

Adolescent ADHD and Adult Physical and Mental Health, Work Performance, and Financial Stress

AUTHORS: Judith S. Brook, EdD,^a David W. Brook, MD,^a Chenshu Zhang, PhD,^a Nathan Seltzer, BA,^a and Stephen J. Finch, PhD^b

^aDepartment of Psychiatry, New York University School of Medicine, New York, New York; and ^bDepartment of Applied Mathematics and Statistics, Stony Brook University, Stony Brook, New York

KEY WORDS

adult attention-deficit/hyperactivity disorder, physical health, mental health, antisocial personality disorder, work performance, financial stress, longitudinal study

ABBREVIATIONS

ADHD—attention-deficit/hyperactivity disorder
aOR—adjusted odds ratio
ASPD—antisocial personality disorder
CD—conduct disorder
CI—confidence interval
OR—odds ratio

Dr Judith S. Brook contributed to the conception and design of the study, the acquisition of data, interpretation of the analysis, drafting the article and reviewing it critically for important intellectual content, and final approval of the version submitted; Dr David W. Brook contributed to the conception and design of the study, interpretation of the data, critical review of the article for important intellectual content, and final approval of the version submitted; Dr Zhang contributed to the conception and design of the study, conducted the data analyses and interpreted the data, drafted and revised sections of the article, and approved the version submitted; Mr Seltzer contributed to the design of the study and interpreting the data, conducted the literature search, drafted and revised sections of the article, and approved the version submitted; and Dr Finch contributed to the design of the study, data analysis and interpretation of the results, reviewed the article critically for scientific content, and approved the version submitted.

www.pediatrics.org/cgi/doi/10.1542/peds.2012-1725

doi:10.1542/peds.2012-1725

Accepted for publication Aug 31, 2012

Address correspondence to Judith S. Brook, EdD, Department of Psychiatry, New York University School of Medicine, 215 Lexington Ave, 15th Floor, New York, NY 10016. E-mail: judith.brook@nyumc.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2013 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

FUNDING: Supported by NIH grants awarded to Dr Judith S. Brook: Research Scientist Award DA000244 and research grant DA003188 from the National Institute on Drug Abuse; research grant CA094845 from the National Cancer Institute. Funded by the National Institutes of Health (NIH).



WHAT'S KNOWN ON THIS SUBJECT: There are a few longitudinal studies that suggest that attention-deficit/hyperactivity disorder (ADHD) in adolescence is associated with later psychiatric disorders, substance use disorders, and impaired work performance.



WHAT THIS STUDY ADDS: Adolescent ADHD is associated with a variety of internal and external stresses in adulthood. Consequently, it is essential to focus intervention efforts on adolescents with ADHD to prevent or alleviate adult difficulties in functioning.

abstract



OBJECTIVE: There is a scarcity of longitudinal studies of adolescents with attention-deficit/hyperactivity disorder (ADHD) followed until adulthood. We studied the relationship between ADHD in adolescence and impaired general physical health, impaired general mental health, antisocial personality disorder, impaired work performance, and high financial stress in adulthood.

METHODS: A prospective design incorporated 6 assessments of participants spanning mean ages from 14 to 37 years. Two baseline assessments were taken between ages 14 and 16 years, and 5 outcome assessments were taken at mean age 37 years. Participants were assessed with structured interviews and questionnaires. The participants were from a community sample of individuals initially drawn in 1975 and followed to a mean age of 37 years in 2009.

RESULTS: The adjusted odds ratios and 95% confidence intervals (CIs) for ADHD in adolescence as related to internal stress in adulthood were 1.82 (95% CI = 1.01–3.25; $P < .05$) for impaired general physical health, 2.36 (95% CI = 1.23–4.51; $P < .01$) for impaired general mental health, and 3.28 (95% CI = 1.51–7.13; $P < .01$) for antisocial personality disorder. The adjusted odds ratios and 95% CIs for ADHD in adolescence as related to external stress were 2.46 (95% CI = 1.37–4.43; $P < .01$) for impaired work performance and 3.33 (95% CI = 1.70–6.55; $P < .001$) for high financial stress.

CONCLUSIONS: Clinicians should focus on early diagnosis and treatment of adolescent ADHD because it is a major predictor of an array of physical, mental, work, and financial problems in adulthood. *Pediatrics* 2013;131:5–13

Attention-deficit/hyperactivity disorder (ADHD) is a major neuropsychiatric disorder diagnosed in children, adolescents, and adults. Adolescents with ADHD are at a greater risk for concurrent problem behaviors such as drug use and delinquency,^{1,2} cognitive problems,^{3–5} mood and anxiety problems,⁶ psychiatric problems including anxiety disorders, and interpersonal difficulties.^{7,8} The current adult literature suggests that ADHD in adulthood is associated with higher health care costs,⁹ cigarette smoking and substance-use disorders,¹⁰ a greater prevalence of psychiatric disorders,^{4,10,11} decreases in work performance and work productivity,^{12,13} and lower educational attainment.⁴ To date, there are only a few community longitudinal studies that have examined the impact of adolescent ADHD on adult functioning.^{4,14,15} Several longitudinal studies indicate that adolescent ADHD is a predictor of (1) internal stress such as that seen in several psychiatric disorders as well as psychological dysfunction in young adulthood,^{4–6,10,16–19} and (2) external stress in the occupational and financial spheres.^{12,20,21}

The present research is designed to extend the above studies and to examine childhood and adolescent ADHD as it relates to internal stress and external stress in the fourth decade of life. We build on previous studies^{4,6,10} in several ways: (1) examining the long-term effects of adolescent ADHD on functioning in the fourth decade of life; (2) assessing significant areas of diverse functioning (ie, internal and external stresses) in adulthood; (3) employing a community sample; and (4) focusing on the implications for prevention and treatment.

In this article, we present the findings from our longitudinal study entitled *Children and Adults in the Community*. The specific hypotheses are that: participants with ADHD in adolescence are more likely to have internal stress

(impaired general physical health, impaired general mental health, and anti-social personality disorder [ASPD]) and external stress (impaired work performance and high financial stress) in their late 30s.

METHODS

Participants and Procedure

The present sample was a probability sample of families residing in 2 upstate New York counties (ie, Albany and Saratoga), which has been described in previous publications.²² The original study in 1975 (T1) assessed problem behaviors in children as reported by their mothers. Data were obtained from the children in 1983 (T2, $N = 756$), 1985–1986 (T3, $N = 739$), 1992 (T4, $N = 750$), 1997 (T5, $N = 749$), 2002 (T6, $N = 673$), and 2005–2006 (T7, $N = 607$). The mean ages (SDs) of the participants at each wave were 14.1 (2.8) at T2, 16.3 (2.8) at T3, 22.3 (2.8) at T4, 27.0 (2.8) at T5, 31.9 (2.8) at T6, and 36.6 (2.8) at T7, respectively. In this article, we report on 551 participants who (1) had ADHD assessments at both T2 and T3 and (2) took part in our study at T7.

Extensively trained and supervised interviewers administered interviews in private, with the exception of the 2005–2006 data collection. In 2005–2006, self-administered questionnaires were used. Written informed consent was obtained from participants and their mothers in 1983, 1986, and 1992, and from the participants only in 1997, 2002, and 2005–2006. The Institutional Review Board of New York University School of Medicine authorized the use of human subjects in this research study. Additional information regarding the study methodology is available from previous publications.²²

Twenty-two of the 756 T2 participants had missing data on the T2 ADHD variable. In our analyses, we included 551 participants who had a T2 ADHD assessment and participated at T7. To assess the

effects of attrition, we compared the 551 participants in the present analyses to the 183 participants who had a T2 ADHD assessment and did not participate at T7. There was a significantly higher percentage of females in the group of 551 individuals (55%) than in the group of 183 individuals (31.7%) ($\chi^2[1] = 29.8, P < .001$). There was a significantly lower percentage of participants with ADHD at T2 in the group studied (10%) as compared with those not included (18.6%) ($\chi^2[1] = 9.5, P < .01$). There was also a significantly lower percentage of participants with conduct disorder (CD) at T2 in the group studied (9.3%) as compared with those not included (19.1%) ($\chi^2[1] = 12.9, P < .001$). To partially account for the effects of gender and early CD, we statistically controlled for these 2 factors.

Measures

ADHD at T2–T3

Adaptations of the Diagnostic Interview Schedule for Children²³ were administered to participants in 1983 (T2), and again in 1985–1986 (T3) to assess psychiatric disorders including ADHD and CD.²⁴ Because symptoms of ADHD include an unusually high and chronic level of inattention, hyperactivity, or both, items about functional impairment from ADHD and CD were added to the Diagnostic Interview Schedule for Children. For example, 3 to 5 items were added to assess interference in school and social activities. Criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition*²⁵ were used to classify the participants with respect to ADHD. The percentage of the participants who met the *Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition* criteria for ADHD at T2 or T3 or both was 13.1%.

Impaired General Physical Health at T7

We assessed the participants' general physical health, which included

measures of general physical health, role limitations due to physical health, and physical functioning (Table 1).

Impaired General Mental Health at T7

We assessed the participants' general mental health, which included measures of general mental health and role limitations due to emotional problems (Table 1).

ASPD at T7

We assessed adult ASPD by using an adaptation of the University of Michigan Composite International Diagnostic Interview ASPD measure.²⁷ A participant received a score of 1 on the measure of adult ASPD if the participant met 2 criteria. First, a pervasive pattern of disregard for and violation of the rights of others, as indicated by 3 (or more) of 7 criteria listed in the *Diagnostic and*

Statistical Manual of Mental Disorders, Fourth Edition (eg, irritability and aggressiveness; Table 1).²⁸ Second, anti-social behavior did not occur exclusively during the course of a schizophrenic or manic episode. Otherwise, a participant received a score of 0 on the measure of adult ASPD.

Impaired Work Performance at T7

We measured the participants' work performance, which consisted of an indicator variable of unemployed or laid off at some time during the last calendar year and measures of skipped work and work responsibility (Table 1).

High Financial Stress at T7

We assessed the participants' symptoms due to financial worries (Table 1).

Control Variables

In the current study, the control variables were as follows: socio-demographic characteristics (ie, gender, age at T2, T2 residency in Albany County, T7 educational level, and T7 annual income), T2–T3 CD,²⁵ T7 cigarette smoking,²⁹ and T7 marijuana use²⁹ (see Table 2 for the coding, means, and SDs).

Analytical Plan

For each of the dependent variables (ie, impaired T7 general physical health, impaired T7 general mental health, and high T7 financial stress), a participant was assigned a score of 1 for the respective indicator variable if at least 1 of the component values was 1 SD below its mean. For impaired T7 work performance, a participant was assigned a score of 1 if the participant was unemployed or laid off at some time during the past calendar year or at least 1 of the other 2 component values was 1 SD below its mean. We conducted bivariate logistic regression analyses to test, without controls, whether adolescent ADHD (the independent variable) was associated with the indicators of adult

TABLE 1 Measures of Adult General Physical Health, General Mental Health, ASPD, Work Performance, and Financial Stress

Scale	Number of Items	Sample Item and Source	Cronbach's α
Impaired general physical health component scales at T7			
General physical health ^a	5	How true or false is it that you seem to get sick a little easier than other people? ²⁶	.83
Role limitations due to physical health ^b	4	During the past 4 weeks, how much of the time have you cut down on the amount of time you spent on work or other activities as a result of your physical health? ²⁶	.95
Physical functioning ^c	10	Does your health now limit you in moderate activities, such as moving a table, pushing a vacuum cleaner, or playing golf? ²⁶	.94
Impaired general mental health scales at T7			
General mental health ^d	5	During the past 4 weeks, how much of the time have you been very nervous? ²⁶	.86
Limitations due to emotional problems ^b	3	During the past 4 weeks, how much of the time have you cut down on the amount of time you spent on work or other activities as a result of any emotional problems? ²⁶	.92
ASPD at T7 ^e	—	Have you been in physical fights repeatedly (including physical fights with your spouse or children)? ²⁸	—
Impaired work performance scales at T7			
Unemployed or laid off ^e	1	Were you unemployed or laid off at some time during the last calendar year?	NA
Skipped work ^f	2	How often have you skipped work? (original)	.74
Work responsibility ^f	5	How often have you been receiving good evaluations from your boss for your work? (original)	.51
Financial stress			
Symptoms due to financial worries ^g	4	Because of your current financial situation, is it true that you sometimes worry about losing your job? (original)	.79

NA, not applicable.

^a Five-point scale: definitely true (1) – definitely false (5).

^b Four-point scale: none of the time (1) – all of the time (4).

^c Three-point scale: no, not limited (0) – yes, a lot (2).

^d Five-point scale: all of the time (1) – none of the time (5).

^e Two-point scale: no (0) – yes (1).

^f Five-point scale: never (0) – often (4).

^g Four-point scale: not at all true (1) – definitely true (4).

TABLE 2 Coding, Means, and SDs of the Independent and Control Variables Used in the Present Analyses (*N* = 551)

Independent and Control Variables	Coding	Mean	SD
T2 or T3 ADHD	No (0)–yes (1)	0.13	0.34
Gender	Girl (0)–boy (1)	0.45	0.50
T2 age	Years	14.52	2.79
T2 residency in Albany County	No (0)–yes (1)	0.46	0.50
T7 educational level	8th grade or below (1)–graduate student (11)	8.11	2.60
T7 annual income	\$0 (0)–\$100 000 (18)	12.9	5.03
T2 or T3 CD	No (0)–yes (1)	0.14	0.35
T7 cigarette smoking	Never (0)–more than 1 and a half packs a day (7)	1.87	2.11
T7 marijuana use	Never (0)–every day (10)	1.94	2.38

CD is a repetitive and persistent pattern of behavior in which the basic rights of others or major age-appropriate societal norms are violated.

impaired general physical health, impaired general mental health, ASPD, impaired work performance, and high financial stress (T7). We then conducted multivariate logistic regression analyses to examine the associations between earlier adolescent ADHD and each of the dependent variables after controls. We also reported bivariate and multivariate logistic regression analyses that examined the associations between the control variables (eg, gender) and the dependent variables. In addition, we conducted supplemental logistic regression analysis to compare those who had ADHD at both T2 and T3 to those who had ADHD at only T2 or only T3.

RESULTS

ADHD was persistent during adolescence with 6.7% of the participants having ADHD at T2 only, 3.4% reporting ADHD only at T3, and 3.3% reporting ADHD at both T2 and T3. Those who had ADHD at T2 were 13.7 times ($P < .001$)

more likely to have ADHD at T3 than those who did not have ADHD at T2. Table 3 presents the percentages of adults at T7 with impaired general physical health, impaired general mental health, ASPD, impaired work performance, and high financial stress for the whole sample and for those with and without ADHD at T2 or T3. As compared with those who had no ADHD at T2 and T3, the participants with ADHD at T2 or T3 had greater fractions of adult impaired general physical health ($\chi^2[1] = 14.67$, $P < .001$), impaired general mental health ($\chi^2[1] = 8.9$, $P < .01$), ASPD ($\chi^2[1] = 28.95$, $P < .001$), impaired work performance ($\chi^2[1] = 22.16$, $P < .001$), and high financial stress at T7 ($\chi^2[1] = 17.04$, $P < .001$).

Table 4 presents the results of the logistic regression analyses of ADHD in adolescence as related to the dependent variables (with or without the control variables). Without controls, adolescent ADHD (at T2 or T3) was

TABLE 3 Percentages of Impaired General Physical Health, Impaired General Mental Health, ASPD, Impaired Work Performance, and High Financial Stress in the Late 30s for the Whole Sample and for the Participants With or Without ADHD in Adolescence (*N* = 551)

	Whole Sample, <i>N</i> = 551, %	ADHD: Yes, <i>N</i> = 72, %	ADHD: No, <i>N</i> = 479, %
Impaired general physical health in the late 30s	24.9	43.1	22.1
Impaired general mental health in the late 30s	18.0	30.6	16.1
ASPD in the late 30s	9.3	26.4	6.7
Impaired work performance in the late 30s	24.9	47.2	21.5
High financial stress in the late 30s	13.6	29.2	11.3

For the indicator variables, see the Measurement section.

significantly associated with a greater likelihood of adult impaired general physical health (odds ratio [OR] = 2.66 [95% confidence interval (CI) = 1.59–4.45]; $P < .001$), impaired general mental health (OR = 2.30 [95% CI = 1.32–4.01]; $P < .01$), ASPD (OR = 5.01 [95% CI = 2.65–9.45]; $P < .001$), impaired work performance (OR = 3.27 [95% CI = 1.96–5.45]; $P < .001$), and high financial stress (OR = 3.24 [95% CI = 1.81–5.80]; $P < .001$). With control variables, adolescent ADHD (T2 or T3) was significantly associated with a greater likelihood in adulthood of having impaired general physical health (adjusted OR [aOR] = 1.82 [95% CI = 1.01–3.25]; $P < .05$), impaired general mental health (aOR = 2.36 [95% CI = 1.23–4.51]; $P < .01$), ASPD (aOR = 3.28 [95% CI = 1.51–7.13]; $P < .01$), impaired work performance (aOR = 2.46 [95% CI = 1.37–4.43]; $P < .01$), and high financial stress (aOR = 3.33 [95% CI = 1.70–6.55]; $P < .001$).

Bivariate logistic regression analyses indicated that most of the control variables were significantly associated with the dependent variables (see Appendix for details). Table 5 presents each aOR from the multivariate logistic regression analyses. After adjusting for other factors (including adolescent ADHD), marijuana use at T7 was significantly associated with a greater likelihood of adult impaired T7 general mental health (aOR = 1.15 [95% CI = 1.05–1.26]; $P < .01$), T7 ASPD (aOR = 1.24 [95% CI = 1.11–1.39]; $P < .001$), and impaired T7 work performance (aOR = 1.19 [95% CI = 1.10–1.30]; $P < .001$). In addition, the following control variables were significantly associated with a greater likelihood of having T7 ASPD: male gender (aOR = 2.35 [95% CI = 1.15–4.79]; $P < .05$) and smoking cigarettes at T7 (aOR = 1.19 [95% CI = 1.02–1.39]; $P < .05$). In contrast, a greater annual income at T7 (aOR = 0.93 [95% CI = 0.87–0.99]; $P < .05$) was significantly associated with less likelihood of having T7 ASPD.

TABLE 4 ORs and aORs From Bivariate and Multivariate Logistic Regressions: ADHD in Adolescence as Related to Adult Impaired General Physical Health, Impaired General Mental Health, ASPD, Impaired Work Performance, and High Financial Stress in the Late 30s ($N = 551$)

Independent Variables	Impaired General Physical Health in the Late 30s, OR (or aOR) (95% CI)	Impaired General Mental Health in the Late 30s, OR (or aOR) (95% CI)	ASPD in the Late 30s, OR (or aOR) (95% CI)	Impaired Work Performance in the Late 30s, OR (or aOR) (95% CI)	High Financial Stress in the Late 30s, OR (or aOR) (95% CI)
Bivariate analysis without controls: T2 or T3 ADHD	2.66 (1.59–4.45)***	2.30 (1.32–4.01)**	5.01 (2.65–9.45)***	3.27 (1.96–5.45)***	3.24 (1.81–5.80)***
Multivariate analysis with controls: T2 or T3 ADHD	1.82 (1.01–3.25)*	2.36 (1.23–4.51)**	3.28 (1.51–7.13)**	2.46 (1.37–4.43)**	3.33 (1.70–6.55)***

Control variables consisted of gender, age, original residency in Albany County, CD in adolescence, adult educational level, annual income, cigarette smoking, and marijuana use.

* $P < .05$;

** $P < .01$;

*** $P < .001$ (2-tailed tests).

TABLE 5 aORs From Multivariate Logistic Regressions: Factors Related to Adult Impaired General Physical Health, Impaired General Mental Health, ASPD, Impaired Work Performance, and High Financial Stress in the Late 30s ($N = 551$)

Independent Variables	Impaired General Physical Health in the Late 30s, aOR (95% CI)	Impaired General Mental Health in the Late 30s, aOR (95% CI)	ASPD in the Late 30s, aOR (95% CI)	Impaired Work Performance in the Late 30s, aOR (95% CI)	High Financial Stress in the Late 30s, aOR (95% CI)
T2 or T3 ADHD	1.82 (1.01–3.25)*	2.36 (1.23–4.51)**	3.28 (1.51–7.13)**	2.46 (1.37–4.43)**	3.33 (1.70–6.55)***
Gender	0.97 (0.63–1.51)	0.52 (0.31–0.86)*	2.35 (1.15–4.79)*	1.43 (0.92–2.24)	0.81 (0.47–1.42)
T2 age	0.98 (0.91–1.05)	1.04 (0.95–1.13)	0.98 (0.87–1.10)	0.93 (0.86–1.00)*	1.01 (0.92–1.11)
T2 residency in Albany County	1.04 (0.69–1.56)	0.74 (0.47–1.18)	1.23 (0.64–2.37)	1.07 (0.71–1.63)	0.99 (0.60–1.66)
T2 or T3 CD	1.26 (0.70–2.27)	0.87 (0.44–1.73)	2.06 (0.98–4.34)	1.39 (0.78–2.48)	0.55 (0.25–1.21)
T7 education	0.85 (0.78–0.92)***	0.97 (0.88–1.07)	1.00 (0.87–1.15)	0.95 (0.88–1.04)	0.95 (0.85–1.06)
T7 annual income	0.96 (0.92–1.00)	0.95 (0.91–0.99)*	0.93 (0.87–0.99)*	0.95 (0.91–0.99)*	0.96 (0.92–1.02)
T7 smoking	0.97 (0.87–1.07)	1.05 (0.94–1.18)	1.19 (1.02–1.39)*	1.00 (0.90–1.11)	1.14 (1.01–1.28)*
T7 marijuana use	1.00 (0.92–1.09)	1.15 (1.05–1.26)**	1.24 (1.11–1.39)***	1.19 (1.10–1.30)***	1.07 (0.96–1.18)

* $P < .05$;

** $P < .01$;

*** $P < .001$ (2-tailed tests).

Based on the supplemental logistic regression analyses, adolescents who had ADHD at both T2 and T3, as compared with adolescents who had ADHD at only 1 of T2 or T3, had a greater likelihood of having impaired general physical health (OR = 5.2 [95% CI = 1.60–16.86]; $P < .01$) and ASPD (OR = 4.4 [95% CI = 1.39–13.91]; $P < .05$) in adulthood.

DISCUSSION

To our knowledge, this is the first longitudinal follow-up study of adolescents with ADHD as it relates to both internal and external functioning in the fourth decade of life. The findings support our hypotheses that participants with ADHD in adolescence are more likely to have impaired general physical health, impaired general mental health, ASPD, impaired

work performance, and greater financial stress in their late 30s. The findings highlight the considerable adverse effects of ADHD in adolescence because of its long-lasting effects on a broad range of life adjustment and role functioning dimensions. Our findings add to the results of earlier investigators who have studied the association of ADHD with specific adverse aspects of functioning such as psychiatric disorders,^{4,11} physical health,³⁰ and impaired role performance.^{12,13} Our findings remained significant despite controlling for a wide range of important possible confounding factors. Thus, from a methodological perspective, the findings are not only innovative but also suggest that the results are of great clinical significance.

The findings are generally in accord with previous studies that have relied on samples of clinically referred children and adolescents for ADHD who were followed-up into adulthood.^{4–6,16–18,20,21} For example, Miller et al¹⁶ found an increase in personality disorders in adulthood, including ASPD, among clinically referred adolescents. Barkley et al²⁰ found that patients referred for treatment of ADHD in adolescence were more likely to receive lower work performance ratings from employers in adulthood when compared with a group of community controls.

The present findings revealing that ADHD is a risk factor for later impaired physical health have received some support in the literature.^{9,30,31} Families who have a child with ADHD should be

alert to the possibility of subsequent impaired health in that child. The results also highlight the greater prevalence of psychopathology in adults who had ADHD at an earlier point in time. Our findings regarding the relationship between earlier ADHD and later ASPD are in accord with Mannuzza et al,^{4,5} who examined the adult psychiatric status of hyperactive boys. Moreover, they are consistent with those of Biederman et al¹⁸ who conducted a 10-year follow-up study of youth who had ADHD.

A mechanism that may mediate between ADHD in adolescence and adult ASPD is the parent–child attachment relationship. Parents whose children have ADHD may have difficulty in forming a close mutual parent–child relationship.³² A close parent–child mutual attachment relationship may insulate the individual from ASPD. The clinical significance of an impaired early attachment relationship in individuals with ASPD has been documented in several studies.^{32,33}

ADHD in adolescence is also associated with adult depressive mood and anxiety.^{8,19,34} Fischer et al¹⁹ pointed to the role of ADHD in major depressive disorders. Children with ADHD may become demoralized as a result of rejection by their peers and their poor performance in school. This demoralization as a result of ADHD may then manifest itself in depressed mood as well as other psychiatric disorders.

The present longitudinal results add to the literature by emphasizing the significance of ADHD in adolescence as a risk factor for later impaired work performance. This may be due to the fact that adults with ADHD tend to be impulsive and inattentive and may lack persistence in attending to work related tasks.³⁵ This finding is in accord with studies carried out by Kessler et al¹² and Biederman et al.¹³

Similarly, adults who had ADHD in adolescence were more likely to have high

financial stress in later life. One of the mechanisms that may play a key role in creating the circumstances for high financial stress is the lower level of income attained by adults with ADHD. However, even after controlling for income, ADHD was still related to financial stress. It may be that the distractibility associated with ADHD interferes with financial planning and maintaining control over one's financial resources. This is likely to contribute to anxiety regarding one's finances and economic future.

Regarding the role of substance use, the use of marijuana had pervasive adverse effects on the individual in that it was associated with both an increased probability of adverse internal factors (ie, impaired general mental health and ASPD), and difficult external factors (ie, impaired work performance). Several studies have revealed similar findings even though those samples were somewhat different.³⁶ We add to this important literature by demonstrating that the adult use of marijuana is associated with a broad array of both adverse internal and external factors in individuals in their late 30s. Smoking was also associated with both internal and external factors. Although marijuana use predicts internalizing and external factors as noted earlier, some of the internal and external factors studied predict later marijuana use. Moreover, there is evidence that ASPD also correlates with the increased risk of marijuana dependence. Individuals meeting criteria for marijuana dependence are far more likely to meet criteria for ASPD.³⁷

This research has a number of strengths. First, we used a developmental life-span approach covering several significant stages of development. Second, we examined major areas of internal and external functioning. Indeed, the current study demonstrated theoretically hypothesized associations between adolescent

ADHD and impaired physical health, impaired mental health, ASPD, impaired work performance, and high financial stress in adulthood. Third, our findings are generalizable, because we used a longitudinal study design and a large community sample, and we controlled for a number of possible confounding factors. Fourth, the findings can be translated into the clinical setting and public policies.

This study has several important limitations. First, our sample consisted mainly of white participants, and there was some attrition of ADHD children, which limits its generalizability. Second, we relied on self-report measures (eg, physical health, general mental health, *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* psychiatric disorder of ASPD, work performance, and financial stress). However, multiple studies have shown that self-reports have validity.³⁸ Third, we did not obtain a measure of adult ADHD at T7. As a result, future studies should focus on the continuity of a diagnosis of ADHD in adulthood to distinguish more accurately between adults with ADHD persistence and those with remission. Fourth, the number of participants with both ADHD and other psychiatric conditions was not large enough to examine comorbidity with ADHD. Future research using a larger sample would benefit greatly from examining ADHD and other aspects of psychiatric comorbidity. The findings of the current study have major implications for the prevention and treatment of ADHD and its consequences. Using a community sample of adults both with and without ADHD during adolescence, our results suggest a strong linkage between ADHD in adolescence and internal factors (eg, physical difficulties and ASPD) and external factors (eg, occupational and financial problems) in a 23-year follow-up study. These data covering 3 decades highlight the possible adverse

consequences associated with ADHD. Because ADHD in adolescence can have severe long-term repercussions, it is important that clinicians diagnose and treat ADHD as early as possible. Future research should also attempt to clarify

the factors that can alter the course of ADHD from adolescence to adulthood. In addition, future research will profit from examining the mechanisms that operate between ADHD and internal and external stress.

ACKNOWLEDGMENTS

The authors thank Dr Martin Whiteman for his thoughtful comments and suggestions about this article. We also thank 2 anonymous reviewers for their comprehensive review of our article.

REFERENCES

1. Wilens TE, Faraone SV, Biederman J, Gunawardene S. Does stimulant therapy of attention-deficit/hyperactivity disorder beget later substance abuse? A meta-analytic review of the literature. *Pediatrics*. 2003; 111(1):179–185
2. Thapar A, van den Bree M, Fowler T, Langley K, Whittinger N. Predictors of antisocial behaviour in children with attention deficit hyperactivity disorder. *Eur Child Adolesc Psychiatry*. 2006;15(2):118–125
3. Willcutt EG, Pennington BF, DeFries JC. Twin study of the etiology of comorbidity between reading disability and attention-deficit/hyperactivity disorder. *Am J Med Genet*. 2000;96(3):293–301
4. Mannuzza S, Klein RG, Bessler A, Malloy P, LaPadula M. Adult outcome of hyperactive boys. Educational achievement, occupational rank, and psychiatric status. *Arch Gen Psychiatry*. 1993;50(7):565–576
5. Mannuzza S, Klein RG, Bessler A, Malloy P, LaPadula M. Adult psychiatric status of hyperactive boys grown up. *Am J Psychiatry*. 1998;155(4):493–498
6. Biederman J, Petty CR, Evans M, Small J, Faraone SV. How persistent is ADHD? A controlled 10-year follow-up study of boys with ADHD. *Psychiatry Res*. 2010;177(3): 299–304
7. Jersild AT, Brook JS, Brook DW. *The Psychology of Adolescence*. New York, NY: Macmillan; 1978
8. March JS, Swanson JM, Arnold LE, et al. Anxiety as a predictor and outcome variable in the multimodal treatment study of children with ADHD (MTA). *J Abnorm Child Psychol*. 2000;28(6):527–541
9. Hodgkins P, Montejano L, Sasane R, Huse D. Cost of illness and comorbidities in adults diagnosed with attention-deficit/hyperactivity disorder: a retrospective analysis. *Prim Care Companion CNS Disord*. 2011; 13(2):PCC.10m01030
10. Wilens TE, Martelon M, Joshi G, et al. Does ADHD predict substance-use disorders? A 10-year follow-up study of young adults with ADHD. *J Am Acad Child Adolesc Psychiatry*. 2011;50(6):543–553
11. Arias AJ, Gelernter J, Chan G, et al. Correlates of co-occurring ADHD in drug-dependent subjects: prevalence and features of substance dependence and psychiatric disorders. *Addict Behav*. 2008;33(9):1199–1207
12. Kessler RC, Adler L, Ames M, et al. The prevalence and effects of adult attention deficit/hyperactivity disorder on work performance in a nationally representative sample of workers. *J Occup Environ Med*. 2005;47(6):565–572
13. Biederman J, Faraone SV. The effects of attention-deficit/hyperactivity disorder on employment and household income. *MedGenMed*. 2006;8(3):12
14. Brook DW, Brook JS, Zhang C, Koppel J. Association between attention-deficit/hyperactivity disorder in adolescence and substance use disorders in adulthood. *Arch Pediatr Adolesc Med*. 2010;164(10):930–934
15. Brook JS, Duan T, Zhang C, Cohen PR, Brook DW. The association between attention deficit hyperactivity disorder in adolescence and smoking in adulthood. *Am J Addict*. 2008;17(1):54–59
16. Miller CJ, Flory JD, Miller SR, Harty SC, Newcorn JH, Halperin JM. Childhood attention-deficit/hyperactivity disorder and the emergence of personality disorders in adolescence: a prospective follow-up study. *J Clin Psychiatry*. 2008;69(9):1477–1484
17. Weiss G, Hechtman L, Milroy T, Perlman T. Psychiatric status of hyperactives as adults: a controlled prospective 15-year follow-up of 63 hyperactive children. *J Am Acad Child Psychiatry*. 1985;24(2):211–220
18. Biederman J, Monuteaux MC, Mick E, et al. Young adult outcome of attention deficit hyperactivity disorder: a controlled 10-year follow-up study. *Psychol Med*. 2006;36(2): 167–179
19. Fischer M, Barkley RA, Smallish L, Fletcher K. Young adult follow-up of hyperactive children: self-reported psychiatric disorders, comorbidity, and the role of childhood conduct problems and teen CD. *J Abnorm Child Psychol*. 2002;30(5):463–475
20. Barkley RA, Fischer M, Smallish L, Fletcher K. The persistence of attention-deficit/hyperactivity disorder into young adulthood as a function of reporting source and definition of disorder. *J Abnorm Psychol*. 2002;111(2):279–289
21. Weiss G, Hechtman LT. *Hyperactive Children Grown Up: ADHD in Children, Adolescents, and Adults*. 2nd ed. New York, NY: Guilford; 1993
22. Cohen P, Cohen J. *Life Values and Adolescent Health*. Mahwah, NJ: Lawrence Erlbaum Associates; 1996
23. Costello AJ, Edelbrock CS, Dulcan MD, Kalas R, Klaric SH. *Report of the NIMH Diagnostic Interview Schedule for Children (DISC)*. Washington, DC: National Institute of Mental Health; 1984
24. Anderson SE, Cohen P, Naumova EN, Must A. Relationship of childhood behavior disorders to weight gain from childhood into adulthood. *Ambul Pediatr*. 2006;6(5):297–301
25. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 3rd ed, revised. Washington, DC: American Psychiatric Association; 1987
26. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30(6):473–483
27. Kessler RC, Nelson CB, McGonagle KA, et al. The epidemiology of co-occurring mental disorders and substance use disorders in the National Comorbidity Survey: implications for service utilization. *J Consult Clin Psychol*. 1996;73:389–399
28. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 4th ed, text revision. Washington, DC: American Psychiatric Association; 2000
29. Johnston JD, Bachman JG, O'Malley PM. *Monitoring the Future Study*. Ann Arbor, MI: Institute for Social Research, University of Michigan, Survey Research Center; 1994
30. Hodgkins P, Montejano L, Sasané R, Huse D. Risk of injury associated with attention-deficit/hyperactivity disorder in adults enrolled in employer-sponsored health plans: a retrospective analysis. *Prim Care Companion CNS Disord*. 2011;13(2):PCC.10m01031
31. Fasmer OB, Halmøy A, Eagan TM, Oedegaard KJ, Haavik J. Adult attention deficit

- hyperactivity disorder is associated with asthma. *BMC Psychiatry*. 2011;11:128
32. Johnson JG, Cohen P, Chen H, Kasen S, Brook JS. Parenting behaviors associated with risk for offspring personality disorder during adulthood. *Arch Gen Psychiatry*. 2006;63(5):579–587
 33. Brook JS, Brook DW, Gordon AS, Whiteman M, Cohen P. The psychosocial etiology of adolescent drug use: a family interactional approach. *Genet Soc Gen Psychol Monogr*. 1990;116(2):111–267
 34. Pine DS, Klein RG. Anxiety disorders. In: Rutter M, Bishop D, Pine DS, et al, eds. *Rutter's Child and Adolescent Psychiatry*. Malden, MA: Blackwell Publishing Ltd.; 2009:628–647
 35. Pliszka SR. Patterns of psychiatric comorbidity with attention-deficit/hyperactivity disorder. *Child Adolesc Psychiatr Clin N Am*. 2000;9(3):525–540, vii
 36. Brook JS, Pahl K, Brook DW. Tobacco use and dependence. In: Essau CA, ed. *Adolescent Addiction: Epidemiology, Assessment, and Treatment*. Boston, MA: Academic Press; 2008:149–178
 37. Compton WM, Conway KP, Stinson FS, Collier JD, Grant BF. Prevalence, correlates, and comorbidity of DSM-IV antisocial personality syndromes and alcohol and specific drug use disorders in the United States: results from the national epidemiologic survey on alcohol and related conditions. *J Clin Psychiatry*. 2005;66(6):677–685
 38. Harrison LD, Martin SS, Enev T, Harrington D. *Comparing Drug Testing and Self-report of Drug Use Among Youths and Young Adults in the General Population*. Rockville, MD: Substance Abuse and Mental Health Services Administration, Office of Applied Studies; DHHS publication SMA 07-4249, Methodology Series M-7 2007

APPENDIX ORs From Bivariate Logistic Regression Analyses: Factors Related to Adult Impaired General Physical Health, Impaired General Mental Health, ASPD, Impaired Work Performance, and High Financial Stress in the Late 30s ($N = 551$)

Independent Variables	Impaired General Physical Health in the Late 30s, OR (95% CI)	Impaired General Mental Health in the Late 30s, OR (95% CI)	ASPD in the Late 30s, OR (95% CI)	Impaired Work Performance in the Late 30s, OR (95% CI)	High Financial Stress in the Late 30s, OR (95% CI)
T2 or T3 ADHD	2.66 (1.59–4.45)***	2.30 (1.32–4.01)**	5.01 (2.65–9.45)***	3.27 (1.96–5.45)***	3.24 (1.81–5.80)***
Gender	0.94 (0.64–1.38)	0.55 (0.35–0.87)*	2.43 (1.33–4.43)**	1.44 (0.98–2.12)	0.84 (0.51–1.38)
T2 age	0.98 (0.91–1.05)	1.01 (0.94–1.10)	0.96 (0.87–1.07)	0.92 (0.86–1.00)*	0.99 (0.91–1.08)
T2 residency in Albany County	1.22 (0.83–1.80)	0.84 (0.54–1.31)	1.25 (0.70–2.23)	1.17 (0.80–1.73)	1.04 (0.64–1.69)
T2 or T3 CD	2.00 (1.21–3.32)**	1.33 (0.74–2.39)	4.44 (2.37–8.33)***	2.44 (1.48–4.02)***	1.18 (0.61–2.31)
T7 education	0.82 (0.76–0.89)***	0.91 (0.84–0.99)*	0.83 (0.75–0.93)**	0.89 (0.82–0.95)**	0.87 (0.80–0.96)**
T7 annual income	0.95 (0.92–0.98)**	0.94 (0.90–0.97)***	0.95 (0.91–1.00)*	0.96 (0.93–0.99)*	0.95 (0.91–0.99)*
T7 smoking	1.07 (0.98–1.17)	1.13 (1.03–1.25)*	1.36 (1.20–1.54)***	1.13 (1.03–1.23)**	1.21 (1.08–1.34)***
T7 marijuana use	1.01 (0.94–1.10)	1.13 (1.04–1.22)**	1.28 (1.17–1.42)***	1.20 (1.12–1.30)***	1.09 (0.99–1.20)

* $P < .05$;

** $P < .01$;

*** $P < .001$ (2-tailed tests).

Adolescent ADHD and Adult Physical and Mental Health, Work Performance, and Financial Stress

Judith S. Brook, David W. Brook, Chenshu Zhang, Nathan Seltzer and Stephen J. Finch

Pediatrics 2013;131;5

DOI: 10.1542/peds.2012-1725 originally published online December 10, 2012;

Updated Information & Services

including high resolution figures, can be found at:
<http://pediatrics.aappublications.org/content/131/1/5>

References

This article cites 26 articles, 1 of which you can access for free at:
<http://pediatrics.aappublications.org/content/131/1/5#BIBL>

Subspecialty Collections

This article, along with others on similar topics, appears in the following collection(s):
Developmental/Behavioral Pediatrics
http://www.aappublications.org/cgi/collection/development:behavioral_issues_sub

Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
<http://www.aappublications.org/site/misc/Permissions.xhtml>

Reprints

Information about ordering reprints can be found online:
<http://www.aappublications.org/site/misc/reprints.xhtml>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Adolescent ADHD and Adult Physical and Mental Health, Work Performance, and Financial Stress

Judith S. Brook, David W. Brook, Chenshu Zhang, Nathan Seltzer and Stephen J. Finch

Pediatrics 2013;131;5

DOI: 10.1542/peds.2012-1725 originally published online December 10, 2012;

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/131/1/5>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2013 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

