Posttraumatic Stress Disorder in Adult Attention-Deficit/Hyperactivity Disorder: Clinical Features and Familial Transmission

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ABSTRACT

Objective: Attention-deficit/hyperactivity disorder (ADHD) is characterized by clinically significant functional impairment due to symptoms of inattention and/or hyperactivity and impulsivity. Previous research suggests a link, in child samples, between ADHD and posttraumatic stress disorder (PTSD), which is characterized by (1) chronically reexperiencing a traumatic event, (2) hyperarousal, and (3) avoiding stimuli associated with the trauma while exhibiting numbed responsiveness. This study sought to address the link between ADHD and PTSD in adults by providing a comprehensive comparison of ADHD patients with and without PTSD across multiple variables including demographics, patterns of psychiatric comorbidities, functional impairments, quality of life, social adjustment, and familial transmission.

Method: Participants in our controlled family study conducted between 1998 and 2003 were 190 adults with *DSM-IV* ADHD who were attending an outpatient mental health clinic in Boston, Massachusetts; 16 adults with *DSM-IV* ADHD who were recruited by advertisement from the greater Boston area; and 123 adult controls without ADHD who were recruited by advertisement from the greater Boston area. All available first-degree relatives also participated. Subjects completed a large battery of self-report measures (the Quality of Life Enjoyment and Satisfaction Questionnaire, items from the Current Behavior Scale, the Social Adjustment Scale Self-Report, and the Four Factor Index of Social Status) designed to assess various psychiatric and functional parameters. Diagnoses were made using data obtained from structured psychiatric interviews (Structured Clinical Interview for *DSM-IV* Axis I Disorders, Clinician Version, and the Schedule for Affective Disorders and Schizophrenia for School-Aged Children-Epidemiologic Version).

Results: The lifetime prevalence of PTSD was significantly higher among adults with ADHD compared with controls (10.0% vs 1.6%; $P = .004$). Participants with ADHD and those with ADHD + PTSD did not differ in core symptoms of ADHD nor in age at onset, but those with ADHD + PTSD had higher rates of psychiatric comorbidity than those with ADHD only (including higher lifetime rates of major depressive disorder, oppositional defiant disorder, social phobia, agoraphobia, and generalized anxiety disorder) and worse quality of life ratings for all domains. Familial risk analysis revealed that relatives of ADHD probands without PTSD had elevated rates of both ADHD (51%) and PTSD (12%) that significantly differed from rates among relatives of controls (7% [$P \leq .001$] and 0% [$P \leq .05$], respectively). A similar pattern of elevated risk for ADHD and PTSD (80% and 40%) was observed in relatives of probands with ADHD + PTSD ($P \leq .001$ for both conditions).

Conclusions: The comorbidity of PTSD and ADHD in adults leads to greater clinical severity in terms of psychiatric comorbidity and psychosocial functioning. The familial coaggregation of the 2 disorders suggests that these disorders share familial risk factors and that their co-occurrence is not due to diagnostic errors.

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Recent literature has begun to suggest a link between attention-deficit/hyperactivity disorder (ADHD) and posttraumatic stress disorder (PTSD) in children and adults. Pediatric studies have indicated that youth with ADHD are more likely than those without ADHD to develop PTSD and vice versa.[1–3] A recent longitudinal follow-up study[4] of children of both sexes with ADHD who were grown up also documented a significant risk for PTSD in ADHD. Likewise, rodent studies[5–7] have linked nicotine exposure during pregnancy to a rodent model of ADHD[5] and to impairment in fear extinction.[6,7]

Despite these intriguing pediatric findings, less is known about the association between ADHD and PTSD in adults. Adler et al[8] found an increased risk for ADHD in combat veterans with PTSD and concluded that ADHD may be a risk factor for the development of PTSD. Gurvits et al[9] found that 30% of both male and female subjects with PTSD had 6 or more inattention symptoms in childhood, compared to only 11% of the adults without PTSD. Gurvits et al[9] also reported that 20% of the adults with PTSD and ADHD had 6 or more hyperactivity symptoms in childhood, compared to 0% of the adults with PTSD. Furthermore, mean Clinician-Administered PTSD Scale scores were significantly correlated ($r = 0.42$) with mean childhood ADHD scores as assessed by the Wender Utah Rating Scale.[9] Likewise, in a sample of cigarette smokers, Mitchell et al[10] found that adults with PTSD reported greater ADHD symptom severity than those without PTSD. Finally, Kessler et al[11] reported a bidirectional and significant risk between ADHD and PTSD in a large epidemiologic sample, which suggests that the association between ADHD and PTSD cannot be attributed to referral bias.

Despite these intriguing findings, little is known about the implications of PTSD for adults with ADHD or the nature of this association. Moreover, no prior research has examined the familial cotransmission of ADHD and PTSD. Such information would provide valuable information about the ways in which adults with comorbid ADHD and PTSD differ from those

Clinical Points

- Although individuals with attention-deficit/hyperactivity disorder (ADHD) and individuals with ADHD plus posttraumatic stress disorder (PTSD) may not differ in terms of ADHD symptom severity, current evidence suggests that patients with ADHD + PTSD will most likely experience greater functional impairments and higher rates of psychiatric comorbidities.
- Adults with ADHD are at high risk for PTSD; therefore, assessing for the presence of both disorders is encouraged.
- Relatives of ADHD and ADHD + PTSD probands are at greater risk of developing one or both of the disorders.

with ADHD alone that could impact diagnosis and service delivery and shed light on whether the association between the 2 disorders is due to shared familial risk factors.

The main aim of the current study was to examine the association between ADHD and PTSD by providing a comprehensive comparison of ADHD patients with and without PTSD across multiple domains: demographics, psychiatric comorbidities, functional impairments, quality of life, social adjustment, and familial transmission. We hypothesized that the comorbid condition of ADHD + PTSD would be associated with more psychiatric comorbidity and more functional impairments than ADHD alone. We also hypothesized that ADHD and PTSD would be cotransmitted in families. We also sought to test hypotheses about potential artifacts that might lead to a spurious association between ADHD and PTSD. Adler et al[8] speculated that the impulsive behaviors of individuals with ADHD may put them at risk for experiencing traumatic events, which therefore predicts that PTSD onset should occur after ADHD onset. If this theory is true, then we should find greater levels of ADHD symptoms among patients with the comorbid condition. To the best of our knowledge, this study is the first comprehensive evaluation of the implications of PTSD in adults with ADHD.

METHOD

Participants

Detailed study methodology has been previously described.[12–14] Briefly, subjects in our controlled family study were male and female and were between the ages of 18 and 55 years. We excluded potential subjects if they had major sensorimotor handicaps (deafness, blindness), psychosis, inadequate command of the English language, or a full-scale IQ of less than 80. No ethnic or racial group was excluded. We used 2 ascertainment sources to recruit ADHD subjects: clinical referrals to psychiatric outpatient clinics at Massachusetts General Hospital, Boston (clinical subsample, n = 190), and advertisements in the greater Boston area (community subsample, n = 16). We recruited all potential non-ADHD subjects (controls) (n = 123) through advertisements in the greater Boston area. From these proband groups, we ascertained 46 adult relatives of control probands and 88 relatives of ADHD probands.

A 3-stage ascertainment procedure was used to select the participants with ADHD. The first stage was the subject's referral (for ADHD subjects) or response to media advertisements (for ADHD and control subjects). The second stage screened (for ADHD subjects) or ruled out (for control subjects) for the diagnosis of ADHD by using a telephone questionnaire. The questionnaire asked about symptoms of ADHD and asked questions regarding study inclusion and exclusion criteria. The third stage confirmed (for ADHD subjects) or ruled out (for control subjects) the diagnosis with face-to-face structured interviews with the individuals. Only subjects who received a positive (ADHD subjects) or negative (control subjects) diagnosis at all 3 stages were accepted. After receiving a complete description of the study, the subjects provided written informed consent. The institutional review board of Massachusetts General Hospital, Boston, granted approval for this study.

Assessment Measures

We interviewed all subjects with the Structured Clinical Interview for *DSM-IV* Axis I Disorders (SCID),[15] supplemented with modules from the Schedule for Affective Disorders and Schizophrenia for School-Aged Children-Epidemiologic Version (K-SADS-E),[16] adapted for *DSM-IV*, to cover ADHD and other disruptive behavior disorders. The structured interview also included questions regarding academic tutoring, repeating grades, and placement in special academic classes.

On the K-SADS-E, subjects were first queried about childhood ADHD and disruptive behavioral disorder symptoms, and, if these were present in childhood, subjects were then asked about continuation of the symptoms into adulthood and the emergence of other symptoms. Age at onset was defined as the first emergence of impairing symptoms. Interviewers also collected information for psychiatric diagnoses in child relatives (aged 6 to 18 years) using the K-SADS-E.

Family members of the proband subjects were interviewed separately using the SCID for adults and the K-SADS-E for children. Only first-degree family members (eg, children, parents) were interviewed. We conducted direct interviews with the first-degree relatives and indirect interviews with their mothers (ie, the mothers completed the interview about their offspring). We combined the data from direct and indirect interviews by considering a diagnostic criterion positive if it was endorsed in either interview.

Initial diagnoses were prepared by the study interviewers and then reviewed by a diagnostic committee of board-certified child and adolescent and adult psychiatrists and licensed psychologists. The diagnostic committee was blind to the subject's ascertainment group and all nondiagnostic data (eg, cognitive functioning). Diagnoses were made for 2 points in time: lifetime and current (past month).

The interviewers had been instructed to take extensive notes about the symptoms for each disorder. These notes and the structured interview data were reviewed by the diagnostic committee so that the committee could make a best-estimate diagnosis as described by Leckman et al.[17]

Definite diagnoses were assigned to subjects who met all diagnostic criteria. Diagnoses were considered definite only if a consensus was achieved that the criteria were met to a degree that would be considered clinically meaningful. By "clinically meaningful," we mean that the data collected from the structured interview indicated that the diagnosis should be a clinical concern due to the nature of the symptoms, the associated impairment, and the coherence of the clinical picture.

On the basis of our previous work, we considered a subject to have ADHD if the subject met full *DSM-IV* criteria for the disorder (n = 127) or, in the case of subjects with late-onset ADHD, if the subject met full *DSM-IV* criteria for ADHD except for the age-at-onset criterion (n = 79). We previously demonstrated that the full-criteria ADHD group and late-onset ADHD group had similar clinical correlates, including patterns of Axis I comorbidity, personality traits, and neuropsychological deficits.[18,19]

We computed κ coefficients of agreement by having experienced, board-certified child and adult psychiatrists and licensed clinical psychologists diagnose subjects from audiotaped interviews. Based on 500 assessments from interviews of children and adults, the median κ coefficient was 0.98. The κ coefficients for individual diagnoses included 0.88 for ADHD, 1.0 for conduct disorder, 1.0 for major depressive disorder, 0.95 for mania, 1.0 for separation anxiety, 1.0 for agoraphobia, 0.95 for panic, 1.0 for substance use disorder, and 0.89 for tics/Tourette syndrome.

Quality of Life Enjoyment and Satisfaction Questionnaire. Quality of life was assessed with the short-form version of the Quality of Life Enjoyment and Satisfaction Questionnaire (Q-LES-Q).[20] The Q-LES-Q is a self-report instrument that evaluates enjoyment and satisfaction in various areas of daily functioning, including physical health, work, social relationships, family, and general activities. Each item is scored using a 5-point Likert scale (1 = very poor and 5 = very good) on which higher scores indicate greater enjoyment and satisfaction. The Q-LES-Q is a commonly used and well-validated tool with good test-retest reliability and high internal consistency.[21,22]

Deficient Emotional Self-Regulation. We used 8 items from the self-report Current Behavior Scale developed by Barkley et al[23] to assess deficient emotional self-regulation (DESR). The scale asks subjects to describe their behavior in the prior 6 months. Responses to each item on the scale range from 0 (never or rarely) to 3 (very often). Using our control subjects as a normative sample, we defined subjects as having DESR if their score on the Barkley DESR subscale was equal to or greater than the 95th percentile of the control distribution.

Social Adjustment Scale Self-Report. Social functioning was assessed using the Social Adjustment Scale Self-Report.[24] This self-report instrument quantifies social functioning within 7 major areas: work and school, social and leisure, family outside of the home, primary relationship, parental role, family unit, and financial status. There are a total of 54 questions, and each item is rated on a 5-point scale on which higher numbers represent greater impairment in social functioning. The Social Adjustment Scale Self-Report has been shown to be a valid measure of functional status and is widely used both clinically and in academic research.[25]

Occupation/education. Socioeconomic status was assessed using the Hollingshead Four Factor Index of Social Status.[26]

Statistical Analyses

We first compared the 3 groups of subjects (control, ADHD, and ADHD + PTSD groups) on potentially confounding demographic variables. Then, we examined differences in functional parameters between the 3 groups while controlling for potential demographic confounds. Our analyses used logistic regression for binary outcomes and ordinal logistic regression for ordinal outcomes. If any group reported zero events for an outcome, we used exact logistic regression. The Holm[27] sequential Bonferroni procedure to adjust *P* values for multiple comparisons was employed for asserting statistical significance for the omnibus tests comparing the 3 groups. If the omnibus test was significant, we used the .05 α level to assert significance for pairwise comparisons among the 3 groups.

RESULTS

Descriptive Statistics

In our ADHD sample compared to our non-ADHD (control) sample, the lifetime prevalence (10.0% vs 1.6%; $\chi^2_1 = 8.35$, $P = .004$) and current prevalence (4.2% vs 0.0%; $\chi^2_1 = 4.70$, $P = .03$) of PTSD were significantly higher. For subsequent analyses, the lifetime PTSD cohort (n = 20) constituted our ADHD + PTSD group.

Control participants were younger than both ADHD groups (Table 1). However, no significant age difference existed between the ADHD and ADHD + PTSD groups. The 2 ADHD groups did not differ on clinical features of ADHD (eg, age at onset of ADHD, number of current symptoms, number of childhood symptoms) or ADHD treatment status. However, as indicated in Table 1, our ADHD + PTSD group, in comparison with the other groups, was more likely to be female, to have a lower socioeconomic status (class 4), and to be of nonwhite race/ethnicity. Because of these demographic differences, all subsequent analyses were corrected for sex, age, and race/ethnicity.

The ADHD and ADHD + PTSD groups had similar mean numbers of current inattention symptoms (7.2 vs 7.8; $z = 0.7$, $P = .5$) and hyperactivity-impulsivity symptoms (6.0 vs 6.4; $z = 1.2$, $P = .2$). The 2 ADHD groups also had similar levels of past ADHD symptoms, both inattention ($\chi^2_1 = 0.38$, $P = .535$) and hyperactivity-impulsivity ($\chi^2_1 = 0.57$, $P = .450$). The 2 groups also did not differ significantly in the age at onset of ADHD (6.5 years vs 8 years; $z = 1.2$, $P = .2$). The prevalence of PTSD did not differ among ADHD subtypes based on current symptoms ($\chi^2_2 = 1.5$, $P = .5$) or lifetime symptoms ($\chi^2_2 = 0.14$, $P = .9$).

Within the ADHD + PTSD group, the mean age at onset of PTSD (18.3 years) was significantly older than the age at

Table 1. Demographic Features of the Sample by Proband Group (N = 329)

Variable	No ADHD (Controls) (n = 123)	ADHD (n = 186)	ADHD + PTSD (n = 20)	Test Statistic	Omnibus *P* Value
Age of proband, mean ± SD, y	29.8 ± 8.7	35.9 ± 10.9[a**]	39.7 ± 8.8[a***]	$F_{2,326} = 17.46$	< .001
Sex, male, n/n (%)	56/123 (46)	99/186 (53)	6/20 (30)[a*,b*]	$\chi^2_1 = 4.80$	.09
Marital status, n/n (%)				$\chi^2_2 = 13.13$	.01
Never married	93/121 (77)	104/181 (57)[a**]	11/19 (58)[a**]		
Married	19/121 (16)	48/181 (27)	6/19 (32)		
Divorced	9/121 (7)	29/181 (16)	2/19 (11)		
Race/ethnicity, n/n (%)				$\chi^2_4 = 10.36$	< .001
White	95/123 (77)	168/185 (91)	13/19 (68)		
African American	6/123 (5)	9/185 (5)	3/19 (16)		
Asian	9/123 (7)	1/185 (1)	0/19 (0)		
Hispanic	4/123 (3)	5/185 (3)	2/19 (11)[a*]		
Other	9/123 (7)	2/185 (1)	1/19 (5)		
Socioeconomic status, n/n (%)[c]				$\chi^2_3 = 37.21$	< .001
1	40/120 (33)	53/173 (31)	3/19 (16)[a*,b*]		
2	75/120 (63)	82/173 (47)	7/19 (37)		
3	4/120 (3)	23/173 (13)	3/19 (16)		
4	1/120 (1)	15/173 (9)	6/19 (32)[a***,b***]		
ADHD treatment type, n/n (%)				$\chi^2_3 = 0.88$	.830
Counseling	NA	10/181 (6)	2/20 (10)		
Medication	NA	42/181 (23)	5/20 (25)		
Combination	NA	45/181 (25)	3/20 (15)		
None	NA	84/181 (46)	10/20 (50)		

[a]Versus controls for pairwise comparisons. [b]Versus ADHD for pairwise comparisons. [c]According to the Hollingshead Four Factor Index of Social Status.
*$P \leq .05$, **$P \leq .01$, ***$P \leq .001$.
Abbreviations: ADHD = attention-deficit/hyperactivity disorder, NA = not applicable, PTSD = posttraumatic stress disorder.

Table 2. Lifetime Prevalence of Psychiatric Disorders by Proband Group (N = 329)[a]

Psychiatric Disorder	Controls (n = 123), n (%)	ADHD (n = 186), n (%)	ADHD + PTSD (n = 20), n (%)	χ^2_2	Omnibus *P* Value
Major depressive disorder	7 (6)	52 (28)[b*,c**]	13 (65)[b***]	31.30	< .001
Bipolar disorder[d]	0 (0)	10 (5)	1 (5)	0.03	.858
Conduct disorder	3 (2)	50 (27)[b***]	6 (30)[b***]	21.60	< .001
Oppositional defiant disorder	1 (1)	60 (32)[b***,c*]	12 (60)[b***]	24.03	< .001
Simple phobia	17 (14)	34 (18)	7 (35)[b*]	4.56	.102
Alcohol abuse	40 (33)	100 (54)[b***]	11 (55)[b*]	14.93	< .001
Alcohol dependence	7 (6)	47 (25)[b***]	8 (40)[b***]	21.65	< .001
Drug abuse	20 (16)	82 (44)[b***]	9 (45)[b**]	12.16	.007
Drug dependence	7 (6)	36 (19)[b***]	6 (30)[b***]	14.33	< .001
Social phobia	12 (10)	46 (25)[b***,c***]	13 (65)[b***]	24.64	< .001
Agoraphobia	3 (2)	22 (12)[b**,c*]	7 (35)[b***]	14.70	.001
Panic disorder	7 (6)	31 (17)[b**]	7 (35)[b***]	12.75	.002
Generalized anxiety disorder	4 (3)	42 (23)[b***,c*]	10 (50)[b***]	23.77	< .001

[a]Cox proportional hazards model except where noted, with values displayed as frequency (percent at risk). All significant omnibus and subsequent pairwise statistics were confirmed with permutation tests of 1,000 iterations.
[b]Versus controls for pairwise comparisons.
[c]Versus ADHD + PTSD for pairwise comparisons.
[d]Fisher exact test was utilized, with values displayed as frequency (percent meeting full diagnostic criteria for bipolar disorder).
*$P \leq .05$, **$P \leq .01$, ***$P \leq .001$.
Abbreviations: ADHD = attention-deficit/hyperactivity disorder, PTSD = posttraumatic stress disorder.

onset of ADHD (6.9 years) ($t_{20} = 7.4$, $P < .0001$). With the exception of a single case of PTSD that had onset in the same year as the onset of ADHD, onset for all cases of PTSD was subsequent to onset of ADHD. When we excluded cases of late-onset ADHD, the age at onset of ADHD was always prior to the onset of PTSD, except for 1 patient. The difference in ages at onset for the 2 disorders remained significant ($t_{20} = 5.9$, $P < .0001$).

Psychiatric Comorbidity

Both ADHD groups had higher rates of psychiatric comorbidity than the control group (Table 2). Compared with the ADHD group, the ADHD + PTSD group had higher lifetime rates of major depressive disorder, oppositional defiant disorder, social phobia, agoraphobia, and generalized anxiety disorder.

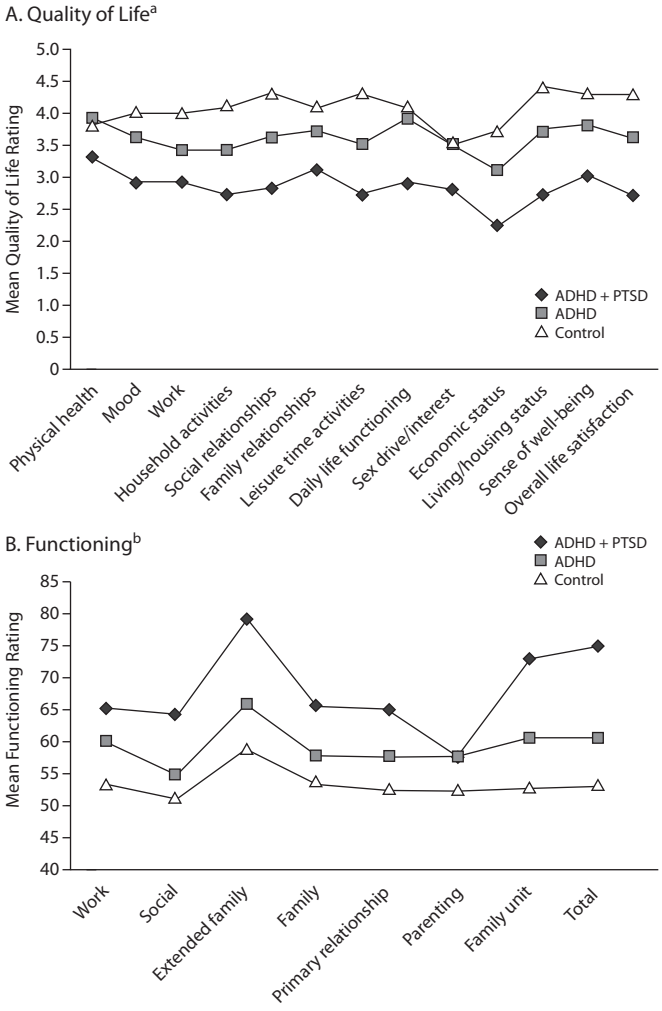
Functional Impairments

The ADHD + PTSD group was more likely to have received special education supports during primary and secondary school ($\chi^2_1 = 4.18$, $P = .041$). Having PTSD was associated with higher levels of DESR (56% vs 31% for ADHD alone; $\chi^2_1 = 6.5$, $P = .01$). In contrast, PTSD was not associated with higher rates of motor vehicle operation citations

or accidents, arrests, or convictions ($P > .10$ for all), nor was it associated with a history of academic tutoring or repeated grades ($P > .40$ for both).

As shown in Figure 1A, PTSD negatively affected quality of life ratings for all Q-LES-Q domains relative to both control participants ($P < .01$) and those with ADHD, although, for the latter comparisons, only the following subscales were significant ($P < .05$): social relationships, leisure time activities, functioning in daily life, economic status, living/housing status, sense of well-being, and overall life satisfaction. Functioning data from the Social Adjustment Scale Self-Report indicated that adults with ADHD + PTSD rated themselves as more impaired than controls or those with ADHD for all domains except parenting ($P < .05$ for all except parenting) (Figure 1B).

Figure 1. Ratings of (A) Quality of Life and (B) Functioning: Comparisons Between Probands With ADHD (n = 186), Probands With ADHD + PTSD (n = 20), and Controls (n = 123)



[a]According to the Quality of Life Enjoyment and Satisfaction Questionnaire. ADHD + PTSD versus control: $P < .01$ for all. ADHD + PTSD versus ADHD: $P < .05$ for social relationships, leisure time activities, functioning in daily life, economic status, living/housing status, sense of well-being, and overall life satisfaction.

[b]According to the Social Adjustment Scale Self-Report. ADHD + PTSD versus control: $P < .01$ for all except parenting, which was $P < .05$. ADHD + PTSD versus ADHD: $P < .05$ for all except parenting.

Abbreviations: ADHD = attention-deficit/hyperactivity disorder, PTSD = posttraumatic stress disorder.

Familial Transmission

Because relatives of probands with ADHD + PTSD were more likely to be African American and have lower socioeconomic status than relatives of probands with ADHD and relatives of controls (Table 3), all analyses were covaried for these differences. Compared with relatives of control probands, both groups of relatives of ADHD probands had significantly elevated rates of both PTSD and ADHD (Table 4). The 2 groups of relatives of ADHD probands did not differ significantly from one another in rates of either ADHD or PTSD, but this contrast had low power due to the small number of relatives of ADHD + PTSD probands.

DISCUSSION

Our results from this large controlled family study of adults with and without ADHD confirm results from prior studies[1–4,8–11] reporting that ADHD is associated with PTSD. This work extends prior research by clarifying the clinical correlates of PTSD among ADHD patients, the temporal sequencing of the 2 disorders, and their familial transmission. Although ADHD + PTSD probands did not differ from other ADHD probands with regard to the clinical features of ADHD, the comorbid condition of ADHD + PTSD led to greater clinical severity in terms of other psychiatric comorbidities and more impaired psychosocial functioning. Our work also suggests that ADHD and PTSD share familial etiologic risk factors.

The ADHD probands with and without PTSD did not differ in their severity of inattention or hyperactivity-impulsivity symptoms. This finding suggests that the occurrence of traumatic events in the ADHD + PTSD group cannot be simply attributed to higher levels of either inattentiveness or impulsivity. Despite these similarities in the diagnostic features of ADHD, probands with PTSD showed evidence of greater severity in terms of psychiatric comorbidity and psychosocial functioning. With regard to psychiatric comorbidity, the ADHD + PTSD group had higher lifetime rates of major depressive disorder, oppositional defiant disorder, social phobia, agoraphobia, and generalized anxiety disorder. They also showed greater evidence of functional impairment in their school history and in their current social functioning and quality of life.

Severity of ADHD symptoms in the ADHD and ADHD + PTSD groups was similar; nonetheless, functional impairment was significantly greater in the ADHD + PTSD cohort. This finding is consistent with both child and adult research[28,29] suggesting that psychiatric comorbidity exerts a negative additive effect on functioning: individuals with a psychiatric comorbidity are more functionally impaired than those with ADHD alone.

Among ADHD probands, PTSD also predicted higher rates of DESR. *Deficient emotional self-regulation* refers to (1) deficits in self-regulating the physiologic arousal

Table 3. Demographic Features of Relatives of Probands Shown by Proband Diagnostic Group (N = 134)

Variable	Relatives of Probands With No ADHD (Controls) (n = 46)	Relatives of Probands With ADHD (n = 83)	Relatives of Probands With ADHD + PTSD (n = 5)	Test Statistic	Omnibus *P* Value
Age of relative, mean ± SD, y	38.6 ± 16.3	41.4 ± 17.5	31.0 ± 14.1	$F_{2,131} = 1.14$	.324
Male relative, n/n (%)	13/46 (28)	30/83 (36)	1/5 (20)	$\chi^2_1 = 1.22$	.543
Race/ethnicity, n/n (%)				$\chi^2_4 = 24.16$	.002
White	37/46 (80)	76/83 (92)	3/5 (60)		
African American	2/46 (4)	5/83 (6)	2/5 (40)[a**,b**]		
Asian	6/46 (13)	0/83 (0)	0/5 (0)		
Hispanic	1/46 (2)	0/83 (0)	0/5 (0)		
Other	0/46 (0)	2/83 (2)	0/5 (0)		
Socioeconomic status, n/n (%)[c]				$\chi^2_3 = 29.64$	< .001
1	13/44 (30)	30/81 (37)	0/5 (0)[a**,b**]		
2	21/44 (48)	36/81 (44)	1/5 (20)		
3	7/44 (16)	9/81 (11)	0/5 (0)		
4	3/44 (7)	6/81 (7)	4/5 (80)[a**,b**]		

[a]Versus controls for pairwise comparisons. [b]Versus ADHD for pairwise comparisons. [c]According to the Hollingshead Four Factor Index of Social Status.
**$P \leq .01$.
Abbreviations: ADHD = attention-deficit/hyperactivity disorder, PTSD = posttraumatic stress disorder.

Table 4. Risk of Psychiatric Disorders in Relatives of Probands Shown by Proband Diagnostic Group (N = 134)[a]

Diagnosis	Relatives of Probands With No ADHD (Controls) (n = 46), n (%)	Relatives of Probands With ADHD (n = 83), n (%)	Relatives of Probands With ADHD + PTSD (n = 5), n (%)	χ^2_2	Omnibus *P* Value
ADHD	3 (7)	42 (51)[b***]	4 (80)[b***]	20.1	< .001
PTSD	0 (0)	10 (12)[b*]	2 (40)[b***]	11.4	.003

[a]Cox proportional hazards model, with values displayed as frequency (percent at risk). All significant omnibus and subsequent pairwise statistics were confirmed with permutation tests of 1,000 iterations.
[b]Versus controls. No significant differences existed between relatives of probands with and without PTSD.
*$P \leq .05$, ***$P \leq .001$.
Abbreviations: ADHD = attention-deficit/hyperactivity disorder, PTSD = posttraumatic stress disorder.

caused by emotions, (2) difficulties inhibiting inappropriate behavior in response to either positive or negative emotions, (3) problems refocusing attention from strong emotions, and (4) disorganization of coordinated behavior in response to emotional activation.[30] Because DESR, like PTSD, has been associated with increased morbidity in ADHD,[31–34] additional work is needed to determine whether DESR is a cause or outcome of PTSD in adults with ADHD.

Prior studies[35–37] show that when ADHD and PTSD have been studied separately, each has been shown to exhibit genetic transmission. Our familial transmission data show that the relatives of ADHD probands had significantly elevated rates of PTSD, regardless of the presence of PTSD in the probands. This finding suggests that ADHD and PTSD share familial etiologic risk factors. Although prior family-genetic studies of PTSD have not assessed ADHD, the twin study by Koenen et al[36,37] found shared heritability between PTSD and both major depression and nicotine dependence, both of which are frequently comorbid with ADHD. Twin studies are needed to determine whether the familial cotransmission of ADHD and PTSD can be attributed to genetic or environmental familial risk factors.

Our family study data also suggest that ADHD + PTSD may be a more severe familial variant of ADHD. This inference derives from the much greater rates of ADHD and PTSD among relatives of ADHD + PTSD probands as compared with relatives of ADHD probands. For example, compared with relatives of ADHD probands, relatives of ADHD + PTSD probands had more than twice the prevalence of ADHD and PTSD. However, these differences were not significant due to the small number of relatives of ADHD + PTSD probands. Thus, these findings should be used for hypothesis-generating purposes only.

The familial transmission data also address the idea that ADHD among PTSD patients is misdiagnosed due to clinical features of PTSD that might confound ADHD diagnosis, such as hyperarousal and inattention.[38–40] If PTSD had caused an ADHD-like syndrome that was misdiagnosed as ADHD, we would not expect to find an elevated prevalence of ADHD among ADHD + PTSD probands. The idea that ADHD among PTSD patients is a mimic of ADHD is further contradicted by our finding that age at onset of PTSD was typically subsequent to the age at onset of ADHD.

Our work has several clinical implications. Clinicians who treat adults with ADHD should be alert to the fact that their ADHD patients are at high risk for PTSD. Moreover, among ADHD patients, the presence of PTSD signals a more complicated course and outcome. For clinicians who focus on the treatment of PTSD, it would be prudent to assess for ADHD and treat the associated ADHD once adequate symptom stabilization and safety are achieved for the PTSD. Our data also suggest that ADHD symptoms should not be viewed as a complication of PTSD.

This study has some limitations. First, the numbers of PTSD patients and their relatives were relatively small. Although this fact would not have caused spurious findings of statistical significance, it did limit our power to detect some effects. The cross-sectional design of this study limited our ability to establish the sequencing of ADHD and PTSD symptoms. Thus, we relied on retrospective reports by

patients. Additionally, the presence of a PTSD-only comparison group would have been ideal, especially for establishing the cotransmission of the 2 disorders.

Despite these limitations, our study adds to our understanding of the association of PTSD and ADHD in adults and provides new insights as to the clinical ramifications of this association for the affected patients as well as their families. Our data suggest that, among ADHD patients, PTSD is not caused by excessive hyperactivity-impulsivity or inattention symptoms and that ADHD symptoms are not sequelae of PTSD. Instead, our work suggests that ADHD and PTSD share familial environmental risk factors and that the accumulation of these factors in ADHD + PTSD patients leads to a relatively severe course and outcome.

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Potential conflicts of interest: In 2012, **Dr Biederman** has received research support from Elminda, Janssen, McNeil, and Shire and has received an honorarium from the MGH Psychiatry Academy and The Children's Hospital of Southwest Florida/Lee Memorial Health System for tuition-funded CME courses. In 2011, he received an honorarium from the MGH Psychiatry Academy for a tuition-funded CME course; received an honorarium for presenting at an international scientific conference on ADHD; received an honorarium from Cambridge University Press for a chapter publication; and received royalties from a copyrighted rating scale used for ADHD diagnosis (these royalties were paid by Eli Lilly, Shire, and AstraZeneca to the Department of Psychiatry at MGH). In 2010, he received a speaker fee from a single talk given at Fundación Dr Manuel Camelo A.C. in Monterrey, Mexico; provided single consultations for Shionogi and Cipher (the honoraria for these consultations were paid to the Department of Psychiatry at MGH); and received an honorarium from the MGH Psychiatry Academy for a tuition-funded CME course. In previous years, he received research support, consultation fees, or speaker fees from Abbott, Alza, AstraZeneca, Boston University, Bristol-Myers Squibb, Celltech, Cephalon, Eli Lilly, Esai, Fundación Areces (Spain), Forest, GlaxoSmithKline, Gliatech, Hastings Center, Janssen, McNeil, Medice (Germany), Merck, MMC Pediatric, NARSAD, National Institute on Drug Abuse, New River, National Institute of Child Health and Human Development, NIMH, Novartis, Noven, Neurosearch, Organon, Otsuka, Pfizer, Pharmacia, Phase V Communications, Physicians Academy, The Prechter Foundation, Quantia Communications, Reed Exhibitions, Shire, Spanish Child Psychiatry Association, The Stanley Foundation, UCB Pharma, Veritas, and Wyeth. **Dr Spencer** has received research support from Shire, Cephalon, Eli Lilly, GlaxoSmithKline, Janssen, McNeil, Novartis, Pfizer, the National Institute of Mental Health (NIMH), and the US Department of Defense; has been a speaker or has served on the speakers bureaus for Shire, Eli Lilly, GlaxoSmithKline, Janssen, McNeil, and Novartis; has been an advisor or has served on the advisory boards for Alcobra, Shire, Cephalon, Eli Lilly, GlaxoSmithKline, Janssen, McNeil, Novartis, and Pfizer; has received research support from royalties and licensing fees on copyrighted ADHD scales through Massachusetts General Hospital (MGH) corporate-sponsored research and licensing; and has a US patent application pending (provisional number: 61/233,686), through MGH corporate licensing, on a method to prevent stimulant abuse. In the past year, **Dr Faraone** has been a consultant for and has received research support from Shire, Otsuka, and Alcobra and has also received research support from the National Institutes of Health (NIH); has been on the clinical advisory board for Akili Interactive Laboratories; and has received royalties from books published by Guilford Press (*Straight Talk about Your Child's Mental Health*) and Oxford University Press (*Schizophrenia: The Facts*). In previous years, he was a consultant for or served on the advisory boards for, or participated in continuing medical education (CME) programs sponsored by Shire, McNeil, Janssen, Novartis, Pfizer, and Eli Lilly. **Drs Antshel** and **Kaul** and **Mss Hier** and **Hendricks** have no potential conflicts of interest or financial disclosures to report.

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