Educational and Occupational Underattainment in Adults With Attention-Deficit/Hyperactivity Disorder: A Controlled Study

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Objective: Attention-deficit/hyperactivity disorder (ADHD) has been consistently associated with intellectual, educational, and employment deficits. This study evaluated subjects to determine whether the educational and occupational deficits associated with ADHD are what would be expected given their intellectual abilities or lower than expected given their intellectual abilities.

Method: Participants derived from a casecontrol study of adults with (N = 224) and without (N = 146) DSM-IV ADHD. Subjects were comprehensively assessed with structured diagnostic interviews and neuropsychological assessments. Educational and occupational attainments were based on Hollingshead socioeconomic status scale. The expected educational and occupational levels of participants with ADHD were computed using ordered logistic regression models as a function of age, sex, and full scale IQ of controls. The study was conducted from 1998 to 2003.

Results: Based on their IQ, subjects with ADHD were predicted to have significantly more education than they actually attained. Additionally, based on their observed education, participants with ADHD were predicted to have significantly higher occupational levels than actually observed.

Conclusion: These findings indicate that ADHD is associated with significant educational and occupational underattainments relative to what would have been expected on the basis of intellectual potential.

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Corresponding author and reprints: Joseph Biederman, M.D., Pediatric Psychopharmacology Unit, Massachusetts General Hospital, 15 Parkman St., Warren 705, Boston, MA 02114 (e-mail: jbiederman@partners.org). ttention-deficit/hyperactivity disorder (ADHD) is a highly prevalent neurobiological disorder estimated to affect up to 10% of children worldwide.¹ Although initially conceptualized as a pediatric-only disorder, it is now known to continue into adolescence and adulthood in a large number of cases.² Current epidemiologic data estimate the prevalence of ADHD among adults at 5% in the U.S. population.^{3,4}

ADHD has been consistently associated with intellectual, educational, and employment deficits. For example, significant differences in IQ have been documented in large samples of boys⁵ and girls⁶ with ADHD when compared with youth of the same age and gender without the disorder. Likewise, studies of ADHD have consistently documented that ADHD is associated with high levels of grade retention,^{7,8} need for tutoring, and placement in special classes.^{5,6,9} Similarly, findings in referred^{10–13} and community¹⁴ samples of adults with ADHD document that ADHD is associated with high levels of educational and employment deficits.

Because lower IQ scores have been associated with missed educational opportunities,¹⁵ which in turn can limit employment options, the path toward occupational deficits in people with ADHD has been thought to start with intellectual impairments. However, it remains unknown whether the educational and occupational deficits associated with ADHD are what would be expected given their intellectual abilities (low attainment) or lower than expected given their intellectual abilities (underattainment). Considering that ADHD is a treatable disorder¹⁶ and that educational and occupational deficits in subjects with ADHD might represent underattainment, early diagnosis and aggressive treatment of the disorder are of critical importance and could potentially avert these complications.

The main aim of this study was to evaluate whether educational and occupational functioning in subjects with ADHD represent low attainment or underattainment relative to expectations based on intellectual abilities. To this end, we evaluated educational and occupational functioning in a large sample of well-characterized and compre-

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hensively assessed adults with and without ADHD, attending to IQ. We hypothesized that ADHD will be associated with educational and occupational underattainment relative to that expected by IQ. To the best of our knowledge, this is the first evaluation of these issues in ADHD.

METHOD

Subjects

Men and women between the ages of 18 and 55 years were eligible for this study. We excluded potential participants if they had major sensorimotor handicaps (e.g., deafness, blindness), psychosis, autism, inadequate command of the English language, or a full scale IQ less than 70. No ethnic or racial group was excluded. The study was conducted from 1998 to 2003.

Participants with ADHD (N = 224) were ascertained from referrals to a psychiatric clinic at a major university hospital and through media advertisements. We recruited non-ADHD control participants (N = 146) through e-mail broadcasts to employees at the same institution where the participants with ADHD were recruited and through media advertisements in the same media outlets as those used to recruit participants with ADHD. A 3-stage ascertainment procedure was used to select all participants. The first stage was the participant's referral (for participants with ADHD only) or response to media advertisements. The second stage confirmed (for participants with ADHD) or ruled out (for controls) the diagnosis of ADHD by using a telephone questionnaire. The questionnaire asked about the symptoms of ADHD, as well as questions regarding study inclusion and exclusion criteria. The third stage confirmed (for participants with ADHD) or ruled out (for controls) the diagnosis of ADHD with face-toface structured interviews with these individuals. To be given a full diagnosis of adult ADHD, the participant must have endorsed full DSM-IV criteria and described a chronic course of ADHD symptomatology from childhood to adulthood. Only participants who received a positive (participants with ADHD) or a negative (controls) diagnosis at all 3 stages were accepted into the study. Of the 224 participants with ADHD, 106 (47%) had received pharmacotherapy for ADHD at some time in their life. The institutional review board approved this study, and all participants completed a written informed consent statement before inclusion in the study.

Psychiatric Assessments

All participants were assessed with the Structured Clinical Interview for DSM-IV¹⁷ to assess psychopathology, supplemented with modules from the Kiddie Schedule of Affective Disorders and Schizophrenia-Epidemiologic Version (adapted from DSM-IV)¹⁸ to assess ADHD and other childhood disorders. The interviewers had undergraduate degrees in psychology, and they were trained to high levels of interrater reliability for the assessment of psychiatric diagnoses. We computed k coefficients of agreement by having experienced, boardcertified child and adult psychiatrists and licensed clinical psychologists diagnose participants from audio-taped interviews made by the assessment staff. Based on 500 interviews of children and adults, the median κ coefficient was 0.98. The κ coefficients for individual diagnoses included the following: ADHD (0.88), conduct disorder (1.0), oppositional defiant disorder (0.90), antisocial personality disorder (0.80), major depression (1.0), mania (0.95), separation anxiety (1.0), agoraphobia (1.0), panic (0.95), obsessive-compulsive disorder (1.0), generalized anxiety disorder (0.95), specific phobia (0.95), posttraumatic stress disorder (1.0), social phobia (1.0), substance use disorder (1.0), and tics/Tourette's syndrome (0.89). These measures indicated excellent reliability between ratings made by the nonclinician interviewers and experienced clinicians.

A committee of board-certified child and adult psychiatrists and psychologists resolved all diagnostic uncertainties. The committee members were blind to the participants' ascertainment group, ascertainment source, and all nondiagnostic data. Diagnoses were considered positive if, on the basis of interview results, DSM-IV criteria were unequivocally met to a clinically meaningful degree. We estimated the reliability of the diagnostic review process by computing κ coefficients of agreement between clinician reviewers. For these clinical diagnoses, the median reliability between individual clinicians and the diagnoses assigned by the review committee was 0.87. The κ coefficients for individual diagnoses included the following: ADHD (1.0), conduct disorder (1.0), oppositional defiant disorder (0.90), antisocial personality disorder (1.0), major depression (1.0), mania (0.78), separation anxiety (0.89), agoraphobia (0.80), panic (0.77), obsessive-compulsive disorder (0.73), generalized anxiety disorder (0.90), specific phobia (0.85), posttraumatic stress disorder (0.80), social phobia (0.90), substance use disorder (1.0), and tics/ Tourette's syndrome (0.68).

IQ, Education, and Occupation

Using the methods of Sattler,¹⁹ we estimated full scale IQ from the vocabulary and block design subtests of the Wechsler Adult Intelligence Scale-III.²⁰ Neurocognitive measures were administered to all subjects by psychometricians who were blind to diagnostic/ascertainment status and who received ongoing supervision by a licensed clinical neuropsychologist. These psychometricians participated in an extensive training course in which they were introduced to principles of neuropsychological assessment and taught to administer measures. Prior to administering tests themselves, they observed senior raters until they reached high levels of reliability for scoring.

Initial test administrations were then observed and double coded by a senior rater to insure proficiency and reliability in test administration and scoring.

A modified Hollingshead scale²¹ assessed educational and occupational status. The modified version contained employment opportunities reflective of contemporary life.

Statistical Analysis

By using ordered logistic regression (due to the ordinal nature of the outcome measures), the educational level of the control participants was modeled as a function of age, gender, and full scale IQ. By using this model, the expected educational level was computed for the participants with ADHD. Similarly, an ordered logistic regression model predicting occupational level from educational level, age, gender, and full scale IQ was created using the control participants. By using this model, the expected occupational level of participants with ADHD was computed in 2 ways: (1) with the observed educational level of participants with ADHD and (2) with the educational level of participants with ADHD estimated from the first model. Wilcoxon matched-pairs signed rank tests compared the expected education and occupation estimates of participants with ADHD with their observed education and occupation. All tests were 2 tailed. We used an α level of .05 to assert statistical significance.

RESULTS

Sociodemographic Characteristics

There were 224 participants with ADHD and 146 participants without ADHD. Two participants with ADHD were excluded due to missing IQ scores. Thus, the sample for this analysis consisted of 222 participants with ADHD and 146 control participants. Fifty-three percent of participants with ADHD were men compared to 45% of controls ($\chi^2 = 1.98$, df = 1, p = .16). Compared to controls, participants with ADHD had an older mean \pm SD age (36.5 \pm 10.7 versus 30.3 \pm 8.7 years, t = -5.86, p < .001) and had a lower mean \pm SD estimated full scale IQ score (111.0 \pm 14.1 versus 115.8 \pm 12.8, t = 3.31, p = .001). However, the 2 groups had similar age ranges (ADHD = 18-55, controls = 19-55) and estimated full scale IQ ranges (ADHD = 78-149, controls = 79-145), indicating that statistical models based on the control data would be applicable to calculating estimates for the participants with ADHD. Although 44.7% of participants with ADHD had taken some type of psychotropic medication within 24 hours of IQ testing, they did not have different mean \pm SD IQ scores than participants with ADHD that did not take medication $(109.9 \pm 14.1 \text{ versus } 112.0 \pm 14.1, t = 1.06,$ p = .29).



Figure 1. Observed and Expected Rates of Educational Levels

in Adults With ADHD^a

^aObserved and expected distributions were compared using Wilcoxon matched-pairs signed-rank test.

Abbreviation: ADHD = attention-deficit/hyperactivity disorder.

Predictors of Educational and Occupational Levels in Controls

The models based on findings in controls showed that educational level was significantly predicted by full scale IQ (z = 3.33, p = .001) and occupational level was significantly predicted by educational level (z = 6.42, p < .001) and age (z = 2.96, p = .003).

Observed and Estimated Educational Levels in Participants With ADHD

The distributions of the observed and estimated educational levels of participants with ADHD were significantly different from one another (z = -7.98, p < .001). Underattainment was apparent for college graduates and those with graduate degrees (educational levels 6 and 7); 84% of adults with ADHD were expected to be college graduates, but only 50% actually attained this level of education (Figure 1).

Observed and Estimated Occupational Levels in Participants With ADHD

Based on the model predicting occupational attainment with the observed educational level of participants with ADHD, the estimated occupational levels for participants with ADHD significantly differed from their observed occupational levels (z = -4.29, p < .001). Underattainment was apparent at the professional levels (Hollingshead occupational levels 6 and above). Specifically, while 80% of participants with ADHD were expected to have attained a Hollingshead occupational level of 6 or more (semiprofessional to major professional) based on their educational attainment, only 58% of participants with ADHD attained this level of occupation (Figure 2). Figure 2 also illustrates the expected occupational levels had participants with ADHD achieved the education level predicted based on their intellectual abilities. These expected occupational levels in participants with ADHD were significantly different from their observed occupational levels (z = -7.88, p < .001). On the basis of their expected levels of education, 95% of participants with ADHD were expected to attain a Hollingshead occupational level of 6 or higher. Instead, only 58% attained this level.

Effect of Comorbidity

To confirm that the findings above were attributable to ADHD and not to psychiatric comorbidities associated with ADHD, observed and expected educational and occupational attainment were compared in participants with ADHD with (N = 149, 67.1%) and without (N = 73,32.9%) major lifetime comorbidities (not mutually exclusive: mood disorder with severe impairment [34.2%], alcohol or drug dependence [36.9%], multiple (≥ 2) anxiety disorders [34.2%], or antisocial personality disorder [17.7%]). Participants with ADHD without lifetime comorbidity were estimated to have more education than observed (z = -4.68, p < .001), as were participants with ADHD with lifetime comorbidity (z = -6.47, p < .001). Likewise, on the basis of estimated educational levels, participants with ADHD without lifetime comorbidity were estimated to have higher occupational levels than observed (z = -4.137, p < .001), as were participants with ADHD with lifetime comorbidity (z = -6.71,p < .001).

Effect of Treatment

Nearly half of the participants with ADHD (47.5%) had received pharmacotherapy for ADHD at some point in their life. There were no significant differences between participants with and without pharmacotherapy on rates of educational underattainment (70.5% versus 78.4%, $\chi^2 = 1.85$, df = 1, p = .17), occupational underattainment based on observed education (55.2% versus 59.5%, $\chi^2 = 0.41$, df = 1, p = .52), or occupational underattainment based on expected education (70.5% versus 77.6%, $\chi^2 = 1.46$, df = 1, p = .23).

DISCUSSION

The main aim of this study was to investigate whether the level of occupational and educational achievement in individuals with ADHD was commensurate with their IQ. Our results showed that ADHD was associated with significantly decreased educational and occupational functioning relative to that expected based on intellectual potential. These results indicate that the well-documented deficits in educational and occupational functioning in previous studies of subjects with ADHD²² represent





^aObserved and expected distributions were compared using Wilcoxon matched-pairs signed-rank tests. Abbreviation: ADHD = attention-deficit/hyperactivity disorder.

underattainments in these domains relative to expectations based on intellectual abilities.

Our results documenting that ADHD is associated with lower educational achievement than age- and sexmatched controls are consistent with pediatric studies^{5,6} documenting high levels of grade retention, tutoring, and placement in special classes in participants with ADHD relative to controls. Likewise, our findings concur with previous follow-up studies^{9,23} documenting that children with ADHD experienced significant educational impairments by young adulthood. Our results are also consistent with the results of a recent survey¹⁴ of 1001 adults with and without ADHD in the community, which showed that significantly fewer participants with ADHD achieved academic milestones beyond some high school relative to controls and that participants with ADHD were significantly more likely than controls to be held back in school and need academic support.

More importantly, our analysis indicated that ADHD was associated with significantly decreased educational attainment independent of IQ. By documenting that educational deficits in subjects with ADHD may be largely due to the ADHD itself and not solely to intellectual endowment, our study provides an important, hopeful perspective into the topic of educational impairments in subjects with ADHD. Considering that ADHD is a treatable disorder,¹⁶ these findings would suggest that educational deficits in subjects with ADHD may be at least partially correctable if the disorder were to be adequately treated. Improvement in the symptoms of ADHD will help children and adolescents achieve educational goals that previously may have been out of reach. Our results may be an

impetus for securing early treatment for students with ADHD.

Also, our findings are consistent with the literature documenting lower occupational functioning in adults with ADHD. These data are consistent with the lower socioeconomic status reported in several previous studies^{10,11,24,25} of adults with ADHD. They are also consistent with results¹⁴ from the survey of adults with ADHD described above, which reported significant occupational impairment, underemployment, and unemployment in adults with ADHD compared with controls, as well as with recent results¹⁴ that estimated loss of workforce productivity to be \$8900 to \$15,400 per person with ADHD.²⁶

Our results, however, showing that the impaired occupational functioning in individuals with ADHD reflects underattainment and not simply low attainment are novel and noteworthy. Although academic achievement is strongly associated with IQ in the population,¹⁵ individuals with ADHD in this study attained less education than expected by their intellectual abilities. Likewise, although education is a strong predictor of occupational achievement in the population, our study found that individuals with ADHD attained significantly lower occupational standing compared to what would be expected by their educational level.

In addition to economic liability, educational and occupational underattainment can exert a heavy toll on one's self-esteem and general outlook in life. For example, adults with ADHD in the community that participated in the survey¹⁴ described earlier reported strikingly worse optimism and self-acceptance when compared with controls. Because the majority of the adults in this study have never been treated for ADHD, these findings raise the possibility that these negative effects could have been mitigated if affected individuals had been treated. Although we did not find an effect of pharmacotherapy on underattainment, our binary measure of any lifetime treatment may have been too crude to detect an effect. Age of patient receiving treatment, duration of treatment, dosage, and other variables may have to be considered to fully determine whether treatment has a positive effect on educational and occupational underattainment.

Our findings must be considered in light of some methodological limitations. Because the ADHD group was referred, our results cannot be generalized to nonreferred samples. The control group was recruited primarily through e-mail broadcasts to employees at the same institution where the participants with ADHD were recruited. Although this control group provided a range of educational and occupational levels and was a valid comparator to our case series, it may not have been representative of the general population. Additionally, our sample was composed of mainly white participants (90% of participants with ADHD); thus, results may not generalize to other ethnic groups.

Despite these limitations, this study showed that ADHD is associated with significantly decreased educational attainment relative to what would be expected based on intellectual potential. Results also indicate that the occupational attainment in individuals with ADHD was significantly lower than that expected by educational attainment and markedly lower than expected by intellectual endowment. These findings stress the critical importance of early identification and aggressive treatments for subjects with ADHD. Appropriate interventions could be highly beneficial in reducing the disparity between ability and attainment for individuals with ADHD. In turn, educational success could lead to more advanced occupational opportunities for individuals with ADHD. Higher occupational achievement would lead to enhanced economic status as well as higher self-esteem.²⁷ Thus, intervention could prove to have significant public health implications.

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