assessing co-occurring ADHD and oppositional defiant disorder,\(^12\) conduct disorder,\(^7,12,14,16\) and depressive and anxiety disorders.\(^14,21\) Calculations of the mean prevalence rates across studies were highest for oppositional defiant disorder (35.2%), followed by conduct disorder and anxiety disorders (25.7% and 25.8%), and depressive disorders (18.2%).

In the 1 investigation that employed *DSM-IV* criteria, Wolraich and colleagues\(^9\) found that rates of co-occurring oppositional defiant disorder, conduct disorder, anxiety disorder, and depressive disorder were similar to those found in the studies previously mentioned. Of interest, Wolraich et al found markedly different patterns of co-occurring disorders according to diagnostic subtype. When they examined the inattentive subtype, significantly fewer children had co-occurring disruptive behavior disorders (ie, oppositional defiant disorder, conduct disorder) compared with the hyperactive/impulsive and combined subtypes. In addition, children with the predominantly hyperactive/impulsive subtype evidenced fewer co-occurring internalizing (ie, anxiety, depressive) and learning problems. Thus, externalizing disorders (ie, oppositional defiant disorder, conduct disorder) seem to be associated with the hyperactive/impulsive dimension of ADHD; internalizing disorders (ie, anxiety, depression, learning disabilities) seem to be more frequently associated with the inattention dimension of the disorder.

The rate of co-occurrence between ADHD and learning disabilities is difficult to establish because few studies have employed *DSM* criteria for learning disorders. As a result, many studies were not included in this review. August and Garfinkel\(^7\) examined the frequency of specific reading disability among children with ADHD. For children to be classified as having a specific reading disability, children had to be reading disabled relative to their peers of the same chronological age and relative to their general level of intellectual functioning. Twenty-two percent of their sample of children with ADHD met these criteria. In the study by Wolraich and colleagues,\(^9\) only 11% of the children classified as having ADHD according to *DSM-IV* criteria were reported to have learning disabilities. The lower rate of learning disabilities in that study may reflect the use of a restrictive methodology to classify children as learning disabled,\(^4\) with the classification simply based on teachers’ indication of whether the child had a learning disability diagnosis. Clearly, additional research regarding the co-occurrence of ADHD and learning disabilities is needed.

### Prevalence of ADHD and Co-occurring Conditions in the Pediatric Office Setting

Significant changes in the health care system have placed increasing demands on pediatric primary care providers to assess and manage children who present with ADHD symptoms. Some research has suggested that children’s symptom display may differ as a function of psychiatric versus pediatric clinic setting.\(^23\) Numerous studies have examined the symptoms of children with ADHD evaluated in psychiatric settings, but not enough attention has been devoted to children evaluated in primary care offices.

Two groups of investigators reported on the prevalence of ADHD in the primary care setting.\(^24–26\) and their findings were presented in the technical review. Lindgren et al.\(^26\) examined 457 consecutive 6- to 12-year-old patients from primary care settings. Prevalence of ADHD under different inclusion criteria (ie, 8 vs 10 symptoms) was estimated. Symptoms were assessed from parents’ reports based on *DSM-III-R* criteria. As might be expected, prevalence rates differed according to cutoff criteria. A prevalence of 11.2% occurred when the cutoff was 8 symptoms. A lower prevalence rate (3.7%) was revealed with the more conservative 10-symptom cutoff. In contrast to concerns expressed in the popular media that this disorder is overdiagnosed by pediatricians,\(^22\) the data here suggest that prevalence rates of ADHD in primary care settings are similar to rates in general population studies.

In an epidemiologic study conducted in Pittsburgh by Costello and colleagues,\(^24–25\) 300 children were assessed from a pool of 789 patients from 2 health maintenance organization clinics. The Diagnostic Interview Schedule for Children (DISC),\(^28\) a structured
<table>
<thead>
<tr>
<th>Table 2: Diagnostic Criteria for ADHD Across Versions of the Diagnostic and Statistical Manual</th>
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</table>

### DSM-III

**A. Inattention.** At least three of the following:
1. Often fails to finish things he or she starts
2. Often doesn’t seem to listen
3. Easily distracted
4. Has difficulty concentrating on schoolwork or other tasks requiring sustained attention
5. Has difficulty sticking to play activity

**B. Impulsivity.** At least three of the following:
1. Often acts before thinking
2. Shifts excessively from one activity to another
3. Has difficulty organizing work (this not being due to cognitive impairment)
4. Needs a lot of supervision
5. Frequently calls out in class
6. Has difficulty awaiting turn in games or group situations

**C. Hyperactivity.** At least two of the following:
1. Runs about or climbs on things excessively
2. Has difficulty sitting still or fidgets excessively
3. Has difficulty staying seated
4. Moves about excessively during sleep
5. Is always "on the go" or acts as if "driven by a motor"

**D. Onset before the age of 7**

**E. Duration of at least 6 months**

**F. Not due to schizophrenia, affective disorder, or severe or profound mental retardation**

### DSM-III-R

**A. A disturbance of at least 6 months during which at least eight of the following are present**
1. Often fidgets with hands or feet or squirms in seat (in adolescents, may be limited to subjective feelings of restlessness)
2. Has difficulty remaining seated when required to do so
3. Is easily distracted by extraneous stimuli
4. Has difficulty awaiting turn in games or group situations
5. Often blurts out answers before questions have been completed
6. Has difficulty following through on instructions from others (not due to oppositional behavior or failure of comprehension), eg, fails to finish chores
7. Has difficulty sustaining attention in tasks or play activities
8. Often shifts from one uncompleted activity to another
9. Has difficulty playing quietly
10. Often talks excessively
11. Often interrupts or intrudes on others, eg, butts into other children's games
12. Often does not seem to listen to what is being said to him or her
13. Often loses things necessary for tasks or activities at school or at home (eg, toys, pencils, books, assignments)
14. Often engages in physically dangerous activities without considering possible consequences (not for the purpose of thrill-seeking), eg, runs into street without looking

**B. Onset before the age of 7**

**C. Does not meet the criteria for pervasive developmental disorder**

### DSM-IV

**A. Either (1) or (2):**

(1) Six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

- **Inattention:**
  a. Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
  b. Often has difficulty sustaining attention in tasks or play activities
  c. Often does not seem to listen when spoken to directly
  d. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or is reluctant to engage in tasks that require sustained mental effort such as schoolwork or homework)
  e. Often has difficulty organizing tasks and activities
  f. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
  g. Often loses things necessary for tasks or activities (eg, toys, school assignments, pencils, books, or tools)
  h. Is often easily distracted by extraneous stimuli
  i. Is often forgetful in daily activities

(2) Six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

- **Hyperactivity:**
  a. Often fidgets with hands or feet or squirms in seat
  b. Often leaves seat in classroom or in other situations in which remaining seated is expected
  c. Often runs around or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)
  d. Often has difficulty playing or engaging in leisure activities quietly
  e. Is often "on the go" or often acts as if "driven by a motor"
  f. Often talks excessively
  g. Often blurts out answers before questions have been completed
  h. Often has difficulty awaiting turn
  i. Often interrupts or intrudes on others (eg, butts into conversations or games)

**B. Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years**

**C. Some impairment from the symptoms is present in two or more settings (eg, at school or work) and at home**

**D. There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning**

**E. The 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 (eg, mood disorder, anxiety disorder, dissociative disorder, or a personality disorder)**

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psychiatric interview assessing DSM-III criteria, was administered by a psychiatric social worker. When considering parent reports on the DISC, findings were that 1.4% of the children met DSM-III criteria for a diagnosis of attention-deficit disorder with hyperactivity, and 0.2% met criteria for attention-deficit disorder without hyperactivity. Fewer cases were identified using children’s reports on the DISC, compared with parent reports, indicating that reliance only on children’s reports may show the prevalence rate to be falsely low. This finding underscores the importance of collecting parent interview data. The prevalence rates reported by Costello and colleagues were much lower than those reported by Lindgren et al, probably because older editions of the DSM yielded lower rates of the disorder.

Lindgren et al and Costello et al showed prevalence rates of co-occurring conditions with ADHD ranging from 9% to 38% across disorders. The most prevalent co-occurring conditions were oppositional defiant disorder and anxiety disorder, each with a prevalence rate of 38%. The prevalence rates of depression and conduct disorder (each at 9%) were lower in the primary care setting than those found in the studies of ADHD in the general population. Children considered to have more severe psychiatric disturbances, like depression and conduct disorder, may be triaged to child psychiatric clinics as opposed to pediatric primary care settings. Nonetheless, co-existing conditions are clearly evident among children seen in the primary care setting and merit the careful attention of the primary care provider.

Summary

Examination of the data revealed that prevalence rates of ADHD generally range from 4% to 12% of the elementary school population when the DSM-III, DSM-III-R, or DSM-IV is used, with higher rates of the disorder among males and with higher rates reported from school settings than community settings. Only 2 studies provided information on the prevalence of ADHD in primary care settings, with 1 reporting 11% of children met criteria for ADHD, and the second reporting that less than 2% of children met criteria for the disorder. Additional research examining the prevalence of this disorder in pediatric settings is needed. Overall, the findings regarding the prevalence of ADHD support the American Academy of Pediatrics clinical practice guideline assertion that it is reasonable for primary care pediatricians to initiate an evaluation for ADHD when children present with symptoms that include inattention, hyperactivity, impulsivity, academic underachievement, and behavior problems.

ADHD frequently co-occurs with additional emotional, behavioral, and learning problems in community and primary care settings, with disruptive behavior disorders being most common, followed by internalizing and learning problems. Finally, the investigation that examined conditions co-occurring with the DSM-IV subtypes supported the current nosology that conceptualizes ADHD as a 2-dimensional disorder. Interestingly, co-occurring disruptive behavior problems seem to have more frequent associations with the hyperactive/impulsive dimension of ADHD, whereas internalizing and learning problems are more strongly associated with the inattentive dimension of the disorder. Thus, as recommended in the clinical practice guideline, the evaluation of ADHD should include evaluation for other conditions that may co-occur with the disorder.

Assessment of ADHD

Assessment of ADHD in the primary care settings may include both behavior rating scales and medical and laboratory tests. The utility of these instruments in the identification of ADHD was examined.

Behavior Rating Scales

A widely employed tool for the assessment of ADHD has been the use of behavior rating scales and checklists. These scales can be completed by parents, teachers, and other informants. The informant is asked to summarize the extent to which the child exhibits particular behaviors over a specified time. The advantages of behavior rating scales include ease of administration, cost effectiveness, and the range of information provided by multiple informants. These instruments can be classified into either broad-band checklists or ADHD-specific measures. ADHD-specific measures are those that specifically assess the core symptoms of the disorder, whereas broad-band checklists measure a variety of child behavior problems. Regarding broad-band rating scales, information obtained may include scores that sum across all types of child behavior problems (ie, total global scale scores), scores that sum across types of internalizing problems such as depression and anxiety (ie, internalizing scale scores), and scores that sum across types of externalizing problems such as aggression and conduct problems (ie, externalizing scale scores). Some measures provide scores for subscales that assess adaptive behavior. To be included in the technical review, it was required that the ADHD-specific and broad-band rating scales included a parent version of the scale and had normative data available. Also, broad-band checklists had to include subscales designed to measure symptoms associated with ADHD. The rating scales reviewed are listed in Table 3.

Effect sizes were calculated for each of these rating subscales. An effect size refers to the difference in mean scores between 2 populations (eg, children referred with ADHD vs nonreferred children) divided by an estimate of the individual standard deviation. A larger effect size is more desirable because it suggests less overlap between the 2 populations. Hence, an effect size of 1.0 or less would reflect substantial overlap between the distribution of scores across the 2 populations. In contrast, an effect size of 3.0 suggests little overlap between scores attained for the 2 populations, with the mean scores for the 2 populations falling 3 standard deviation units apart. Consequently, one could consider the 2 populations relatively distinct.

A higher effect size is indicative of greater sensitivity and specificity of the measure. For example, assuming that the populations with and without the
disorder are normally distributed and have equal variances, and considering the case whereby sensiti-
vity equals specificity, an effect size of 3.0 would be
associated with a sensitivity and specificity of 0.94
and a false-positive and false-negative rate of 6%.
In contrast, an effect size of 1.0, under the same
conditions, would be associated with a sensitivity
and specificity of 0.71, which is associated with a
false-positive and false-negative rate of 29%.

Broad-band rating scales and checklists were eval-
uated for their ability to discriminate children re-
ferred for ADHD from their nonreferred peers. Table
3 presents the broad-band rating scale studies that
allowed the calculation of effect sizes for total prob-
lem, internalizing, externalizing, and adaptive func-
tioning indices or subscales. The average effect size
across broad-band measures using total global scale
scores was 1.5. Effect sizes using domain scales (ie,
the internalizing, externalizing, and adaptive func-
tioning scales) generally ranged from 0.7 to 1.4, with
the exception of the externalizing scales on the par-
ent and teacher forms of the Conners’ Scales, which
had significantly better discriminatory power. Taken
together, the findings do not provide sufficient evi-
dence to support a reliance on either broad-band
checklist total problem indices or scales assessing
externalizing, internalizing, or adaptive behavior to
screen for or diagnose ADHD. However, these scales
may be used for other purposes such as screening for
coccurring problems in other areas (eg, anxiety,
depression, conduct problems).

Also available to practitioners are several rating
scales that specifically assess symptoms related to
ADHD. The studies that were reviewed used
ADHD-specific measures to discriminate between
children diagnosed with ADHD and typically devel-
oping children. Because few studies used control
groups with other psychiatric disorders (eg, learning
disabilities, conduct disorder), it is difficult to eval-
uate the efficacy of these rating scales in differenti-
ating children with ADHD from those with other
psychiatric diagnoses. Table 4 presents studies of
ADHD-specific rating scales. These studies allowed
the calculation of effect sizes for global ADHD symp-
toms and subscales that assess specific types of
ADHD symptoms (ie, inattention, impulsivity, over-
activity). The overall range of effect sizes varied
across measures. Effect sizes for global ADHD symp-

### TABLE 3. Broad-Band Checklists: Ability to Detect Referred Versus Nonreferred Participants*

<table>
<thead>
<tr>
<th>Study</th>
<th>Behavior Rating Scale</th>
<th>Age</th>
<th>Gender</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Scales</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achenbach, 1991†</td>
<td>CBCL/4-18-R</td>
<td>4-11</td>
<td>M</td>
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<td>Achenbach, 1991‡</td>
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<tr>
<td>Naglieri, LeBuffe, and Pfeiffer, 1994§</td>
<td>DSMD</td>
<td>5-12</td>
<td>MF</td>
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<tr>
<td>Connors, 1997</td>
<td>CPRS-R:LS DSM-IV</td>
<td></td>
<td>MF</td>
<td>2.3</td>
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<tr>
<td></td>
<td>CTRS-R:LS DSM-IV</td>
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<td>MF</td>
<td>2.0</td>
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<td><strong>Externalizing Scales</strong></td>
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<td>Naglieri, LeBuffe, and Pfeiffer, 1994§</td>
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<td></td>
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<td><strong>Internalizing Scales</strong></td>
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<td>Achenbach, 1991‡</td>
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Teacher Rating Scale; CATQ-HI
SSQ-O-II
Rating Scale, Long Version; SSQ-O-I
*CPRS-R:L
Policy and Research; 1999.

rating scales as a time-efficient and cost-effective
tool (ie, teachers), we endorse the use of behavior
symptomatology from caregivers and school person-
cally diagnose ADHD, global rating scales may be
perform well in discriminating between children
and Inattention Subscales of the SNAP Checklist 32

TABLE 4. ADHD-Specific Checklists: Ability to Detect ADHD Versus Normal Controls*

<table>
<thead>
<tr>
<th>Study</th>
<th>Behavior Rating Scales</th>
<th>Age</th>
<th>Gender</th>
<th>Effect Size</th>
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<td>CTRS-R:L-ADHD Index</td>
<td>6–17</td>
<td>MF</td>
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<td>CPRS-R:L-DSM-IV Symptoms</td>
<td>6–17</td>
<td>MF</td>
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<td>MF</td>
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<td>Breen, 1989</td>
<td>SSQ-O-I</td>
<td>6–11</td>
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<tr>
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<td>SSQ-O-II</td>
<td>6–11</td>
<td>F</td>
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Hyperactivity Subscales
Ullmann, Sleator, & Sprague, 1997
Atkins, Pelham, & Licht, 1985
Horn, Wagner, & Ichilongo, 1989
Horn, Wagner, & Ichilongo, 1989
Tarnowski, Prinz, & Nay, 1986

Inattention Subscales
Ullmann, Sleator, & Sprague, 1997
Atkins, Pelham, & Licht, 1985
Horn, Wagner, & Ichilongo, 1989
Horn, Wagner, & Ichilongo, 1989

Impulsivity Subscales
Atkins, Pelham, & Licht, 1985
Horn, Wagner, & Ichilongo, 1989
Horn, Wagner, & Ichilongo, 1989

* CPRS-R:L = 1997 Revision of the Conners Parent Rating Scale, Long Version; CTRS-R:L = 1997 Revision of the Conners Teaching Rating Scale, Long Version; SSQ-O-I = Barkley’s School Situations Questionnaire—Original Version, Number of Problem Settings Scale; SSQ-O-II = Barkley’s School Situations Questionnaire—Original Version, Mean Severity Scale; ACTeRS = ADD-H: Comprehensive Teacher Rating Scale; CATQ-HI = Conners Abbreviated Teacher Questionnaire—Hyperactivity Index.

Summary
Overall, rating scales of specific ADHD symptoms were more useful in diagnosis than global indices on broad-band checklists. Among the ADHD-specific rating scales that were reviewed, the ADHD Index and the DSM-IV Symptoms Scale of the 1997 revision of the Conners’ Rating Scale30 and the Hyperactivity and Inattention Subscales of the SNAP Checklist42 performed well in discriminating between children with ADHD and normal controls. It should be noted, however, that while parent- or teacher-completed broad-band scales are not recommended to specifically diagnose ADHD, global rating scales may be useful to screen for co-occurring problems. Given the recommendations set forth in the practice guideline3 that the assessment of ADHD requires evidence of symptomatology from caregivers and school personnel (ie, teachers), we endorse the use of behavior rating scales as a time-efficient and cost-effective means to gather data regarding the display of the core symptoms of ADHD. In addition, the collection of behavior ratings from teachers and caregivers will fulfill the DSM requirement that there be cross-situational evidence of the disorder. Although rating scales are convenient for use in the pediatric office setting, we caution against their use in isolation. Information collected via rating scales must be supplemented with a clinical history, including age of onset and duration of symptoms, and careful interview, which includes an assessment of the functional consequences of the behaviors.

Medical and Laboratory Screening Tests
Several medical screening tests and laboratory measures have been used to evaluate children with suspected ADHD. These tests include blood lead levels, thyroid function, radiographic assessment, electroencephalography, neurologic screening examinations, and continuous performance tasks, as well as other miscellaneous laboratory assessments.

The association between elevated lead levels and delays in cognitive functioning, including attention problems, has been consistently reported.36–37 This begs the question regarding the utility of lead level measurements in the assessment of ADHD. Six studies were reviewed, with no statistically significant associations in 3 of the investigations.38–40 One study reported a positive association between lead level and behavior problems.15 Two studies examined children screened for disruptive behavior problems and found associations between elevated lead levels and behavior problems.41–42 However, because these studies did not assess ADHD, the extent to which their findings may be applied to children with this
disorder is unknown. These findings suggest an association between elevated lead levels and a range of behavior problems including inattention. However, the routine use of lead screening as a diagnostic indicator for ADHD is not supported. A key issue here is that by elementary school age, children who have had lead effects will almost always have normal lead levels.

Abnormal thyroid function can produce a variety of behavior effects in children, ranging from impairments in concentration to severe neuropsychological deficits. Four studies of thyroid function were reviewed, and none of the 4 showed an association between abnormal thyroid levels and ADHD. In 3 of the studies, none of the children with ADHD had clinically significant thyroid dysfunction. In a study by Weiss, Stein, Trommer, and Refetoff, 2% of the ADHD cohort had abnormal thyroid levels compared with <1% of the comparison control group. In total, these studies fail to support the use of thyroid function tests to screen for ADHD.

Recent attention also has been devoted to investigating whether there are morphologic differences between the brain structures of individuals with ADHD relative to their normally developing peers. The technical review examined 9 studies that used either computerized tomography or magnetic resonance imaging to compare children with ADHD with a comparison control group. No differences were found between children with ADHD and comparison controls in 2 of the investigations. In the other 7 studies, asymmetries, differences in shape or volume of the ventricles, and differences in brain size occurred between ADHD and normally developing children. In each of these studies, structures in the children with ADHD were smaller than those of comparison controls. These studies are provocative and will likely direct new research that has the potential to shed light on the pathogenesis of this disorder. However, because other child psychiatric control groups (eg, children with learning problems or other disruptive behavior disorders) have not been included, the specificity of these findings to ADHD is not clear. Furthermore, although some studies have revealed significant group differences, the degree of within group variance and overlap between groups make imaging of little use for individual diagnostic purposes. That is to say, the imaging findings do not discriminate adequately between children with ADHD and those without. For these reasons, the use of imaging procedures is not currently supported as a diagnostic tool for assessment of ADHD.

One of the most widely researched medical tests for evaluating children with ADHD is the electroencephalogram (EEG) to examine event-related potentials (ERPs). Eight studies met criteria for inclusion in Green and colleagues' technical review. Overall, no major EEG abnormalities (ie, evidence of seizure activity) were found for children with ADHD. Several investigations reported minor differences in ERP's functioning, including longer latencies at the P3 site, longer latencies of certain waves for brainstem auditory-evoked potentials,58 more slow waves and fewer α-waves, and asymmetry in peak amplitude evoked-response potentials. These findings are variable and do not provide any compelling evidence for a particular EEG pattern for patients with ADHD.

Over the years, various neuropsychological screens, or soft sign assessments were believed to shed light on the pathogenesis of the ADHD disorder. Five studies using such assessments met criteria for inclusion in the technical review. Reeves and colleagues found that children with ADHD evidenced higher rates of neurodevelopment abnormalities than comparison control children on 9 tests of sensorimotor coordination, but no differences between groups were found for prenatal or perinatal problems or speech problems. Trommer and colleagues found that children with ADHD evidenced a greater number of errors on a psychomotor task designed to assess inattention. However, the ranges for the number of errors exhibited by the ADHD and control group were similar, casting doubt on the clinical significance of this group difference. The remaining 3 studies revealed no differences between ADHD and comparison control children on various neurodevelopment tasks (eg, the Revised Neurologic Examination for Subtle Signs, Mazes subtest of the Wechsler Intelligence Scales for Children). These findings do not support the use of neurodevelopment measures for diagnosis of ADHD.

Some isolated studies measuring neurotransmitters (eg, serotonin levels, dopamine receptors, epinephrine), hormones (eg, growth hormone releasing factor), and proteins were also reviewed in the TRI report. Each study reported findings suggestive of possible biological differences between children with ADHD and controls, but the findings were too sparse and preliminary to indicate a definitive relationship.

Finally, studies examining computerized and pencil and paper tests of sustained attention and impulsivity (eg, continuous performance tests) were reviewed in the TRI report. These measures poorly discriminated children with ADHD from their normally developing peers. Both indices of inattention and indices of impulsivity provided by continuous performance tasks were poor predictors of ADHD, with most effect sizes lower than 1.0. Thus, the power of discrimination of these tests is not sufficient to support their use in the assessment and diagnosis of ADHD.

Summary

Many medical tests and laboratory assessments have been investigated in relation to ADHD. Across studies that included blood lead levels, morphologic features, and thyroid abnormalities, no compelling evidence supported an association between abnormalities on these various tests and the presence of ADHD. Morphologic studies offered some preliminary support for brain-related differences between children with and without the disorder, but additional studies with control groups of children with other psychiatric and developmental disorders and larger sample sizes will be necessary before brain morphology becomes useful in diagnosing ADHD.
Based on these data, it is recommended in the practice guideline that laboratory and medical diagnostic tests discussed above not be used routinely in determining a diagnosis of ADHD.

**CONCLUSIONS**

Children with ADHD are frequently encountered in the primary care setting. It is important that the diagnosis of this condition by primary care providers be based on procedures supported by evidence from empirical investigations. Here findings were highlighted from a comprehensive review of the literature regarding the prevalence of ADHD and co-occurring conditions in community and primary care settings, as well as evidence regarding the utility of behavior rating scales and medical tests in the assessment process.

In community samples of school-aged children, the prevalence rates of the disorder generally ranged from 4% to 12%, with similar or lower rates in pediatric samples. In the literature examined for the purpose of the technical review, the most frequently co-occurring disorder was oppositional defiant disorder (33%), followed by conduct disorder and anxiety disorder (each at ~25%). Approximately 20% had co-occurring depressive disorders, and 12% to 22% had learning disabilities. Anxiety, depression, and learning disabilities were recently found to co-occur more frequently in children with the inattentive subtype of ADHD, and disruptive behavior disorders co-occurred more frequently in children presenting with hyperactive/impulsive symptoms. With regard to assessment, behavior rating scales and medical screening tests have been investigated. ADHD-specific scales are reliable and valid for the assessment of the disorder, but global or broad-domain scales are not. There is no compelling evidence to support the use of medical and laboratory tests in the identification of ADHD.

The findings of this review have significant implications for practice and research. Given the prevalence rates of ADHD, primary care pediatricians should be prepared to identify children with the disorder. Clinicians should use ADHD-specific rating scales completed by caregivers and teachers in their efforts to identify children suspected for ADHD. Ratings from multiple informants should be employed to ascertain the DSM-IV criterion of cross-situational symptom display. Broad-band scales may be useful in the identification of problems or symptoms that may co-occur with ADHD, but their use in diagnosing ADHD is not supported. Also, the use of medical and laboratory tests to diagnose ADHD is not indicated. In addition to behavior rating scales, a thorough history of symptoms and the effect of these symptoms on the child’s current functioning should be evaluated.

Examination of the literature summarized in the technical review reveals important areas for additional investigation. For example, most of the literature used DSM-III and DSM-III-R criteria to identify children with ADHD. Fewer studies using DSM-IV criteria have addressed the prevalence and assessment of ADHD. These questions need to be examined with DSM-IV criteria and parameters associated with the specific ADHD subtypes. Most research conducted to date has predominantly reported on samples of boys with ADHD. Investigations targeting girls with this disorder are sorely needed. As well, research has primarily focused on elementary-school-aged children; there is a need for investigations examining this disorder among preschoolers and adolescents. Finally, the studies reviewed used control groups composed of either nonreferred children or typically developing comparison controls. Greater efforts are needed to evaluate the specificity of ADHD-specific rating scales in discriminating between children with ADHD and those with other psychiatric disorders where ADHD does not co-occur.

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