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Comparing Methods to Determine Persistence of Childhood ADHD into Adulthood: A Prospective, Population-Based Study

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Abstract

Objective: To compare the rate of persistence of ADHD into adulthood as determined by a norm-referenced versus non-norm-referenced diagnostic interview, and by standardized questionnaires.

Method: Adults from a birth cohort, including research-identified childhood ADHD cases (N=232; mean age 27.0 years; 167 males, 65 females) and controls (N=335; mean age 28.6 years; 210 males, 125 females) were administered the MINI International Neuropsychiatric Interview, the Murphy-Barkley Symptoms Checklist (MB) and the Wender Utah Rating Scale (WURS).

Results: Among the childhood ADHD cases, 29.3% fulfilled criteria for adult ADHD using a norm-referenced approach to MINI scoring, versus 13.8% using published MINI criteria. Among subjects meeting norm-referenced diagnostic criteria, 41.8% and 69.1% were classified as adult ADHD using the MB and WURS, respectively.

Conclusions: A non-norm-referenced approach resulted in a significant underestimate of the rate of adult ADHD. Reliance on either of two adult ADHD questionnaires would have further reduced this estimate.

Keywords

ADHD; adults; diagnosis; structured interview; questionnaires

INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is the most common childhood neurodevelopmental disorder (Barbaresi et al., 2002; Froehlich et al., 2007) and has been reported to affect 4.4% of adults (Kessler et al., 2006). However, estimates of the persistence

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Declaration of Conflicting Interests

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of ADHD from childhood to adulthood have ranged from 6% to 66% (R. A. Barkley, Fischer, Smallish, & Fletcher, 2002; Biederman, Petty, Clarke, Lomedico, & Faraone, 2011; Biederman, Petty, Evans, Small, & Faraone, 2010; Biederman, Petty, Monuteaux, et al., 2010; Gittelman, Mannuzza, Shenker, & Bonagura, 1985; Halperin, Trampush, Miller, Marks, & Newcorn, 2008; Kessler et al., 2006; Kessler et al., 2005; Lara et al., 2009; Mannuzza, Klein, & Moulton, 2003; Rasmussen & Gillberg, 2000), in part due to differences in criteria and methods employed to diagnose ADHD in adults. Among the issues to consider in establishing the most appropriate approach for adult ADHD diagnosis are symptom thresholds, accuracy of recall of childhood ADHD symptoms, assessment of the impact of adult ADHD symptoms across settings, and the method to obtain diagnostic information about ADHD symptoms (e.g. structured diagnostic interviews or questionnaires). In order to meet the needs of the many adults affected by ADHD, it is imperative that accurate, efficient diagnostic approaches be made available, particularly for the internal medicine and family medicine clinicians who often are called upon to diagnose and treat adults with ADHD.

The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV TR)(Association, 2000) required six or more inattentive and/or six or more hyperactive-impulsive symptoms to make a childhood ADHD diagnosis. However, the number of ADHD symptoms decreases with age and a lower symptom threshold may be more appropriate for adults (R. A. Barkley et al., 2002; Biederman, Mick, & Faraone, 2000). In the fifth edition of the DSM (DSM-5), the diagnostic threshold was reduced to 5 ADHD symptoms for persons age 17 years and older.(American Psychiatric Association. & American Psychiatric Association. DSM-5 Task Force., 2013)

The DSM-IV TR ADHD criteria required that some symptoms were present before age 7 years (Association, 2000), while the DSM-5 shifted the age of onset to before 12 years. (American Psychiatric Association. & American Psychiatric Association. DSM-5 Task Force., 2013) This criterion poses a challenge when adults seek treatment for ADHD, particularly if they do not have a documented childhood ADHD diagnosis.(Mannuzza et al., 2003; Zucker, Morris, Ingram, Morris, & Bakeman, 2002) In addition, there are conflicting findings on the accuracy of adult recall of childhood ADHD symptoms.(R. A. Barkley et al., 2002; Dias et al., 2008; Loney, Ledolter, Kramer, & Volpe, 2007; Mannuzza, Klein, Klein, Bessler, & Shrout, 2002; P. Murphy & Schachar, 2000; Suhr, Zimak, Buelow, & Fox, 2009)

The diagnosis of ADHD requires symptoms causing impairment in two or more settings. (American Psychiatric Association. & American Psychiatric Association. DSM-5 Task Force., 2013) There are conflicting reports about the accuracy of adult self-report of functional impairment from ADHD symptoms.(Faraone & Antshel, 2008; Knouse, Bagwell, Barkley, & Murphy, 2005; Loney et al., 2007; Okie, 2006) The impact of requiring self-report of functional impairment on the rate of diagnosis of ADHD in adults remains uncertain.

The diagnosis of ADHD in childhood depends on standardized, ADHD-specific rating scales completed by parents and teachers.(Subcommittee on Attention-Deficit/Hyperactivity et al., 2011) It may be difficult or inappropriate to obtain comparable information (e.g. from

employers) for adults in whom a diagnosis of ADHD is being considered. It is therefore important to assess the utility of other methods to obtain information, such as structured diagnostic interviews. Previous studies have provided conflicting reports on the accuracy and reliability of rating scales versus structured interviews. (Epstein & Kollins, 2006; Magnusson et al., 2006; O'Donnell, McCann, & Pluth, 2001) Additional research is needed to determine the optimal method for obtaining information from adults presenting for diagnostic evaluation.

In this paper, we describe a study of childhood ADHD cases and non-ADHD controls from the 1976 to 1982 Rochester, Minnesota, birth cohort, who participated in a prospective adult outcome study. We report the rates of persistence of ADHD into adulthood using a structured neuropsychiatric interview, comparing norm-referenced and non-norm-referenced diagnostic cutoffs. We also report on the impact of other diagnostic criteria specified in DSM-5, including recall of childhood ADHD and self-report of impairment from adult ADHD symptoms. Finally, we assessed the sensitivity of two well-known adult ADHD self-report questionnaires using norm-based criteria on a structured neuropsychiatric interview as the “gold standard” for adult ADHD case identification.

METHOD

Study Setting

Rochester, Minnesota is geographically isolated in southeastern Minnesota and virtually all medical care is provided by Mayo Clinic and Olmsted Medical Center. The resources of the Rochester Epidemiology Project (REP) provide infrastructure for population-based research. (Melton, 1996) All medical diagnoses and surgical procedures are recorded and indexed for computerized retrieval. For this ADHD study, all 41 public and private schools in Independent School District 535 (Rochester, MN school system) participated in a contractual research agreement including permission to access cumulative educational records for every child from the 1976–1982 Rochester, MN birth cohort. The study was approved by the IRBs of Mayo Clinic and Olmsted Medical Center. Written informed consent was obtained from participants in the prospective portion of this study.

Subjects

Birth Cohort—This study employed a birth cohort consisting of all children born between January 1, 1976, and December 31, 1982, to mothers residing in Independent School District 535, who continued to live in Rochester until at least age 5 years and who granted permission for use of their medical records for the study (N=5718). (Katusic, Colligan, Barbarese, Schaid, & Jacobsen, 1998)

Identification of Childhood ADHD Cases—Details regarding our criteria and the identification of childhood ADHD cases have been described elsewhere. (Katusic et al., 2005) Subjects were defined as research-identified *childhood* ADHD cases if their school and/or medical records included various combinations of the following 3 different categories of information: (1) documentation in medical and school records of behavioral symptoms consistent with the criteria for ADHD from the *Diagnostic and Statistical Manual of Mental*

Disorders, Fourth Edition (DSM-IV TR); (2) positive ADHD questionnaire results; and (3) documented clinical diagnosis of ADHD. A total of 379 ADHD incident cases were identified. (Katusic et al., 2005)

Recruitment for Prospective Study—Of the 379 research-identified childhood ADHD cases, subjects who provided continued permission to access their medical records for research were invited to participate in a prospective adult outcome study. (Barbarese et al., 2013) A random sample of adults from the same birth cohort who did not have severe intellectual disability and who had also provided access to their medical records for research were also invited to participate.

Adult ADHD Assessment

Mini International Neuropsychiatric Interview—The Mini International Neuropsychiatric Interview (M.I.N.I., Version 5.0.0), including the module for Adult ADHD, was administered to all participants in the prospective study. (Sheehan, Lecrubier, Sheehan, & al, 1997, 1998) The M.I.N.I. is a structured diagnostic interview for DSM-IV TR and ICD-10 psychiatric disorders. The M.I.N.I. was selected for several reasons. The M.I.N.I. was specifically “designed to meet the need for a short but accurate structured psychiatric interview for multicenter clinical trials and epidemiology studies.” (Sheehan et al., 1997, 1998) In validation studies of the M.I.N.I., comparing it to the Structured Clinical Interview for DSM-III-R, Patient Version (SCID-P) and the Composite International Diagnostic Interview (CIDI), kappa values for 17 Axis-I disorders ranged from 0.52 to 0.90, with the exception of “current drug dependence” (0.43). Sensitivity, specificity, positive and negative predictive values were all good in comparison to the SCID-P, CIDI and expert clinical diagnoses. (Sheehan et al., 1997, 1998) Researchers are referred to the published M.I.N.I. validation study for further details. Also, given the large number of subjects and logistical considerations including cost to complete the study, the short administration time of the M.I.N.I. (15–20 minutes) represented a significant advantage compared to instruments such as the SCID (45–60 minutes), Diagnostic Interview Schedule (45–75 minutes) or the Schedule for Affective Disorders and Schizophrenia (90–120 minutes). (Sheehan et al., 1997, 1998) This was particularly important, since we were also collecting other information and performing direct academic testing on all subjects, with findings to be reported in future publications. The M.I.N.I. ADHD module includes 10 childhood ADHD items and 14 items on adult ADHD (10 of which describe overt symptoms of hyperactivity or inattentiveness in adulthood, Table 1). Two additional items ask if some symptoms have “caused significant problems in two or more of the following settings: at school, at work, at home or with family or friends” and if some symptoms had onset prior to age 7 years. (Sheehan et al., 1997, 1998)

At the outset of the study, all research assessments were administered by doctoral level members of the research team, while study coordinators (n=3) observed. After guided study of the M.I.N.I., each study coordinator administered a “practice assessment” to another member of the research team, after which they were allowed to administer the assessment to actual study subjects, while being directly observed by one of the investigators. After successfully completing this step, they were allowed to independently complete study visits.

One of the investigators was available at all times to address any questions or concerns during study visits so that all issues could be immediately resolved before the study visit was completed. Finally, the research team conducted weekly meetings throughout the study, including review of any issues or questions about any of the study instruments that may have arisen in the preceding week.

Responses to the M.I.N.I. were used to derive three different scoring approaches. First, for the research-identified childhood ADHD cases, we scored M.I.N.I. responses according to published criteria, requiring that respondents endorse at least 6/10 childhood symptoms, at least 9/14 adult symptoms and, finally, endorse significant adverse impact of adult symptoms and onset prior to age 7 years. Second, we used a norm-referenced approach, scoring M.I.N.I. responses using a cutoff of 2 standard deviations above the mean number of inattentive or hyperactive/impulsive adult symptoms, respectively, endorsed by participating non-ADHD controls. Last, we scored M.I.N.I. responses using a 5 symptom cutoff consistent with DSM-5 criteria. (American Psychiatric Association. & American Psychiatric Association. DSM-5 Task Force., 2013)

Murphy-Barkley Self Report Checklist for Adults—The Murphy-Barkley Self Report Checklist for Adults (MB) includes 18 items, corresponding to DSM-IV TR ADHD criteria. (Russell A. Barkley, Murphy, & Fischer, 2008; K. Murphy, Barkley, R.A., 1996) Participants rated symptoms as *never/rarely, sometimes, often or very often* present “over the past six months” (current symptoms) and again “as a child of 5 to 12 years” (childhood symptoms). Missing response values were imputed using the mean value of the subject’s non-missing responses separately within each timeframe and symptom category (inattentive or hyperactive/impulsive). Responses were scored separately for childhood/adult timeframes using two approaches. The first used a total numeric score derived by summing the responses for all 18 items (never/rarely=0, sometimes=1, often=2 and very often=3). The second approach employed a total positive symptom count, with responses of “often” or “very often” coded as positive. (K. Murphy, Barkley, R.A., 1996)

Wender-Utah Self-Report Scales—The Wender-Utah Self-Report Scales (WURS) is comprised of 25 items related to ADHD, mood and anxiety. (McCann, Scheele, Ward, & Roy-Byrne, 2000; Rossini & O’Connor, 1995; Stein, Sandoval, Szumowski, & al, 1995; Ward, Wender, & Reimherr, 1993) Participants recorded if each symptom applied to them *not at all/very slightly, mildly, moderately, quite a bit or very much* “over the past 6 months” (i.e. adult symptoms) and “as a child” (i.e. childhood symptoms), respectively. Prior to scoring, missing values were imputed for each subject by using the mean value of the subject’s non-missing responses separately within each timeframe. Responses were scored separately for each timeframe, by calculating total summated scores.

Data Analysis—Based on the responses to the M.I.N.I., we determined the frequency and percentage of research-identified childhood ADHD cases who met criteria for persistent adult ADHD; corresponding 95% confidence intervals (CI) were calculated using a normal approximation to a binomial proportion. A two-sided chi-square test was used to compare the rate of persistent adult ADHD between males and females. Sensitivity and specificity of adult ADHD rating scales (WURS, MB) were determined using the norm-based M.I.N.I.

criteria as the “gold standard” for adult ADHD case identification. Statistical analyses were performed using SAS version 9.2 software (SAS Institute, Inc.; Cary, NC).

RESULTS

Prospective Study Participants

Among the 367 eligible childhood ADHD cases, 232 (167 males, 65 females; mean age 27.0 years) or 63.2% participated in the prospective study. As reported previously, participating and non-participating adults with childhood ADHD were compared on variables including age, race, childhood ADHD treatment history, presence of co-morbid conditions and socioeconomic status at birth, and differed only on high school graduation rates (84.3% for participants vs 64.8% for non-participants; $p < 0.01$). (Barbarese et al., 2013) Non-ADHD controls from the birth cohort ($N = 801$) were invited to participate, yielding 335 participants (210 males, 125 females; mean age 28.6 years).

Persistence of ADHD into Adulthood based on the M.I.N.I.

Employing the published M.I.N.I. diagnostic criteria, 32 (13.8%) of the 232 subjects with research-identified childhood ADHD fulfilled criteria for adult ADHD.

Among the non-ADHD controls, the mean (SD) number of current inattentive or hyperactive/impulsive symptoms was 1.0 (1.3) and 1.3 (1.4), respectively; therefore, the 2 standard deviation cutoff above the mean for either inattentive or hyperactive/impulsive symptoms was 4 symptoms. Using this norm-referenced approach, 90 (38.8%) of the 232 participating childhood ADHD cases fulfilled the criteria for persistent adult ADHD. Among these 90 cases, 68 reported adult ADHD symptoms causing significant problems in two or more settings, so upon requiring this criterion the rate of persistent adult ADHD decreased from 38.8% to 29.3%.

Of the 232 childhood ADHD cases, 167 (72.0%) recalled 6 or more childhood ADHD symptoms and 159 (68.5%) indicated that at least some symptoms were present before age 7 years, as required by DSM-IV TR. (Association, 2000) Among the 68 subjects who fulfilled our norm-referenced criteria for adult ADHD, 60 (88.2%) recalled 6 or more childhood ADHD symptoms. If this additional criterion were required, the rate of persistence of ADHD into adulthood would be reduced from 29.3% to 25.9%. Furthermore, 56 (82.4%) of the 68 subjects indicated that at least some symptoms were present before age 7 years; if this additional criterion were required instead, the rate of persistence of ADHD into adulthood would decrease from 29.3% to 24.1%. If we employed, the DSM-5 threshold of 5 inattentive and/or hyperactive/impulsive symptoms the rate of persistent ADHD would decrease to 13.4% overall. The impact of varying criteria did not differ by gender (Table 2).

Murphy-Barkley Self-Report Checklist for Adults Compared to MINI Normative Definition—Among the 232 childhood ADHD cases, 230 completed the MB. Subjects were classified as meeting criteria for adult ADHD based on 4 different scoring approaches for the MB. Among those cases with persistent adult ADHD based on the norm-referenced MINI criteria, sensitivity of the MB questionnaire ranged from 32.8 to 41.8%. Furthermore,

among the childhood ADHD cases without persistent adult ADHD, specificity ranged from 93.3% to 95.7%, depending on the scoring approach (Table 3).

Wender-Utah Rating Scale Compared to MINI Normative Definition—Compared to the M.I.N.I. norm-referenced approach, the sensitivity of the WURS questionnaire ranged from 50.0% to 69.1%, while the specificity ranged from 77.4 to 88.4%, depending on the scoring approach (Table 4).

DISCUSSION

In this longitudinal, population-based study we present findings on the diagnostic criteria and tools required to diagnose persistence of ADHD into adulthood. We found that published diagnostic symptom thresholds lead to under-diagnosis of adult ADHD in comparison to normative thresholds derived from non-ADHD control subjects from our birth cohort. Among the 90 subjects who endorsed sufficient current symptoms to qualify for an ADHD diagnosis, 68 (75.6%) self-reported adverse impact of these symptoms in multiple settings. The majority (88.2%) of the 68 subjects who fulfilled our norm-referenced criteria for persistent, adult ADHD recalled more than six childhood ADHD symptoms and, among these subjects, the majority (82.4%) also reported at least some symptoms were present prior to age 7 years. We assessed the sensitivity of two adult ADHD self-report questionnaires using the norm-based M.I.N.I. criteria as the “gold standard” for adult ADHD case identification and found that the questionnaires under-identified cases.

Until the publication of DSM-5, the diagnostic threshold for adult ADHD was the same as for childhood ADHD. (American Psychiatric Association. & American Psychiatric Association. DSM-5 Task Force., 2013; Association, 2000) However, the six-symptom DSM-IV-TR threshold was derived from studies of children aged 4 to 17 years.(Russell A. Barkley et al., 2008; Lahey et al., 1994) Prior studies have found that both the number and type of ADHD symptoms decline with age.(Biederman et al., 2000) In a prospective, follow-up study of 147 adults with childhood ADHD, initially diagnosed at a tertiary care psychiatric program, the use of *childhood* diagnostic thresholds in adulthood was equivalent to employing a cutoff 3.5 standard deviations above the mean number of ADHD symptoms endorsed in general by adults.(R. A. Barkley et al., 2002) The 2 standard deviation cutoff in this study was 4 symptoms, identical to our findings. Similarly, we found that the use of published M.I.N.I. cutoffs identified only 13.4% of our childhood ADHD cases as having persistent ADHD, versus the 29.3% rate we found when we employed a normative cutoff derived from our control subjects.(Barbarese et al., 2013) Both the 6 symptom DSM-IV-TR and the 5 symptom DSM-5 cutoff exceed the 4 symptom threshold that constitutes 2 standard deviations above the mean for our population-based non-ADHD controls, with known childhood ADHD case status. (American Psychiatric Association. & American Psychiatric Association. DSM-5 Task Force., 2013; Association, 2000) Thus, the published norms in DSM-5 may be overly restrictive. While the M.I.N.I. ADHD items and the DSM-5 ADHD symptoms are clearly not identical, the M.I.N.I. items included in our adult ADHD case criteria do correspond to major ADHD symptoms (inattention, distractibility, organizational challenges, hyperactivity/fidgetiness and impulsivity). Nevertheless, while we could not make direct comparisons between these M.I.N.I. items and DSM 5 items, our

findings do reflect adult subjects' responses to questions that do clearly correspond to core ADHD symptoms.

Recently, the age-of-onset criterion for ADHD diagnosis was revised upward, from 7 to age 12 years. (American Psychiatric Association. & American Psychiatric Association. DSM-5 Task Force., 2013) This diagnostic criterion continues to pose a challenge when adults seek treatment for ADHD, particularly if they do not have a documented childhood ADHD diagnosis. (Mannuzza et al., 2003; Zucker et al., 2002) Barkley et al reported that only 47% of their subjects recalled sufficient childhood ADHD symptoms to qualify for a DSM-III-R ADHD diagnosis. (R. A. Barkley et al., 2002) In another prospective study of 176 males with childhood ADHD followed to age 25 years, 78% accurately recalled their childhood ADHD based on a structured, DSM-III-R based diagnostic interview. (Mannuzza et al., 2002) Several studies have reported moderate to high correlation between adult subjects self-reported versus parent-reported childhood ADHD symptoms. (Dias et al., 2008; P. Murphy & Schachar, 2000; Zucker et al., 2002) Loney et al found limited correlation between current (obtained during adolescence) and retrospectively recalled (obtained during young adult follow-up) childhood ADHD symptoms in study of boys referred for psychiatric evaluation at age 9 years. (Loney et al., 2007) In our cohort of 232 adults with documented childhood ADHD, 167 (72.0%) recalled 6 or more childhood ADHD symptoms while 159 (68.5%) recalled onset of symptoms before age 7. Among the 68 adults who fulfilled our norm-referenced criteria for significant adult ADHD symptoms, 60 (88.2%) reported 6 or more childhood ADHD symptoms and 52 (76.5%) reported some symptoms with onset prior to age 7 years. Thus, in our population-based cohort, requiring recall of childhood ADHD had a modest negative impact on the likelihood of an adult ADHD diagnosis.

The diagnosis of ADHD requires that symptoms cause impairment in two or more settings. (American Psychiatric Association. & American Psychiatric Association. DSM-5 Task Force., 2013) However, self-report of impairment may be inaccurate due to the tendency of respondents to rate themselves overly positively. (Faraone & Antshel, 2008; Loney et al., 2007) For example, adults with ADHD report their driving performance less accurately than non-ADHD peers. (Knouse et al., 2005) One study suggested that the correlation between ADHD symptoms and functional impairment may be greater in adults than in children. (Faraone & Antshel, 2008) We found that, among the 90 childhood ADHD cases who exceeded our norm-referenced symptom threshold for adult ADHD, only 68 (75.6%) endorsed adverse impact of these symptoms in two or more settings. Thus, it may be more appropriate to rely on other, concrete information to assess impact of adult ADHD symptoms (e.g., job performance and relationships).

ADHD-specific rating scales and questionnaires completed by parents and teachers are a mainstay of the diagnostic process in childhood. (Subcommittee on Attention-Deficit/Hyperactivity et al., 2011) However, it is often impossible to obtain information about ADHD symptoms in adults from informants such as employers or spouses, and even if possible, this may represent a threat to patient confidentiality. (Russell A. Barkley et al., 2008) It is therefore important to determine the most accurate method to obtain diagnostic information from adults. Magnusson et al reported adequate sensitivity of self-report and informant rating scales of adult ADHD symptoms when compared with a semi-structured

diagnostic interview.(Magnusson et al., 2006) In contrast, McCann reported that self-completed ADHD rating scales were sensitive (78 to 98%) but not specific (36–67%) when compared to a semi-structured clinical interview.(McCann et al., 2000) In another study (n=30), Epstein reported that correlations between results from a structured, DSM-IV based diagnostic interview and self-completed ratings scales were moderately strong.(Epstein & Kollins, 2006) We found that reliance on patient-completed rating scales would lead to under-identification of adult ADHD in comparison to a brief, structured, diagnostic interview.

Several limitations should be considered when interpreting our findings. The initial, retrospective identification of ADHD cases in the birth cohort may have been incomplete. However, the comprehensive access to relevant information from school and medical records and use of rigorous research criteria suggest that it is unlikely that we missed a significant number of childhood ADHD cases. Our prospective outcome study included 61% of the original cohort of childhood ADHD cases; however, participants and non-participants differed only on high school graduation rates. Finally, at the time of our original, retrospective study, Rochester, Minnesota was primarily a white, middle class community, so inferences to other populations or settings may be limited. Nevertheless, the residents of Rochester have excellent access to medical care and comprise a homogeneous population (95% white), thereby minimizing the confounding effects of SES, ethnicity, and race on the study questions.

We did not attempt to obtain information from spouses, employers or acquaintances for several reasons. First, since our childhood ADHD cases had been identified retrospectively, we did not have a personal connection to the study subjects until the time of their participation in the prospective phase of the study. (Katusic et al., 2005) As has been pointed out previously, attempts to contact other informants represents a potential threat to patient confidentiality. We therefore judged that attempts to obtain information from other informants would have compromised subjects' willingness to participate if we included this approach. Second, while all of our subjects were born in Rochester, Minnesota, many had moved to other parts of the country by the time the prospective outcome portion of the study was conducted, adding logistical problems to any effort to collect information from other informants. This additional information would be useful in assessing the validity of self-report of ADHD symptoms. However, we were able to partially assess the validity of subject self-report by including information about the extent to which subjects endorsed an adverse impact of ADHD symptoms. We suspect that subjects who endorsed sufficient symptoms to warrant an adult ADHD diagnosis, but who did NOT endorse adverse impact of their symptoms, may have been under-reporting. Finally, it is important to emphasize that 88.2% of our subjects accurately reported their childhood ADHD symptoms, suggesting that they were capable of accurate self-report.

We did not statistically assess the performance of our study coordinators' administration of the M.I.N.I. However, as described, we provided careful training, immediate access to consultation with one of the investigators during each study visit, and ongoing monitoring of any questions or issues that arose during study visits. Furthermore, it is important to emphasize that the M.I.N.I. was specifically designed to be administered by non-clinical

trained interviewers, with questions having a yes/no format and an administration protocol that does not involve clinical judgment on the part of the interviewer. (Sheehan et al., 1997, 1998)

Our findings suggest that failure to use adult-derived norms to establish a diagnostic threshold for ADHD leads to under-identification of cases and, hence, an underestimate of the rate at which childhood ADHD persists into adulthood. Adults with a history of childhood ADHD often accurately recall their childhood symptoms, although requiring them to do so will decrease the likelihood of meeting adult ADHD diagnostic criteria; thus, consideration should be given to using alternate means such as obtaining prior records. Adults with ADHD often do not report significant functional impact of their symptoms. This finding may reflect inherent difficulty with self-awareness and reporting of negative aspects of one's behavior. It may therefore be better to seek alternate approaches to establish functional impact of symptoms by inquiring about performance at work, at home and in the community. Structured diagnostic interviews may be a more appropriate method to obtain information from adults about their ADHD symptoms, compared to patient-completed rating scales. Finally, it is hoped that the findings from this study will be useful to the many clinicians, including non-mental health specialists (e.g. internal medicine and family medicine physicians) who are often called upon to provide diagnostic and treatment services for their patients with adult ADHD.

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Table 1.M.I.N.I. (Version 5.0.0) Neuropsychological Interview ADHD Module Items[†]

W7	*a Are you still distractible?
	*b Are you intrusive, or do you butt in, or say things that you later regret either to friends, at work or home?
	*c Are you impulsive, even if you have better control than when you were a child?
	*d Are you still fidgety, restless, always on the go, even if you have better control than when you were a child?
	*e Are you still irritable and get angrier than you need to?
	*f Are you still impulsive? For example, do you tend to spend more money than you really should?
	*g Do you have difficulty getting work organized?
	*h Do you have difficulty getting organized even outside of work?
	i Are you under-employed or do you work below your capacity?
	j Are you not achieving according to people's expectations of your ability?
	k Have you changed jobs or have been asked to leave jobs more frequently than other people?
	*l Does your spouse complain about your inattentiveness or lack of interest in him/her and/or the family
	m Have you gone through two or more divorces, or changed partners more than others?
	*n Do you sometimes feel like you are in a fog, like a snowy television or out of focus?

[†]M.I.N.I. Version 5.0.0 was normed to DSM-IV and ICD. A newer version (M.I.N.I. 7.0) is currently available.

* Items describing "overt" symptoms of adult ADH

Table 2.

Impact of varying criteria for persistent adult ADHD based on responses to the MINI for 232 subjects with research-identified childhood ADHD

Criteria	Overall (N=232) N (%) 95% CI	Males (N=167) N (%) 95% CI	Females (N=65) N (%) 95% CI	P-value (Males vs. Female)
Strict use of MINI 6 of 10 childhood symptoms and 9 of 14 adult symptoms and adult symptoms causing significant problems in 2 or more settings and some symptoms with onset prior to 7 years of age	32 (13.8%) (9.4-18.2)	24 (14.4%) (9.1-19.7)	8 (12.3%) (4.3-20.3)	0.68
Norm-based MINI criteria Number of adult hyperactive/impulsive (H/I) symptoms and/or adult inattentive (I) symptoms > Mean + 2SD of number H/I or 1 symptoms endorsed by non-ADHD controls and adult symptoms causing significant problems in 2 or more settings	68 (29.3%) (23.5-35.2)	49 (29.3%) (22.4-36.3)	19 (29.2%) (18.2-40.3)	0.99
Norm-based MINI criteria plus recall of >6 childhood symptoms	55 (23.7%) (18.2-29.2)	41 (24.6%) (18.0-31.1)	14 (21.5%) (11.5-31.5)	0.63
Norm-based MINI criteria plus recall of some symptoms with onset prior to 7 years of age	56 (24.1%) (18.6-29.6)	42 (25.2%) (18.6-31.7)	14 (21.5%) (11.5-31.5)	0.56
DSM-5 criteria Five or more adult hyperactive/impulsive and/or inattentive symptoms and adult symptoms causing significant problems in 2 or more settings	31 (13.4%) (9.0-17.7)	20 (12.0%) (7.1-16.9)	11 (16.9%) (7.8-26.0)	0.32
DSM-5 criteria plus recall of >6 childhood symptoms	27 (11.6%) (7.5-15.8)	19 (11.4%) (6.6-16.2)	8 (12.3%) (4.3-20.3)	0.84
DSM-5 criteria plus recall of some symptoms with onset prior to 7 years of age	26 (11.2%) (7.2-15.3)	18 (10.8%) (6.1-15.4)	8 (12.3%) (4.3-20.3)	0.74

TABLE 3:

Murphy-Barkley (MB) Self Report Checklist for Adults Compared to “Gold Standard” Norm-Based MINI Criteria for persistent Adult ADHD Case Definition

MB criteria [†]	Sensitivity	Specificity
Adult symptom <u>score</u> exceeded 1.5 standard deviations above the mean	37.3% (25/67)	93.9% (153/163)
Adult symptom <u>count</u> exceeded 1.5 standard deviations above the mean	41.8% (28/67)	93.3% (152/163)
Adult symptom <u>score</u> exceeded 1.5 standard deviations above the mean and Childhood symptom <u>score</u> exceeded 1.5 standard deviations above the mean	32.8% (22/67)	95.7% (156/163)
Adult symptom <u>count</u> exceeded 1.5 standard deviations above the mean and Childhood symptom <u>count</u> exceeded 1.5 standard deviations above the mean	32.8% (22/67)	95.1% (155/163)

[†]Using the mean and standard deviation from age-based norms for the adult items and using the mean and standard deviation from age- and –sex-based published norms for the childhood items (K. Murphy, Barkley, R.A., 1996)

TABLE 4:

Wender-Utah Rating Scales Compared to “Gold Standard” Norm-Based MINI Criteria for persistent Adult ADHD Case Definition

WURS criteria	Sensitivity	Specificity
Adult symptom score exceeded 2.0 standard deviations above the mean [†]	69.1% (47/68)	77.4% (127/164)
Adult symptom score exceeded 2.0 standard deviations above the mean [†] and Childhood symptom score exceeded 2.0 standard deviations above the mean [†]	67.6% (46/68)	78.0% (128/164)
Adult symptom score exceeded 2.0 standard deviations above the mean [‡] and Childhood symptom score exceeded 2.0 standard deviations above the mean [†]	50.0% (34/68)	88.4% (145/164)

[†]Using the mean and standard deviation from published norms for the adult and childhood symptom scores(Ward et al., 1993)

[‡]Using the mean and standard deviation for the adult symptom scores from the participating non-ADHD controls