Diagnosing ADHD in Adolescence

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Abstract

Objective—This study examines adolescent-specific practical problems associated with current practice parameters for diagnosing ADHD in order to inform recommendations for the diagnosis of ADHD in adolescents. Specifically, issues surrounding the use of self vs. informant ratings, diagnostic threshold, and retrospective reporting of childhood symptoms were addressed.

Method—Using data from the Pittsburgh ADHD Longitudinal Study (PALS), parent, teacher, and self-reports of symptoms and impairment were examined for 164 adolescents with a childhood diagnosis of ADHD (age M=14.74) and 119 demographically similar non-ADHD controls (total N=283).

Results—Results indicated that 70% of the well-diagnosed childhood ADHD group continued to meet DSM-IV-TR diagnostic criteria for ADHD in adolescence; however, an additional 17% possessed clinically significant impairment in adolescence, but did not qualify for a current ADHD diagnosis. The optimal source of information was combined reports from the parent and a core academic teacher. Adolescents with ADHD met criteria for very few symptoms of hyperactivity/impulsivity, suggesting a need to revisit the diagnostic threshold for these items. Additionally, emphasis on impairment, rather than symptom threshold improved identification of adolescents with a gold-standard childhood diagnosis of ADHD and persistent ADHD symptoms. Parent retrospective reports of baseline functioning, but not adolescent self-reports, were significantly correlated with reports collected at baseline in childhood.

Conclusions—We offer recommendations for diagnosing ADHD in adolescence based upon these findings.

Attention Deficit/Hyperactivity Disorder (ADHD) is a chronic mental health disorder with distinct behavioral manifestations in childhood, adolescence, and adulthood (Barkley, 2006;

Barkley, Fischer, Smallish, & Fletcher, 2002). Throughout the lifespan, these individuals display deficits in core symptoms of inattention, hyperactivity, and impulsivity that impair multiple domains of daily life functioning (American Psychiatric Association, 2000). More than a half century of scientific research characterizes children with ADHD as disruptive in the classroom, unpopular with peers, engaging in conflict behavior with family members, and underachieving in academic settings (Atkins, Pelham, & Licht, 1985; Johnston & Mash, 2001; Loe & Feldman, 2007; Pelham & Bender, 1982). A growing body of literature on adult ADHD suggests that this disorder later is characterized by significant work-related impairments, driving problems, difficulties with romantic and interpersonal relationships, higher rates of criminal behavior, and risk for substance use disorders (Barkley, Fischer, Smallish, & Fletcher, 2006; Mannuzza, Gittelman-Klein, Bessler, Malloy, & LaPadula, 1993; Satterfield & Schell, 1997; Thompson, Molina, Pelham, & Gnagy, 2007; Weiss & Hechtman 1993). In the transitional period between childhood and adulthood, adolescents with ADHD continue to display the impairments of children with ADHD (peer relations-Bagwell, Molina, Pelham, & Gnagy, 2001; academics-Barbaresi et al., 2007; Barkley, Anastopoulos, Guevremont, & Fletcher, 1991; family conflict-Edwards, Barkley, Laneri, Fletcher, & Metevia, 2001) and begin to experience the impairments that characterize adults with ADHD (substance use- Molina et al., 2007; driving problems-Thompson et al., 2007). In addition, there are impairments associated with ADHD that are specific to adolescence (i.e., delinquency, Sibley et al., 2011; school drop-out, Kent et al., 2011; early initiation of sexual behavior; Flory, Molina, Pelham, Gnagy, & Smith, 2006). Thus, adolescence is a very challenging time for a person with ADHD.

Despite the breadth of serious problems noted above, longitudinal studies of ADHD consistently report that DSM symptom severity declines with age (Fischer et al., 1993; Hart, Lahey, Loeber, Applegate, & Frick, 1995; Molina et al., 2009; Willoughby, 2003) and that the disorder remits in up to 70% of adolescents diagnosed with childhood ADHD (Barkley, Fischer, Edelbrock, & Smallish, 1990; Gittelman, Mannuzza, Shenker, & Bonagura, 1985; Hill & Schoener, 1996), However, adolescents with ADHD display serious impulsive and inattentive behaviors, many with permanent negative consequences (Wolraich et al., 2005). Therefore, it seems counterintuitive to assert that ADHD diminishes in adolescence. Perhaps more likely, current diagnostic practices inadequately recognize adolescent manifestations of this disorder.

Current practice parameters suggest that in childhood and adolescence, practitioners should use DSM criteria to diagnose ADHD based on direct reports from parents and teachers (American Academy for Child and Adolescent Psychiatry, 2007; American Academy of Pediatrics, 2001). This process involves establishing the presence of six or more DSM symptoms of either Inattention or Hyperactivity/Impulsivity, impairment in more than one setting, and the presence of symptoms by age seven. Evidence suggests that diagnostic rating scales and informant interviews can be employed equivalently to provide information on the presence of symptoms (Pelham, Fabiano, & Massetti, 2005; Wright, Waschbusch, & Frankland, 2007), and as a general clinical practice, most experts suggest combining informant reports to maximize available diagnostic information (De Los Reyes & Kazdin, 2005; Offord et al., 1996; Piacentini, Cohen, & Cohen, 1992; Rubio-Stipec, Fitzmaurice, Murphy, & Walker, 2003). Within the practice parameters noted above, which were

developed for the diagnosis of children, there may be several contributing factors to an inadequate assessment of ADHD in an adolescent: 1) reliance on an unsuitable method of obtaining or combining informant reports of functioning in the secondary school environment, 2) using a symptom threshold that is not developmentally sensitive to the typical presentation of adolescents with ADHD, and 3) the inability to establish childhood symptoms in an adolescent presenting for a first-time diagnosis. We discuss each of these factors below.

The recommendation that practitioners combine ADHD symptom reports from parents and teachers stems from findings that children (and adolescents) with ADHD provide notoriously inaccurate self-reports of symptoms and related impairment (Fischer et al., 1993; Loeber, Green, Lahey, and Stouthamer-Loeber, 1991; Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007; Sibley et al., 2010). However, secondary school teachers are far less useful than elementary school teachers as informants of student behavior. Each day, a typical secondary school teacher teaches more than 100 adolescents and typically spends less than an hour with each student (Eccles, 2004). Consequently, most secondary school teachers possess insufficient opportunities to be well-acquainted with individual students. Inter-teacher agreement on ADHD rating scales is very poor at the secondary school level (Evans, Allen, Moore, & Strauss, 2005; Molina, Smith, & Pelham, 2001) as is parent-teacher agreement (Achenbach, McConaughey, & Howell, 1987; Fischer et al., 1993; Offord et al., 1996). Beyond the questionable utility of secondary school teacher reports, it is very difficult to obtain teacher ratings for adolescents due to communication barriers in the middle and high school settings (Evans, Serpell, Schultz, & Pastor, 2007). These findings call into question whether the utility of teacher reports are worth the challenge of pursuing a teacher rating in the secondary school setting.

Additionally, the DSM symptoms of ADHD are derived from observations of elementary school-aged children (APA, 2000; Conners, 1997) and some of these symptoms may appear at a lower baserate and manifest differently in adolescence. However, as is the case with children, symptoms that remain present in adolescents with ADHD likely promote the high level of impairment that these youth display (Wolraich et al, 2005). As an example, one might consider that as specified in the DSM, hyperactivity/impulsivity is largely characterized by motor overactivity (e.g., often runs about or climbs excessively, leaves seat in classroom), but in adolescence these symptoms start to change into adult-like manifestations of this dimension (e.g., feeling restless, difficulty maintaining sedentary activities, acting without thinking; Wender, 1990). These symptoms may lead to problems in school, work, and interpersonal settings but they may not be easily detected on traditional rating scales (e.g., restlessness vs. running around). Although the DSM-V revisions decrease the required symptom count to four for adolescents and adults (www.dsmv.org), the field is yet to empirically validate a reduced symptom threshold for adolescents (though it has for adults- e.g., Barkley, Murphy, & Fischer, 2008).

Finally, some adolescents may not receive a diagnosis of ADHD due an inability to establish ADHD symptoms that caused impairment during childhood (APA, 2000; dsmv.org). In most adolescent cases, this criterion requires someone to recall behavior that occurred five to ten years in the past. Although parents routinely report the onset of impairments as part of the

diagnostic process (Shaffer, Fischer, Lucas, Dulcan, & Schwab-Stone, 2000), it is unclear whether parents (or adolescents) provide reliable retrospective reports of childhood ADHD. Miller, Newcorn, and Halperin (2010) investigated this issue in a sample of youth who were diagnosed with ADHD in childhood and recontacted to provide parent and self-retrospective symptom ratings nine years later. These authors reported that neither parent nor self-retrospective ratings significantly correlated with baseline parent or teacher reports. However, the authors used different protocols to assess functioning at baseline and follow-up and the sample consisted of both adolescents and young adults (*M* age = 18.31). Thus, it is still unclear whether parents can reliably report on their adolescent's childhood functioning.

To investigate the questions raised above, we examined symptom and impairment data from adolescents in the Pittsburgh ADHD Longitudinal Study (PALS). The PALS is a prospective longitudinal study of individuals who received a standard and well-validated diagnosis of ADHD as children at a large child psychiatry ADHD specialty clinic and were recontacted as adolescents and young adults for a series of yearly follow-up visits. To evaluate the diagnostic recommendation to combine parent and teacher reports, we investigated agreement between parent, teacher, and self reports of current symptoms and impairment. We hypothesized that combining teacher reports with parent reports would lead to a significant amount of novel diagnostic information about the adolescents. Next, we evaluated the extent to which available control group-referenced and impairment-based data suggested the need for a reduced diagnostic threshold We hypothesized that a lower diagnostic threshold would be suggested by both approaches and that the current threshold of six symptoms would omit a significant portion of adolescents with a gold-standard childhood diagnosis and current impairment. Finally, we examined the utility of adolescent and parent retrospective reports, hypothesizing that parent retrospective reports would significantly correlate with reports of baseline symptoms gathered years earlier, but adolescent retrospective reports would not.

Method

Participants

ADHD Group—PALS staff recruited the ADHD group from a pool of 516 study-eligible participants diagnosed with DSM-III-R or DSM-IV ADHD in childhood and treated in the ADD Program at Western Psychiatric Institute and Clinic (WPIC) in Pittsburgh, PA from 1987 to 1996. Of the 516, 493 were re-contacted an average of 8.35 years later (SD = 2.79) to participate in annual interviews for the PALS. Of those contacted, 364 (70.5 %) enrolled in the follow-up study. At the first follow-up interview, the ADHD group ranged in age from 11 to 28 with 99% falling between 11 and 25 years of age. Participants entered the follow-up study on a rolling basis between the years 1999–2003 and completed their first follow-up interview immediately upon enrollment.

All probands participated in the Summer Treatment Program (STP) for children with ADHD, an 8-week intervention that included behavioral modification, parent training, and psychoactive medication trials where indicated (Pelham & Hoza, 1996). Clinical staff collected diagnostic information on probands at initial referral for treatment in childhood

(baseline) using parent and teacher DSM-III-R and DSM-IV symptom ratings scales (DBD; Pelham, Evans, Gnagy, & Greenslade, 1992) and a semi-structured diagnostic interview administered to parents by a Ph.D. level clinician. The interview consisted of the DSM-III-R or DSM-IV descriptors for ADHD, Oppositional Defiant Disorder (ODD), and Conduct Disorder (CD) with supplemental probe questions regarding situational and severity factors. It also included queries about other comorbidities to determine the need for additional assessment. Following DSM guidelines, clinicians made diagnoses of ADHD, ODD, and CD if a sufficient number of symptoms were endorsed (considering reports of parents and teachers) to result in diagnosis. Two Ph.D. level clinicians independently reviewed ratings and interviews to confirm DSM diagnoses and when disagreement occurred, a third clinician reviewed the file and the majority decision was used. Clinicians assessed exclusion criteria for probands in childhood (baseline), which included a full-scale IQ < 80, a history of seizures, neurological problems, pervasive developmental disorder, schizophrenia, and/or other psychotic or organic mental disorders. We compared participants in the follow-up study with eligible individuals who did not enroll on demographic (i.e., age at baseline, race, parental education level, and marital status) and diagnostic (i.e., parent and teacher ratings of ADHD and related symptoms) variables collected at baseline. Only one of 14 comparisons was statistically significant ($p<.05$). Participants had a slightly lower average CD symptom rating on a four point scale as indicated by a composite of parent and teacher ratings (participants $M = 0.43$, non-participants $M = 0.53$).

Control Group—Control participants were 240 individuals without ADHD. Research staff recruited control participants for the PALS from the greater Pittsburgh community between 1999 and 2001. Control participants were recruited from several sources including pediatric practices in Allegheny County (40.8%), advertisements in local newspapers (27.5%), local universities and colleges (20.8%), and other methods (10.9%) such as Pittsburgh Public Schools and word of mouth. Control recruitment lagged three months behind the ADHD group enrollment in order to facilitate efforts to obtain demographic similarity (discussed below). Research staff administered a telephone screening interview to parents of potential control participants to gather basic demographic characteristics, history of diagnosis or treatment for ADHD and other behavior problems, presence of exclusionary criteria as previously listed for the ADHD group, and a checklist of ADHD symptoms. Participants who met DSM-III-R criteria for ADHD, either currently or historically, were immediately excluded from study consideration.

If a potential control participant passed the initial phone screen, research staff met to determine whether he/she was demographically appropriate for the study. A team of senior research staff members examined each potential control participants on four demographic variables: 1) age, 2) gender, 3) race, and 4) parent education level. A control participant was study-eligible if his/her enrollment increased the control group's demographic similarity to the participants diagnosed with ADHD. At the end of the recruitment process, the two groups were equivalent on the four demographic variables noted above. An unsuccessful attempt was made to obtain equivalency on parent marital status.

Current Subsample—The current study utilizes data from 164 ADHD participants and 119 controls who were between the ages of 11 and 17 (adolescents) upon entry into the PALS follow-up. Within the ADHD group, the subsample ranged from 5 to 12 years of age at baseline (M=8.29, SD=1.63) with an average of 6.46 (SD=1.84) years between baseline and follow-up. At baseline, 53.8% of probands were diagnosed with comorbid ODD and an additional 31.3% were diagnosed with comorbid CD. The sample contained nine control and twelve ADHD females. Table 1 lists demographic characteristics of this subsample (total N=283). Although the PALS groups as a whole were demographically equivalent, the adolescent subsample possessed significant group differences on parent education level (χ^2(3)=11.42, p= .01) and marital status (χ^2(1)=12.97, p= .00). To control for these group differences, parent education and marital status were covariates in all between group comparisons.

Procedure

As noted, clinical staff gathered baseline diagnostic information for the ADHD group at referral to the clinic during childhood. The University of Pittsburgh Medical Center Institutional Review Board reviewed and approved all procedures. Research staff conducted follow-up interviews in adolescence. Participants conducted all questionnaires (paper and pencil/web-based) privately. During informed consent, staff assured participants of the confidentiality of disclosed materials. In cases where distance prevented travel to WPIC, research staff collected information through mail, telephone, and home visits. Participants attended follow-up interviews yearly beginning in the year of enrollment. Data for the current study were from the first follow-up visit. PALS procedures permitted participants to take stimulant medication on the day of the assessment; however a minority of the ADHD group (<10%) were prescribed stimulant medication at follow-up.

Measures

ADHD Symptoms—At baseline and at follow-up, we measured ADHD symptoms using the *Disruptive Behavior Disorders Rating Scale* (DBD; Pelham et al., 1992b). The DBD lists the DSM-III-R and DSM-IV symptoms of ADHD, ODD, and CD. DSM ADHD rating scales, like the DBD, display nearly identical classification rates as structured or semi-structured interviews (e.g., DISC; Dupaul, Power, McGoey, Ikena, & Anastopoulos, 1998; Ostrander et al., 1998; Power et al., 2001). In addition, the DBD rating scale outperforms the DISC in its ability to predict observational ratings of disruptive behavior (Wright et al., 2007). At baseline and follow-up, parents and teachers of participants provided ratings of (0) not at all, (1) just a little, (2) pretty much, or (3) very much for each symptom on the scale. At follow-up, participants offered self-reports and parents indicated the teacher who taught the class in which the adolescent struggled most. The selected teacher completed ratings for 17% of participants and when this teacher was not available, research staff randomly selected a core academic teacher (e.g., science, math, language arts) to complete the rating. The psychometric properties of the DBD are strong in childhood and adolescent samples, with empirical support for distinguishing factors of inattention, hyperactivity/impulsivity, ODD, and CD, and internally consistent subscales with alphas above .95 (Molina et al., 2001; Pelham et al., 1992a; Pelham et al., 1992b; Pillow, Pelham, Hoza, Molina, & Stultz, 1998; Wright et al., 2007). We obtained dimensional severity scores (i.e., inattention,

hyperactivity/impulsivity) by summing ratings for each symptom on the subscale and dividing by the total number of subscale items. For symptom counts, we counted a symptom as present at the level of (2) pretty much or (3) very much. For retrospective reports, respondents rated the child's behavior at initial referral to the STP.

Functional Impairment—To determine each adolescent's level of functional impairment at follow-up, research staff administered the *Impairment Rating Scale* to parents, adolescents, and the same teacher who completed the DBD (IRS: Fabiano et al., 2006). Respondents indicated the degree of impairment an adolescent displayed in seven domains including academics, peer relations, and overall impairment. Respondents marked an X on a continuum from "no problem, definitely does not need treatment" to "extreme problem, definitely needs treatment." Responses to each of the seven items were coded 0–6 with zero representing no impairment and 6 representing extreme impairment. In the current study, the overall impairment item was used to measure clinically significant impairment. The IRS demonstrates good concurrent, convergent, and discriminant validity (Evans et al., under review; Fabiano et al., 2006). The IRS also accurately identifies impairment in children and adolescents with ADHD across settings and informants, with a score of "3" indicating clinically significant functional impairment (Evans et al., under review; Fabiano et al., 2006).

Analytic Plan

Informant—To address who should be an informant when diagnosing ADHD in adolescence, we examined intercorrelations between self, parent, and teacher reports of current ADHD symptoms (i.e., inattention and hyperactivity/impulsivity) and related impairment within the ADHD sample. Due to multiple comparisons, an alpha-level of $p<.01$ was used in these analyses. To detect group differences, we conducted a series of mixed design analyses with ADHD symptoms (i.e., inattention and hyperactivity/impulsivity) and impairment as dependent variables and group (ADHD vs. control) as the between-subjects predictor. Informant (self vs. parent vs. teacher) was the within-subjects predictor. Parent marital and educational statuses were covariates in the model. Examination of sample moments revealed that all assumptions of the General Linear Model (GLM) were met. Mauchley's test of sphericity was non-significant for all models indicating the appropriateness of the univariate approach. All main effects and interactions were examined. We conducted two 2 (criteria met: yes vs. no) x 5 (informant: parent only, teacher only, self only, combined parent-teacher, combined all raters) Pearson's *chi-square* analysis to investigate whether there were significant differences in the proportion of ADHD participants who met: 1) symptomatological criteria for ADHD and 2) clinically significant impairment by each assessment method. *Post-hoc* follow-up analyses using a Bonferroni adjustment of $p<.01$ tested specific hypotheses regarding the incremental value of informant reporting. When combined reports were utilized, this was done at the item level, by retaining the highest symptom endorsement or impairment level offered by a rater ("OR" rule; Bird, Gould, & Staghezza, 1992).

Diagnostic Threshold—To examine whether available control group-referenced and impairment-based data suggest the need for a reduced diagnostic threshold, we examined the

percentage of participants in both groups who displayed each symptom of ADHD according to combined parent-teacher reports. Then, we determined the mean number of endorsed symptoms of inattention and hyperactivity across each level of impairment (also combined parent-teacher reports). Third, as is common practice for distinguishing developmentally normative behavior (Achenbach, 1991), we established a control group-referenced alternative diagnostic threshold of two standard deviations above the mean of the control group for *either* inattention (1.91) or hyperactivity/impulsivity symptom severity (1.13). We also established a criterion-referenced alternative diagnostic threshold of a score of at least "3" on the IRS according to parent or teacher reports. We then descriptively compared subsets of probands identified by each of these methods (i.e., DSM, control group-referenced, and criterion-based).

Retrospective Report—Given the diagnostic requirement that symptoms be present before age seven, we investigated the ability of parents and participants to report consistently on childhood symptoms. We examined partial intercorrelations between baseline parent and teacher reports and retrospective (at PALS follow-up) parent and self-reports, controlling for number of years since baseline. A Bonferroni adjustment set the alpha-level to $p<.01$ for these analyses. To detect group differences, we conducted two (parent and self) repeated-measures ANOVAs with ADHD symptoms as the dependent variable and report source (parent baseline, teacher baseline, retrospective reports) as the within-subjects predictor. Number of years since baseline was a covariate in this model. Examination of sample moments revealed that assumptions of normality and independence for the GLM were met. Mauchley's test of sphericity was significant for the parent model, indicating a violation of this assumption. As a result the Huynh-Feldt *F*-test was employed to detect univariate effects using a model that accounts for this violation. All main effects and interactions were examined in these models.

Results

Informant

Table 2 displays inter-correlations for parent, self, and teacher reports of symptoms and impairment. Across variables, parent and teacher reports of functioning were significantly correlated; however, there was no relationship between self-reports and parent- and teacher-reports of functioning. After controlling for covariates, there were significant interactions between group and rater for inattention [$F(2,450)= 47.20$, $p<.01$, $\eta_p^2=.17$], hyperactivity/impulsivity [$F(2,450)= 28.15$, $p<.01$, $\eta_p^2=.11$], and overall impairment [$F(2,440)= 42.52$, $p<.01$, $\eta_p^2=.16$], with medium effects for these variables (Cohen, 1988). Post-hoc follow-up analyses (see Figure 1a) revealed that ADHD participants tended to rate their functioning as significantly less problematic than parents and teachers. Diagnostic status [$\chi^2(4)=160.50$, $p<.01$] and clinically significant impairment [$\chi^2(4)=186.00$, $p<.01$] in the ADHD sample varied significantly as a function of assessment method (see Table 3). Follow-up tests further revealed that combined parent-teacher reports resulted in significantly more adolescents meeting symptom [$\chi^2(1)= 8.74$, $p<.01$, $OR=2.01$] and clinically significant impairment [$\chi^2(1)=6.78$, $p<.01$, $OR=1.97$] criteria than parent reports alone. However, combined parent-teacher-self reports did not lead to a significant increase in the number of

ADHD participants who met DSM-IV-TR symptomatological [$\chi^2(1)= 1.15$, $p=.28$, $OR=1.31$] or clinically significant impairment [$\chi^2(1)= .26$, $p=.61$, $OR=1.16$] criteria for ADHD.

Diagnostic Threshold

Table 4 illustrates symptom endorsement patterns across the proband and control groups according to combined parent-teacher reports. As impairment in the ADHD sample increased, there was an upward trend in the number of inattention and hyperactivity/impulsivity symptoms endorsed by either the parent or the teacher (see Figure 2). Table 5 displays variability in the DSM IV-TR, control group-referenced, and criterion-referenced diagnostic procedures.

Retrospective Report

After controlling for the number of years since baseline, parent retrospective reports of symptoms were significantly correlated with parent baseline reports of symptoms (see Table 6). There was no association between self-retrospective reports and parent or teacher baseline reports of symptoms. Parent retrospective reports of childhood ADHD symptoms (see Figure 3) did not differ significantly from parent or teacher baseline reports [$F(1.66, 238.71)= 1.11$, $p=.33$, $\eta_p^2=.01$]. For self-retrospective reports, there was a significant recall period by rating interaction [$F(2,300)= 3.74$, $p=.03$, $\eta_p^2=.02$]. Follow-up analyses indicated that self-retrospective reports suggested significantly fewer symptoms than parent [$F(1,152)= 39.59$, $p<.01$, $\eta_p^2=.21$] and teacher [$F(1,150)= 24.53$, $p<.01$, $\eta_p^2=.14$] baseline ratings, and that this discrepancy was more pronounced for adolescents with shorter recall periods. According to parent retrospective reports, only 49.4% of participants in the ADHD group met symptomatological criteria for ADHD in childhood.

Discussion

These findings demonstrate that there is a substantial subset of adolescents who met criteria for ADHD in childhood and possess clinically significant impairment but do not qualify for an ADHD diagnosis as adolescents. As a result, our data suggest several recommendations to improve the diagnostic process for adolescents with ADHD. These conclusions stem from specific findings: (a) there is incremental benefit to combining parent reports with teacher reports, (b) a less stringent symptom threshold than is codified in the DSM facilitates identification of adolescents with a standard and well-validated diagnosis of ADHD in childhood and current clinically significant impairment, without increasing the rate of false-positives and (c) parent retrospective reports, but not self-retrospective reports, correlated significantly with baseline reports of ADHD symptom severity; however, strict reliance on parent reports of childhood functioning led to false negatives. We discuss each of these findings in turn.

The results of our study suggest that approximately 70% of adolescents with a standard and well-validated childhood diagnosis of ADHD continue to meet DSM-IV-TR criteria for the disorder. This persistence rate is similar to others reported using similar methods (for review see Willoughby, 2003). However, an additional 17.7% of the sample met criteria for ADHD

in childhood, continued to possess clinically significant impairment in adolescence, but did not display enough symptoms to qualify for an ADHD diagnosis. Especially noteworthy was that even the most impaired members of our sample tended to possess subthreshold hyperactive/impulsive symptoms (see Figure 2). These findings are concerning as under-identification of ADHD in adolescence can have serious negative consequences. Often, receiving treatment for ADHD is contingent upon a diagnosis. Adolescents may not qualify for educational accommodations through an Individual Education Plan (IEP) or a Section 504 Plan without a valid ADHD diagnosis (Forness & Kavale, 2002). Furthermore, practitioners may not refer an adolescent for treatment and insurance companies may not reimburse if he/she does not meet diagnostic criteria. The common belief that ADHD frequently remits in adolescence also may hamper treatment development in this population.

Consistent with the diagnostic literature, our data suggest that combining reports from parents and teachers appears to be the best method of informant reporting in adolescence (Offord et al., 1996; Rubio-Stipec et al., 2003). As expected (see Figure 1), adolescents with ADHD rated their symptoms and impairment as significantly lower than parent and teacher ratings would suggest and self-ratings in the ADHD group even converged with ratings of control participant functioning. These data offer further support for the persistence of an ADHD-specific self-perception bias into adolescence (Owens et al., 2007). Our findings also suggest significant moderate correlations (.32-.41) between parent and secondary school teacher reports of functioning. This finding is inconsistent with the only other comparison of parent and secondary school teacher ratings in an ADHD sample, which found no correspondence between these sources (Fischer et al., 1993). Fischer and colleagues collected reports from English and Math teachers (regardless of the student's functioning in these classes), whereas our study attempted to use ratings from the teacher with whom the adolescent struggled most (although this was only possible in 17% of cases) and otherwise randomly selected a core academic teacher. Because teacher ratings are highly variable at the secondary school level (Evans et al., 2005; Molina et al., 2001), perhaps differences in our teacher selection procedure increased correspondence between parent and teacher reports. Despite this correspondence, a single teacher's report led to the identification of additional symptoms and impairment when combined with parent reports, increasing the number of identified adolescents with a standard and well-validated diagnosis of ADHD in childhood. Thus, it appears important that diagnosticians obtain report from at least one teacher when assessing ADHD in adolescence, despite the challenges of obtaining a teacher rating in secondary schools (Evans et al., 2007). Although we can only speculate, it may be the case that a rating from the teacher with whom the adolescent struggles most would be most informative. This approach will also minimize teacher burden, which is an important barrier to assessment and treatment in secondary schools (Evans et al., 2007).

To address under-identification of ADHD in adolescence, we investigated alternatives to the current DSM-IV-TR symptom threshold (see Table 5). We established two alternative criteria based on: 1) control group norms and 2) a psychometrically validated minimum for clinically significant impairment (Evans et al., under review; Fabiano et al., 2006). Utilizing control group symptom norms to identify youth with particularly high levels of ADHD symptoms yielded a subset of youth with very similar characteristics to those meeting DSM-IV-TR criteria at follow-up. On the contrary, the impairment-based subsample contained a

greater proportion of adolescents with a standard and well-validated diagnosis of ADHD in childhood and clinically significant problems in daily life functioning, without increasing the rate of false positive diagnoses (see Table 5). As such, our data seem to imply that greater diagnostic weight should be placed upon level of impairment, rather than symptom level. We suggest that to minimize this imbalance, practitioners should employ a reduced diagnostic threshold (our data might suggest four symptoms; see Figure 2 and Table 5), but should carefully assess and consider level of impairment as related to ADHD symptoms (e.g., impulsive decision making, poor grades due to homework problems, strained peer and family relations). Our data support the current draft of the DSM-V, which posits an adolescent-specific threshold of at least four symptoms of either inattention or hyperactivity/ impulsivity (www.dsm5.org).

Although adolescents with a standard and well-validated diagnosis of ADHD in childhood continued to display symptoms of inattention at a fairly high rate (Range: 58.5–73.8%), symptoms of hyperactivity (Range: 22.0–55.5%) and impulsivity (Range: 46.3–62.8%) were less frequently endorsed. The most frequently unendorsed symptoms tended to be hyperactivity items that described childlike behaviors such as running about or climbing excessively (22.0%), difficulty playing quietly (35.4%), and leaving one's seat in the classroom (39.0%). In addition, our data possessed elevated rates of inattention endorsement within the control group (5.9–21.8%; see Table 4). These finding are consistent with other psychometric investigations of ADHD rating scales in adolescent samples. Generally, these studies suggest that inattention and hyperactivity/impulsivity are distinct core symptoms of ADHD in adolescence, with evidence of the poorest item functioning on hyperactivity items (Conners, Sitarenios, Parker, & Epstein 1998; Molina et al., 2001). It is possible that these findings emerged due to a need to modify DSM symptom descriptors so that they are developmentally appropriate for adolescents (see Table 4). Unfortunately, without evaluating alternatively worded symptoms, we cannot determine whether low symptom endorsement occurs because DSM symptoms of ADHD are poorly worded for adolescents or because adolescents with ADHD simply do not display these symptoms. Interestingly, the latest draft of the DSM-V proposes more comprehensive descriptors of symptom manifestations in adolescence (www.dsm5.org). Future research should evaluate the utility of this wording in the diagnosis of ADHD in adolescents.

This study also suggests that parent retrospective reports can be a valid source of information when ascertaining the presence of childhood symptoms. Although parent retrospective reports did not correlate with teacher reports at baseline, its correspondence with baseline parent reports on the same measure was significant ($r=.50$). Despite this correlation, parent retrospective reports implied that approximately half of the ADHD participants displayed insufficient symptoms for a childhood diagnosis at baseline. This finding is not surprising, as childhood diagnoses were made considering both parent and teacher reports and our attempt at retrospective diagnosis relied only on parent reports. As a result of the false-negatives associated with retrospective diagnosis, it may be necessary to corroborate parent retrospective reports with official school records (i.e., elementary school progress reports) and refrain from strict interpretation of DSM-criteria (i.e., the requirement that six or more symptoms be present in childhood). Self-reports should not be used to

establish childhood symptoms, as they were unrelated to baseline parent and teacher reports. Our findings are contrary to those of Miller and colleagues (2010) who found no relationship between parent retrospective and baseline reports of functioning. This discrepancy may have occurred because we used the same measures at baseline and follow-up, minimizing interference from method variance. Intriguingly, for self but not parent reports, there was lower agreement between baseline and retrospective ratings for shorter recall periods. Perhaps reports of more recent functioning elicit a more severe ADHD-specific self-perception bias. Of course, it could also be the case that reporting accuracy increases with age, and that this effect was driven by age at follow-up, which was correlated with recall period length ($r=.56$).

The results of this study should be considered within the context of its limitations. First, as a clinic-referred sample, the PALS outcomes may not generalize to epidemiological samples of adolescents with ADHD. Most notably, our persistence rate for childhood ADHD might be an overestimate in epidemiological samples. While our sample was demographically representative of the county in which the study occurred, it is important to note that many of our participants came from middle-class families. As a result, our findings may be most generalizable to middle-class, racial-majority males with parents who are high school graduates. Also, we used the control group to establish norms for ADHD symptom severity, given the demographic similarity of this sample to the probands. However, the norms offered by our control group should not be interpreted as epidemiological in nature, as they come from a relatively small local sample. Furthermore, given the small proportion of girls in our sample (<10%), we could not independently examine differential diagnostic trends by gender. However, we reanalyzed all data excluding the females from the sample and the significance of results did not change. It is also possible that daily life impairment as endorsed on the IRS was not completely ADHD-related, as this measure does not specifically instruct reporters to consider only problems related to ADHD.

Strikingly, if current practice parameters were strictly enforced, only 45.1% of the adolescent ADHD group in our sample, who were well-diagnosed in childhood, would have met diagnostic criteria at follow-up (i.e., possess adequate symptom threshold, clinically significant impairment, and positive retrospective parent reports of childhood symptoms). This proportion is even lower if diagnosis in our sample is made without consideration of teacher reports (40.2%). These statistics highlight the need for the establishment of separate practice guidelines for the diagnosis of adolescents with ADHD. Thus, our recommendations are as follows: (1) parent reports of symptoms and impairment (but not self-reports) should be combined with similar reports from a core academic teacher, ideally the one with whom the adolescent struggles most; (2) a lower symptom threshold (4 symptoms) should be employed for the diagnosis of ADHD in adolescents and (3) parent retrospective reports should be obtained, but when necessary, corroborated with objective records from childhood (i.e., report cards, teacher progress reports) to establish childhood ADHD. Finally, an important future direction for research will be the empirical validation of alternatively worded descriptors of DSM ADHD symptoms for use in the adolescent population. It is our hope that these recommendations will lead to improved identification of

adolescents with ADHD, increasing access to treatment and educational services for these youth.

Acknowledgments

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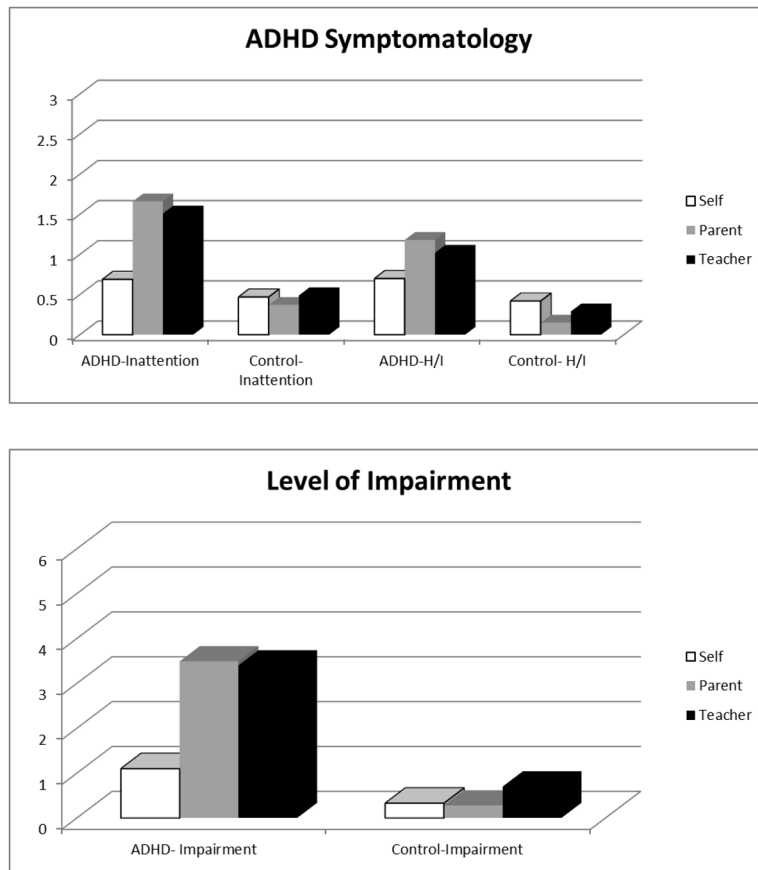
Figure 1. ADHD Symptomatology and Impairment by Rater and Group
Note. Graphs reflect estimated marginal means at the mean of the covariates.
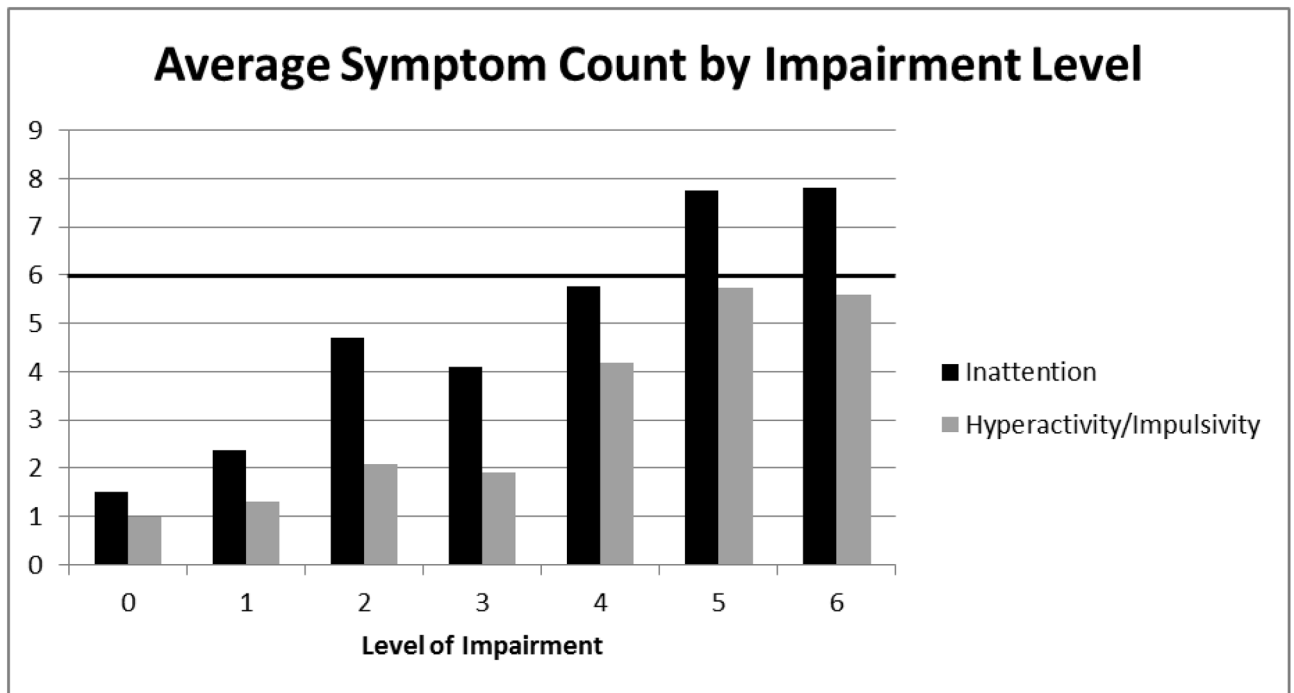
Figure 2. Mean Symptom Endorsement at each IRS Impairment Level within ADHD Group
Note. Clinically significant impairment is indicated by a score of "3" or higher on the
Impairment Rating Scale (Evans et al., under review; Fabiano et al., 2006).
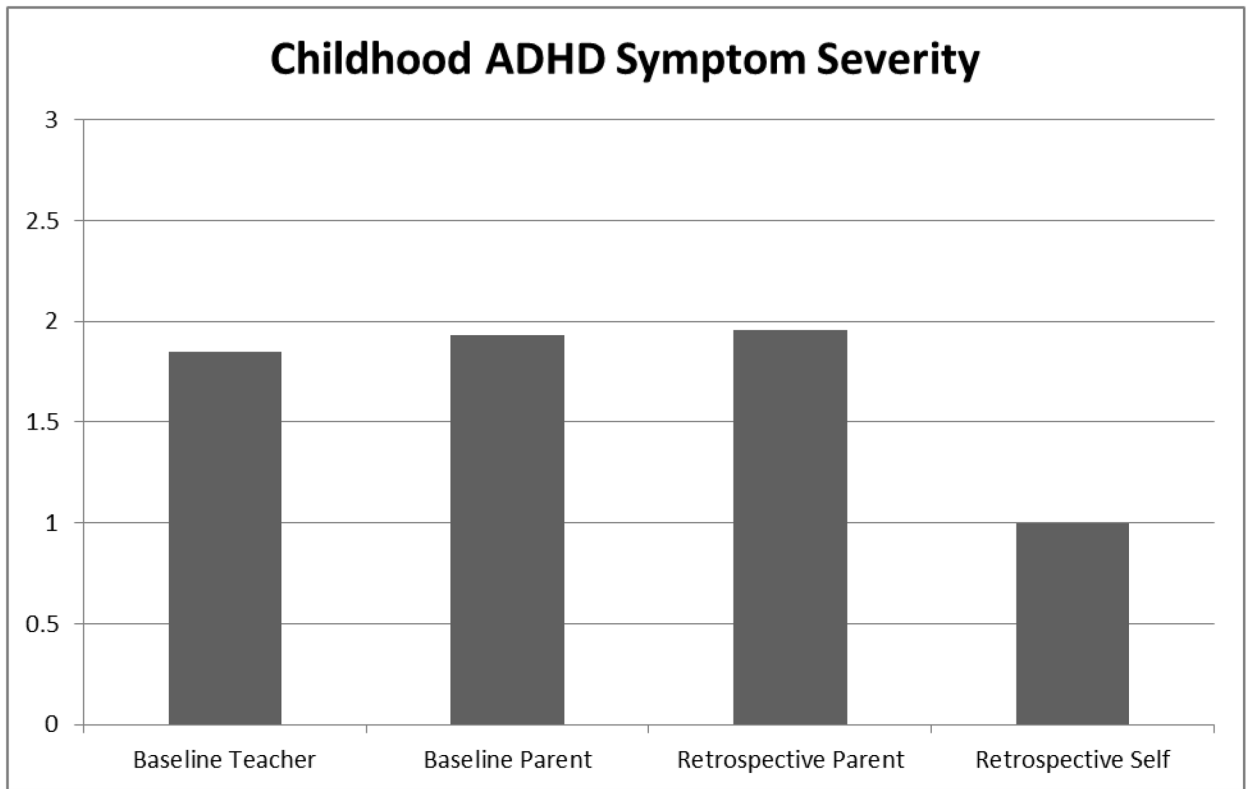
Figure 3. Group-level Retrospective Reporting within the ADHD Sample
Note. Values represent estimated marginal means at the mean of the covariate (years since baseline).

Table 1

Demographic Characteristics of Adolescents at Follow-up Recruitment.

	ADHD	Control
Demographic Variables		
Age (M, SD)	14.74 (1.73)	14.52(1.79)
Gender		
Male (%)	92.7	92.4
Racial Minority (%)	20.7	17.6
African-American (%)	9.2	10.4
Other (%)	11.5	7.2
Highest Parent Education[*]		
High School Grad or GED (%)	7.7	6.7
Part College or Specialized Training (%)	41.9	26.9
College or University Grad (%)	27.1	25.2
Graduate Professional Training (%)	23.2	41.2
% Single Parent Household[*]	36.8	16.9

[*]
$p<.05$

Table 2

Inter-rater Correlations within the ADHD Sample

	Self-Parent	Self-Teacher	Parent-Teacher
Inattention	.01	.11	.41[*]
Hyperactivity/Impulsivity	.08	.20	.35[*]
Overall Impairment	.08	.04	.32[*]

[*] $p<.01$

Table 3

Proportion of ADHD sample meeting symptom and impairment thresholds at follow-up

				Informant		
	Parent	Teacher	Self	Parent-Teacher	Parent-Teacher-Self[a]
Adolescents					
Symptom Threshold	53.5%	49.6%	10.8%	69.6%	75.0%
Clinically Significant Impairment	66.9%	68.2%	17.7%	79.9%	82.1%

Note. Meeting symptom threshold was defined as endorsement of at least six DSM-IV-TR items of Inattention and/or Hyperactivity/Impulsivity. Meeting threshold for clinically significant impairment was defined as a score of "3" or higher on the IRS (Fabiano et al., 2006).

Table 4

Endorsement of ADHD Symptoms According to Combined Parent and Teacher Report

	ADHD (%)	Control (%)	χ^2	OR
Inattention				
Fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities	72.0	21.8	69.27	9.18
Difficulty sustaining attention in tasks or play activities	65.2	5.9	101.00	30.04
Does not seem to listen when spoken to directly	58.5	10.1	68.60	12.59
Does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace	70.1	17.6	76.07	10.95
Has difficulty organizing tasks and activities	70.1	11.8	94.68	17.60
Avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort	62.8	16.8	59.38	8.36
Loses things necessary for tasks or activities	60.4	8.4	78.63	16.60
Easily distracted by extraneous stimuli	73.8	15.1	94.93	15.79
Forgetful in daily activities	60.4	9.2	75.85	14.95
Hyperactivity/Impulsivity				
Fidgets with hands or feet or squirms in seat	55.5	7.6	69.32	15.24
Leaves seat in classroom or in other situations in which remaining seated is expected	39.0	4.2	45.36	14.59
Runs about or climbs excessively in situations in which it is inappropriate	22.0	0.8	27.04	33.19
Difficulty playing or engaging in leisure activities quietly	35.4	3.4	41.29	15.73
"On the go" or often acts as if "driven by a motor"	42.7	2.5	58.11	28.79
Talks excessively	50.0	10.9	47.22	8.15
Blurts out answers before questions have been completed	49.4	5.9	60.93	15.61
Has difficulty awaiting turn	46.3	0.8	72.09	101.91
Interrupts or intrudes on others	62.8	8.4	85.09	18.41

Table 5

Comparison of three Adolescent Diagnostic Methods across Childhood ADHD Sample

	Diagnosed		Impaired without Diagnosis		Diagnosed without Impairment		Symptoms of Inattention[a]	Symptoms of Hyperactivity/Impulsivity[a]
	N	%	N	%	N	%	M(SD)	M(SD)
DSM-IV-TR	110	69.6	28	17.7	12	7.6	7.98(1.33)	5.46(2.72)
Norm-Referenced	116	73.0	22	13.8	11	6.9	7.70(1.73)	5.46(2.56)
Impairment-Based	127	79.9	--	--	--	--	6.87(2.64)	4.85(3.01)

Note. Due to a small amount of missing information, data was available from 158 to159 of 164 probands. DSM-IV-TR criteria includes endorsement of six symptoms of inattention and/or hyperactivity/impulsivity. Norm-referenced criteria refers to possessing a symptom severity score that is at least two SDs above the mean of the control group. Impairment-based criteria refers to possessing a score of "3" or higher on the IRS overall impairment item.

[a]Displays the mean number of symptoms endorsed by the subset of probands identified by each diagnostic method.

Table 6

Correlations between Retrospective and Baseline Report within ADHD sample

	Parent Baseline	Teacher Baseline	Parent Retrospective
Self Retrospective	.05	.08	.06
Parent Retrospective	.50[*]	−.07	--

Note. Partial correlations obtained to control for the number of years between baseline and follow-up.

[*]
 p<.01.