The lifetime impact of attention deficit hyperactivity disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC)

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Background. The aim of the study was to present nationally representative data on the lifetime independent association between attention deficit hyperactivity disorder (ADHD) and psychiatric co-morbidity, correlates, quality of life and treatment seeking in the USA.

Method. Data were derived from a large national sample of the US population. Face-to-face surveys of more than 34 000 adults aged 18 years and older residing in households were conducted during the 2004–2005 period. Diagnoses of ADHD, Axis I and II disorders were based on the Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV version.

Results. ADHD was associated independently of the effects of other psychiatric co-morbidity with increased risk of bipolar disorder, generalized anxiety disorder, post-traumatic stress disorder, specific phobia, and narcissistic, histrionic, borderline, antisocial and schizotypal personality disorders. A lifetime history of ADHD was also associated with increased risk of engaging in behaviors reflecting lack of planning and deficient inhibitory control, with high rates of adverse events, lower perceived health, social support and higher perceived stress. Fewer than half of individuals with ADHD had ever sought treatment, and about one-quarter had ever received medication. The average age of first treatment contact was 18.40 years.

Conclusions. ADHD is common and associated with a broad range of psychiatric disorders, impulsive behaviors, greater number of traumas, lower quality of life, perceived social support and social functioning, even after adjusting for additional co-morbidity. When treatment is sought, it is often in late adolescence or early adulthood, suggesting the need to improve diagnosis and treatment of ADHD.

Introduction

Attention deficit hyperactivity disorder (ADHD), characterized by inattention, hyperactivity and impulsivity, is one of the most common childhood-onset psychiatric disorders (Centers for Disease Control and Prevention, 2010; Merikangas *et al.* 2010). It is associated with increased rates of family conflict, poor peer relationships (Barkley *et al.* 2006; Able *et al.* 2007), unintentional injuries or trauma (Barkley *et al.* 1993;

Swensen *et al.* 2004), impaired driving, substance-use disorders, low educational achievement, decreased work performance (Mannuzza *et al.* 1993; Kessler *et al.* 2009) and high health-care costs (Leibson *et al.* 2001; Meyers *et al.* 2010). Impairing symptoms of ADHD may persist into adulthood in as many as 65% of cases (Faraone *et al.* 2006*a*). The persistence of ADHD suggests that the impact of the disorder goes often beyond childhood and adolescence, and that most health-care professionals, not only pediatricians and child psychiatrists, are likely to encounter individuals with ADHD in their clinical practice.

Despite the public health importance of ADHD, several key areas remain understudied. For example,

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prior studies have shown that individuals with ADHD are at an increased risk for substance-use disorders (Biederman *et al.* 2006*b*; Elkins *et al.* 2007) and other psychiatric disorders (Biederman *et al.* 1991, 2006*b*; Kessler *et al.* 2006; Elkins *et al.* 2007). However, to date, no study has examined which psychiatric disorders are independently associated with ADHD and for which the association disappears after controlling for other disorders. Furthermore, although the co-morbidity of ADHD with Axis I disorders has been extensively documented, no community study has investigated the association between ADHD and personality disorders or the extent to which co-morbidity contributes to explain the levels of disability (Biederman *et al.* 2006*a*; Fayyad *et al.* 2007) and poor social functioning (Barkley *et al.* 2006; Able *et al.* 2007) consistently documented in individuals with ADHD.

The relationship between ADHD and impulsive behaviors is also poorly understood. Clinical studies have indicated that ADHD often co-occurs with behaviors characterized by lack of planning or deficient inhibitory control (Barkley, 1997; Swanson, 2003), such as reckless driving (Barkley *et al.* 1993; Fried *et al.* 2006) and gambling problems (Faregh & Derevensky, 2011). However, whether those associations extend to individuals in the general population is unknown (Froehlich *et al.* 2007).

There is also scarce information regarding treatment-seeking patterns among individuals with ADHD. The National Comorbidity Survey – Adolescent Supplement (NCS-A) found that 59.8% of individuals with attention deficit hyperactivity disorder had sought treatment for ADHD at the time of the survey (Merikangas *et al.* 2011). However, because its age range is 13 to 18 years, its results cannot be extrapolated to adults. By contrast, the National Comorbidity Survey Replication (Kessler *et al.* 2006), which focuses exclusively on adults, found that 25.2% of the respondents had received treatment for ADHD during the last year, but did not provide information on lifetime cumulative treatment rates, which are important to evaluate unmet treatment needs (Biederman *et al.* 2006*b*; Kessler *et al.* 2006; Fayyad *et al.* 2007).

The goal of this study was to fill these gaps in knowledge of adult ADHD by drawing on data from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), a large representative sample of the US adult population. Our goals were to: (1) investigate independent associations between ADHD and co-morbid psychiatric disorders controlling for other Axis I and Axis II co-morbid disorders; (2) examine the associations between ADHD and impulsive behaviors; (3) compare quality of life, perceived health, level of social support and stress among individuals with and without ADHD; and (4) estimate rates of treatment seeking among individuals with ADHD.

Method

The NESARC (Grant *et al.* 2004*b*, 2009) was the source of data. The NESARC target population at wave 1 was the civilian non-institutionalized population 18 years and older residing in households and group quarters. Blacks, Hispanics and adults aged 18–24 years were oversampled, with data adjusted for oversampling, household- and person-level non-response. Interviews were conducted by experienced lay interviewers with extensive training and supervision (Grant *et al.* 2004*b*, 2009). All procedures, including informed consent, received full ethical review and approval from the US Census Bureau and US Office of Management and Budget. After excluding respondents who were ineligible for wave 2 (e.g. deceased), 34 653 respondents were re-interviewed, and sample weights were developed to additionally adjust for wave 2 non-response. Weighted data were then adjusted to be representative of the civilian population of the USA on socio-economic variables based on the 2000 Decennial Census (Grant *et al.* 2009).

Diagnostic assessment

Sociodemographic measures included age, sex, race/ethnicity, nativity and marital status. Socio-economic measures included education, insurance type, employment status and individual income.

The diagnostic interview was the Alcohol Use Disorder and Associated Disabilities Interview Schedule–DSM-IV version (AUDADIS-IV; Grant *et al.* 2007*a*) wave 2 version (Grant *et al.* 2007*b*), a valid and reliable fully structured diagnostic interview designed for use by professional interviewers who are not clinicians.

ADHD was assessed at wave 2 of the NESARC; responders were asked the symptoms of DSM-IV ADHD. Consistent with DSM-IV, lifetime and childhood AUDADIS-IV diagnoses of ADHD required the respondent to meet the DSM-IV symptom thresholds. Subtypes were included as well, accordingly to the DSM-IV definition. Twenty symptom items operationalized the 18 ADHD criteria. Symptoms had to be present for at least 6 months, have onset before the age of 18 years and interfere significantly with social, school or work functioning. The age of onset criterion was increase to 18 years old, as endorsed by the DSM-5 ADHD committee (Faraone *et al.* 2006*b*; Kieling *et al.* 2010). Test–retest reliability for ADHD was good ($k = 0.71$) (Ruan *et al.* 2008). Internal consistency

reliability of the ADHD symptom items (Cronbach's $\alpha = 0.89$) was excellent (Ruan *et al.* 2008).

Mood disorders assessed by the AUDADIS included DSM-IV major depressive disorder (MDD), dysthymia, and bipolar I and II disorder. Anxiety disorders included DSM-IV panic disorder, social anxiety disorder, specific phobias, generalized anxiety disorder (GAD) (Williams *et al.* 2003) and post-traumatic stress disorder (PTSD). Personality disorders were assessed on a lifetime basis at wave 1 and included avoidant, dependent, obsessive-compulsive, paranoid, schizoid, histrionic and antisocial personality disorders. Borderline, schizotypal and narcissistic personality disorders were measured at wave 2. AUDADIS-IV methods to diagnose these disorders are described in detail elsewhere (Hasin *et al.* 2005; Grant *et al.* 2006). Test–retest reliabilities for AUDADIS-IV mood, anxiety, impulsive and personality disorders in the general population and clinical settings were fair to good ($k = 0.40$–0.77) (Canino *et al.* 1999; Grant *et al.* 2003; Petry *et al.* 2005; Ruan *et al.* 2008). Convergent validity was good to excellent for all affective, anxiety and personality diagnoses (Grant *et al.* 2003, 2004*a*, 2005, 2006; Compton *et al.* 2005; Hasin *et al.* 2005; Ruan *et al.* 2008), and selected diagnoses showed good agreement ($k = 0.64$–0.68) with psychiatrist reappraisals (Canino *et al.* 1999).

Extensive AUDADIS-IV questions covered DSM-IV lifetime prevalence and 12-month incidence diagnoses for alcohol and drug-specific abuse and dependence for 10 classes of substances. The good to excellent ($k = 0.70$–0.91) test–retest reliability of AUDADIS-IV substance-use disorder diagnoses has been documented in clinical and general population samples (Grant *et al.* 1995, 2003; Chatterji *et al.* 1997; Hasin *et al.* 1997; Canino *et al.* 1999; Ruan *et al.* 2008). Convergent, discriminant and construct validity of AUDADIS-IV substance-use disorder criteria and diagnoses was good to excellent (Hasin *et al.* 1990, 2003; Hasin & Paykin, 1999), including in the World Health Organization/National Institutes of Health International Study on Reliability and Validity (Room *et al.* 1996; Cottler *et al.* 1997; Hasin *et al.* 1997; Pull *et al.* 1997) where clinical reappraisals documented good validity of DSM-IV alcohol and drug-use disorder diagnoses ($k = 0.54$–0.76). Consistent with DSM-IV, 'primary' AUDADIS-IV diagnoses excluded disorders that were substance-induced or due to general medical conditions. Furthermore, diagnoses of MDD ruled out bereavement.

Impulsive behaviors and lifetime trauma

Behaviors reflecting deficits in executive functions, such as lack of planning and deficient inhibitory control, were also examined. Specifically, the study queried about problems with gambling and spending too much money, reckless driving, quitting jobs without knowing what to do next and having sudden changes in personal goals or career plans. Questions came from the borderline and antisocial personality disorder modules of the AUDADIS-IV, both of which have good reliability ($k = 0.71$ and $k = 0.67$, respectively) (Ruan *et al.* 2008).

As part of the PTSD diagnostic module, all NESARC respondents were asked if they ever experienced any of the 23 traumatic events described during the interview. Lifetime trauma exposure was measured as the number of traumatic events the respondent experienced.

Last 12 months perceived health, social support and stress

Perceived general health during the last 12 months was assessed using the Short Form 12 version 2 (SF-12; Ware *et al.* 2002), a reliable and valid measure of disability used in population surveys, which includes the physical component summary, social functioning scale, role emotional scale and mental health scale (Ware *et al.* 2002). Low social support during the last 12 months was assessed using the Interpersonal Support Evaluation List (ISEL-12), a 12-item scale designed to measure social support (Cohen *et al.* 1997). The Perceived Stress Scale-4 (PSS-4) assesses the individual propensity to perceive an event as stressful, based on the individual's locus of control and self-efficacy (Cohen & Williamson, 1988). Higher values indicate greater likelihood to perceive events as stressful and lower sense of self-efficacy.

Treatment history

Respondents were classified as receiving lifetime treatment if they: (1) visited a doctor, counselor, therapist or psychologist to get help for ADHD; or (2) were prescribed medications to alleviate symptoms related to ADHD. Respondents receiving treatment were also asked the age at which they first sought treatment.

Statistical analyses

Weighted percentages and means were computed to derive sociodemographic and clinical characteristics of respondents with and without a lifetime diagnosis of ADHD. Logistic regression yielded odds ratios (ORs), indicating measures of association between a lifetime diagnosis of ADHD and sociodemographic characteristics, lifetime and 12 months co-morbidity, associated impulsive behaviors, and adverse outcomes.

Two sets of logistic regressions, yielding adjusted ORs were conducted to examine each outcome (e.g. co-morbid psychiatric disorders, associated lifetime number of trauma). The first set adjusted only for sociodemographic characteristics that differed between individuals with and without a lifetime history of ADHD. The second set further adjusted for the presence of other co-morbid psychiatric disorders that differed between individuals with and without a lifetime history of ADHD to identify the independent contribution of ADHD to the outcome of interest (e.g. associated impulsive behaviors).

Because the combined standard error of two means (or percentages) is always equal to or less than the sum of the standard errors of those two means, in our analyses we conservatively consider that two confidence intervals (CIs) whose values do not overlap differ significantly from one another (Agresti, 2002). We consider significant ORs those whose CI does not include 1. Standard errors and 95% CIs for all analyses were estimated by using SUDAAN (version 9.0; Research Triangle Institute, USA), to adjust for the design effects of the NESARC.

Results

Sociodemographic and socio-economic characteristics (Table 1)

The overall lifetime prevalence of the combined sub-type of ADHD was 2.51% (95% CI 2.28–2.76). The odds of ADHD were significantly lower in women than in men (OR 0.64, 95% CI 0.54–0.75) and in blacks (OR 0.62, 95% CI 0.48–0.79), Hispanics (OR 0.66, 95% CI 0.50–0.86), and Asian Americans (OR 0.34, 95% CI 0.17–0.69) than among whites. Being US-born, never married, or in the youngest cohort (ages 18–29 years) increased the risk for ADHD. The risk of ADHD was inversely related to age and to individual and family income.

Lifetime and 12-month co-morbidity (Table 2)

Most individuals with a lifetime history of ADHD (94.98%) had a lifetime history of at least one psychiatric diagnosis, compared with 64.54% in non-ADHD (OR 10.40, 95% CI 7.07–15.30). Individuals with ADHD were significantly more likely than those without ADHD to have a lifetime Axis I disorder (OR 7.73, 95% CI 5.70–10.50) and a personality disorder (OR 6.56, 95% CI 5.52–7.79). All psychiatric disorders, with the exception of alcohol abuse, were significantly associated with ADHD. The strongest associations were with borderline personality disorder (OR 9.32, 95% CI 7.73–11.22), schizotypal personality disorder

(OR 8.07, 95% CI 6.58–9.91), dependent personality disorder (OR 8.79, 95% CI 5.34–14.46) and bipolar disorder (OR 7.60, 95% CI 6.24–9.25). A similar pattern was observed when 12-month, rather than lifetime, diagnoses of Axis I disorders were examined (see the Supplementary material, available online)†. Most individuals with a lifetime history of ADHD (71.84%) had at least one psychiatric diagnosis during the last 12 months, compared with 33.12% in non-ADHD individuals (OR 5.15, 95% CI 4.24–6.26).

After adjusting for sociodemographic characteristics, all associations were reduced but maintained significant. However, after further adjusting for other co-morbid psychiatric disorders, only the associations with lifetime and 12-month alcohol dependence, bipolar disorder, specific phobia, PTSD, GAD, psychotic disorder, schizotypal, narcissistic, borderline, histrionic and antisocial personality disorder remained positive and statistically significant. ADHD was negatively and significantly associated with schizoid personality disorder and dysthymia. All other associations were no longer significant.

Impulsive behaviors and number of traumas (Table 3)

The prevalence of behaviors reflecting lack of planning and deficient inhibitory control was higher among individuals with ADHD than those without ADHD. Individuals with ADHD were more likely to develop lifetime problems with gambling or spending too much money (OR 4.95, 95% CI 3.98–6.17), to drive recklessly (OR 2.81, 95% CI 2.22–3.55), to frequently quit a job without knowing what to do next (OR 4.82, 95% CI 4.02–5.78) and to experience many sudden changes in personal or career goals (OR 4.55, 95% CI 3.75–5.51). After adjusting for sociodemographic and co-morbid disorders, all associations remained significant.

Individuals with ADHD had a significantly greater number of lifetime traumatic events than individuals without ADHD. This difference maintained significance after adjusting for sociodemographic and co-morbidity.

Perceived health, social support and stress (Table 4)

Individuals with ADHD had significantly lower scores on the SF-12 physical, social, emotional and mental subscales. They scored significantly higher on the PSS-4 ($t = 13.15$, $p < 0.0001$) and significantly lower on the ISEL-12 than individuals without ADHD ($t = -6.50$, $p < 0.0001$). All differences remained significant after adjusting for sociodemographic characteristics and co-morbidity.

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† The note appears after the main text.

Table 1. *Sociodemographic and socio-economic characteristics of individuals with and without ADHD in the National Epidemiologic Survey on Alcohol and Related Conditions*

	ADHD (n = 807, 2.51%) % (95% CI)	General population (n = 33 846, 97.49%) % (95% CI)	OR	(95% CI)
Sex				
Male	58.69 (54.69–62.57)	47.64 (46.96–48.32)	1.00	(1.00–1.00)
Female	41.31 (37.43–45.31)	52.36 (51.68–53.04)	0.64	(0.54–0.75)*
Race/ethnicity				
White	78.60 (74.69–82.05)	70.71 (67.51–73.73)	1.00	(1.00–1.00)
Black	7.67 (5.98–9.79)	11.14 (9.87–12.54)	0.62	(0.48–0.79)*
Native American	3.60 (2.23–5.75)	2.15 (1.83–2.53)	1.50	(0.93–2.43)
Asian	1.64 (0.77–3.44)	4.34 (3.40–5.52)	0.34	(0.17–0.69)*
Hispanic	8.49 (6.23–11.46)	11.66 (9.47–14.27)	0.66	(0.50–0.86)*
Nativity				
US-born	94.63 (92.62–96.11)	85.92 (82.89–88.48)	1.00	(1.00–1.00)
Foreign-born	5.37 (3.89–7.38)	14.08 (11.52–17.11)	0.35	(0.26–0.47)*
Age, years				
18–29	30.54 (26.34–35.09)	15.97 (15.35–16.62)	1.00	(1.00–1.00)
30–44	33.59 (29.56–37.88)	29.64 (28.91–30.37)	0.59	(0.47–0.75)*
45–64	31.82 (27.74–36.20)	34.68 (34.05–35.33)	0.48	(0.37–0.62)*
65+	4.05 (2.79–5.83)	19.71 (19.01–20.42)	0.11	(0.07–0.16)*
Education				
Less than high school	16.34 (13.09–20.23)	13.96 (13.08–14.89)	1.27	(0.97–1.67)
High school graduate	29.71 (25.90–33.82)	27.43 (26.37–28.51)	1.18	(0.96–1.44)
Some college or higher	53.95 (49.35–58.48)	58.61 (57.34–59.87)	1.00	(1.00–1.00)
Individual income				
$0–19 999	20.93 (17.78–24.48)	41.95 (40.83–43.07)	1.00	(1.00–1.00)
$20 000–34 999	5.90 (3.97–8.67)	23.15 (22.45–23.86)	0.76	(0.62–0.93)*
$35 000–69 999	51.50 (47.36–55.63)	24.38 (23.61–25.17)	0.70	(0.56–0.88)*
$70 000+	21.67 (18.74–24.91)	10.52 (9.66–11.45)	0.46	(0.30–0.70)*
Family income				
$0–19 999	28.39 (24.73–32.35)	19.37 (18.46–20.32)	1.00	(1.00–1.00)
$20 000–34 999	19.87 (16.84–23.30)	18.86 (18.17–19.58)	0.72	(0.57–0.91)*
$35 000–69 999	28.49 (24.88–32.39)	32.29 (31.49–33.11)	0.60	(0.49–0.75)*
$70 000+	23.25 (19.63–27.32)	29.47 (28.01–30.96)	0.54	(0.42–0.69)*
Marital status				
Married, living with someone as if married	54.92 (50.52–59.25)	64.02 (63.04–64.98)	1.00	(1.00–1.00)
Widowed, divorced or separated	19.02 (16.06–22.37)	18.86 (18.33–19.40)	1.18	(0.94–1.48)
Never married	26.06 (22.55–29.90)	17.12 (16.23–18.06)	1.77	(1.44–2.19)*

ADHD, Attention deficit hyperactivity disorder; CI, confidence interval; OR, odds ratio.

* Significant at $p < 0.05$.

Lifetime treatment history (Table 5)

The lifetime rate of treatment seeking for ADHD was 44.02% (95% CI 39.97–48.14%) and the average age for first treatment seeking was 18.40 years. Counseling and psychotherapy were received by 41.07% of the sample (95% CI 37.11–45.14%), with an average age for first treatment of 18.65 years. Only 27.61% (95% CI 23.93–31.62%) were prescribed medication to treat ADHD. The average age of first treatment for medication was 20.63 years of age.

Discussion

In a large, nationally representative sample of US adults, individuals with a lifetime history of ADHD had an increased prevalence of all psychiatric disorders, even after adjusting for sociodemographic characteristics. However, after adjusting for other co-morbid disorders ADHD was independently associated only with increased risk of bipolar disorder, narcissistic, histrionic, borderline, antisocial and schizotypal personality disorder, GAD, PTSD and specific

Table 2. *Lifetime psychiatric co-morbidity of individuals with and without ADHD in the National Epidemiologic Survey on Alcohol and Related Conditions*

	ADHD (n=807, 2.51%) % (95% CI)	General population (n=33 846, 97.49%) % (95% CI)	OR (95% CI)	aOR[a] (95% CI)	aOR[b] (95% CI)
Any psychiatric disorder	94.98 (92.78–96.54)	64.54 (63.22–65.84)	10.40 (7.07–15.30)	7.57 (5.15–11.13)	7.57 (5.15–11.13)*
Any Axis I disorder	92.64 (90.22–94.50)	61.95 (60.52–63.36)	7.73 (5.70–10.50)	5.59 (4.13–7.58)	3.24 (2.35–4.47)*
Any substance-use disorder	71.68 (67.30–75.68)	44.45 (42.88–46.03)	3.16 (2.60–3.85)	2.16 (1.75–2.67)	1.22 (0.98–1.53)
Nicotine dependence	44.82 (40.49–49.24)	22.57 (21.55–23.61)	2.79 (2.35–3.31)	1.91 (1.60–2.28)	0.92 (0.74–1.14)
Any alcohol-use disorder	57.01 (52.30–61.60)	33.97 (32.48–35.49)	2.58 (2.14–3.11)	1.87 (1.53–2.29)	0.88 (0.71–1.10)
Alcohol abuse	18.08 (14.86–21.82)	19.33 (18.31–20.39)	0.92 (0.72–1.17)	0.78 (0.61–1.00)	0.84 (0.66–1.07)
Alcohol dependence	38.93 (34.76–43.28)	14.64 (13.91–15.40)	3.72 (3.11–4.44)	2.48 (2.04–3.01)	1.24 (1.00–1.55)
Any drug-use disorder	35.68 (31.87–39.67)	11.39 (10.74–12.09)	4.31 (3.65–5.10)	2.75 (2.29–3.30)	1.19 (0.95–1.49)
Drug abuse	27.88 (24.48–31.56)	9.70 (9.12–10.32)	3.60 (3.01–4.3)	2.30 (1.89–2.79)	1.10 (0.87–1.40)
Drug dependence	15.16 (12.30–18.55)	3.07 (2.78–3.39)	5.65 (4.44–7.19)	3.35 (2.61–4.31)	1.01 (0.73–1.38)
Any mood disorder	60.50 (56.41–64.45)	23.13 (22.36–23.91)	5.09 (4.27–6.07)	4.53 (3.77–5.44)	1.97 (1.50–2.59)*
Major depressive disorder	26.39 (22.73–30.41)	16.17 (15.55–16.80)	1.86 (1.51–2.29)	1.74 (1.40–2.16)	0.96 (0.72–1.27)
Bipolar disorder	33.56 (29.37–38.03)	6.23 (5.88–6.61)	7.60 (6.24–9.25)	5.56 (4.49–6.89)	2.47 (1.87–3.25)*
Dysthymia	6.09 (4.41–8.37)	3.36 (3.15–3.60)	1.86 (1.31–2.64)	1.72 (1.20–2.48)	0.62 (0.39–0.98)*
Any anxiety disorder	60.74 (56.43–64.90)	27.24 (26.29–28.21)	4.13 (3.45–4.95)	3.93 (3.29–4.71)	1.85 (1.47–2.31)*
Panic disorder	22.00 (18.89–25.46)	7.02 (6.62–7.44)	3.74 (3.05–4.57)	3.22 (2.62–3.98)	1.10 (0.81–1.48)
Social anxiety disorder	22.82 (19.37–26.68)	6.62 (6.22–7.05)	4.17 (3.38–5.15)	3.39 (2.73–4.22)	1.12 (0.84–1.49)
Specific phobia	35.75 (31.64–40.08)	14.61 (13.89–15.36)	3.25 (2.70–3.92)	3.07 (2.53–3.71)	1.39 (1.09–1.77)*
Post-traumatic stress disorder	21.99 (18.55–25.87)	6.02 (5.68–6.38)	4.40 (3.52–5.51)	4.17 (3.30–5.26)	1.84 (1.37–2.48)*
Generalized anxiety disorder	25.99 (22.34–30.01)	7.19 (6.77–7.64)	4.53 (3.69–5.57)	4.23 (3.41–5.24)	1.42 (1.05–1.93)*
Pathological gambling	1.54 (0.82–2.88)	0.39 (0.30–0.49)	4.04 (2.01–8.12)	3.26 (1.60–6.65)	1.13 (0.49–2.58)
Conduct disorder	20.23 (17.02–23.87)	4.27 (3.95–4.62)	5.68 (4.56–7.09)	3.62 (2.86–4.58)	1.20 (0.88–1.63)
Psychotic disorder	8.81 (6.75–11.41)	2.97 (2.65–3.33)	3.16 (2.33–4.28)	3.14 (2.28–4.32)	1.42 (1.02–1.99)*
Any personality disorder	62.79 (58.59–66.81)	20.46 (19.72–21.22)	6.56 (5.52–7.79)	5.25 (4.40–6.25)	2.82 (2.25–3.54)*
Avoidant	10.61 (8.50–13.16)	2.11 (1.90–2.34)	5.50 (4.26–7.11)	3.85 (2.92–5.06)	0.94 (0.66–1.33)
Dependent	3.06 (2.01–4.64)	0.36 (0.27–0.47)	8.79 (5.34–14.46)	5.41 (3.16–9.27)	0.89 (0.46–1.70)
Obsessive-compulsive	19.34 (16.17–22.97)	7.78 (7.35–8.24)	2.84 (2.28–3.54)	2.55 (2.04–3.19)	0.85 (0.63–1.15)
Paranoid	14.76 (11.98–18.04)	4.06 (3.76–4.39)	4.09 (3.20–5.21)	3.04 (2.34–3.96)	0.71 (0.51–1.00)
Schizoid	9.19 (7.14–11.75)	2.91 (2.67–3.17)	3.38 (2.55–4.48)	2.65 (1.98–3.55)	0.65 (0.45–0.95)*
Schizotypal	22.42 (19.04–26.21)	3.46 (3.19–3.75)	8.07 (6.58–9.91)	6.10 (4.90–7.58)	2.27 (1.70–3.04)*
Narcissistic	25.16 (21.82–28.83)	5.69 (5.31–6.10)	5.57 (4.59–6.76)	4.85 (3.92–6.01)	2.23 (1.75–2.85)*
Borderline	33.69 (29.90–37.71)	5.17 (4.83–5.54)	9.32 (7.73–11.22)	6.83 (5.59–8.36)	2.84 (2.19–3.68)*
Histrionic	10.74 (8.34–13.72)	1.57 (1.42–1.74)	7.54 (5.71–9.95)	5.25 (3.92–7.04)	1.62 (1.12–2.34)*
Antisocial	18.86 (15.80–22.35)	3.46 (3.16–3.78)	6.49 (5.17–8.15)	3.98 (3.12–5.07)	1.53 (1.13–2.07)*

ADHD, Attention deficit hyperactivity disorder; CI, confidence interval; OR, odds ratio; aOR, adjusted odds ratio.

[a] Adjusted for sociodemographic characteristics.

[b] Adjusted for sociodemographic characteristics and other psychiatric disorders.

* Significant at $p < 0.05$.

phobia. Furthermore, after adjusting for co-morbidity, individuals with a lifetime history of ADHD had a significantly higher tendency to engage in behaviors reflecting lack of planning and deficient inhibitory control, and to experience high rates of adverse consequences, including trauma. ADHD was also associated with significantly lower perceived health, social support and higher stress. Although lifetime treatment rates for ADHD were 44.02%, the average age of first treatment contact was 18.40 years of

age, suggesting that ADHD was undertreated in this cohort.

Consistent with previous findings (Kessler *et al.* 2006), our unadjusted analyses showed that ADHD was associated with a broad range of lifetime Axis I disorders (Kessler *et al.* 2006; Fayyad *et al.* 2007). Consistent with clinical studies (Miller *et al.* 2008), we also found extensive co-morbidity with Axis II disorders, which had not been previously examined in national, community samples. After adjusting for

Table 3. *Impulsive behaviors and number of traumas among individuals with and without ADHD in the National Epidemiologic Survey on Alcohol and Related Conditions*

	ADHD (n = 807, 2.51%) % (95% CI)	General population (n = 33 846, 97.49%) % (95% CI)	OR (95% CI)	aOR[a] (95% CI)	aOR[b] (95% CI)
Deficient inhibitory control					
Problem with gambling or spending too much money	22.53 (19.07–26.40)	5.54 (5.23–5.87)	4.95 (3.98–6.17)	3.83 (3.07–4.78)	1.92 (1.47–2.51)*
Reckless driving	25.99 (21.88–30.56)	11.11 (10.38–11.89)	2.81 (2.22–3.55)	2.11 (1.66–2.68)	1.32 (1.02–1.72)*
Lack of planning					
More than once quitting a job without knowing what to do next	45.49 (40.97–50.08)	14.75 (14.14–15.38)	4.82 (4.02–5.78)	3.39 (2.83–4.05)	1.70 (1.40–2.06)*
Many sudden changes in personal goals or career plans	26.23 (22.78–30.01)	7.25 (6.90–7.63)	4.55 (3.75–5.51)	3.53 (2.88–4.34)	1.63 (1.30–2.06)*
Mean number of lifetime traumas (s.e.)	5.78 (0.15)	3.28 (0.03)	$t = 17.29$, $p < 0.0001$	Wald $F = 292.08$, $p < 0.0001$	Wald $F = 100.39$, $p < 0.0001$

ADHD, Attention deficit hyperactivity disorder; CI, confidence interval; OR, odds ratio; aOR, adjusted odds ratio; s.e., standard error.

[a] Adjusted for sociodemographic characteristics.

[b] Adjusted for sociodemographic characteristics and other psychiatric disorders.

* Significant at $p < 0.05$.

Table 4. *Last 12 months perceived health, social support and stress of individuals with and without ADHD in the National Epidemiologic Survey on Alcohol and Related Conditions*

	ADHD (n = 807, 2.51%)	General population (n = 33 846, 97.49%)	t score	p	Wald F test	p^a	Wald F test	p^b
SF-12								
Physical component	48.89 (0.49)	50.29 (0.11)	−2.94	0.0046	23.41	<0.0001	5.42	0.0230
Mental component	45.37 (0.51)	51.58 (0.08)	−12.14	<0.0001	132.05	<0.0001	16.85	0.0001
Social functioning	46.24 (0.49)	51.77 (0.08)	−10.96	<0.0001	122.32	<0.0001	21.31	<0.0001
Role emotional	44.83 (0.53)	49.52 (0.09)	−8.81	<0.0001	88.21	<0.0001	10.91	0.0016
Mental health	45.77 (0.52)	52.09 (0.09)	−12.20	<0.0001	130.27	<0.0001	19.24	<0.0001
ISEL-12	40.68 (0.29)	42.58 (0.05)	−6.50	<0.0001	41.66	<0.0001	11.06	0.0015
PSS-4	5.65 (0.13)	3.82 (0.03)	13.15	<0.0001	152.78	<0.0001	22.37	<0.0001

ADHD, Attention deficit hyperactivity disorder; SF-12, Short Form 12 version 2; ISEL-12, Interpersonal Support Evaluation List; PSS-4, Perceived Stress Scale-4.

Data are given as mean (standard error).

[a] Adjusted for sociodemographic characteristics.

[b] Adjusted for sociodemographic characteristics and other psychiatric disorders.

other co-morbid disorders, individuals with ADHD had higher rates of bipolar disorder, cluster B personality disorders, GAD and PTSD. The higher than expected rate of co-occurrence between ADHD and bipolar disorder has been previously noted across different ages in clinical samples (Nierenberg *et al.* 2005; Singh *et al.* 2006), and is consistent with the documented genetic (Faraone *et al.* 2001), neuroanatomical (Biederman *et al.* 2008*a*) and cognitive-style commonalities between both disorders (Doyle *et al.* 2005). Previous studies also documented an association between childhood ADHD and cluster B personality disorders (Bernstein *et al.* 1996; Miller *et al.* 2008). Clinical studies of ADHD adults have documented higher levels of neuroticism (Jacob *et al.* 2007), novelty seeking and harm avoidance (Jacob *et al.* 2007;

Table 5. *Lifetime treatment history of individuals with ADHD in the National Epidemiologic Survey on Alcohol and Related Conditions*

Lifetime treatment history	% (95% CI)
Ever sought any treatment	44.02 (39.97–48.14)
Ever talking to a therapist for ADHD	41.07 (37.11–45.14)
Ever taking medication for ADHD	27.61 (23.93–31.62)
Mean first age at any treatment, years (S.E.)[a]	18.40 (0.74)
Mean first age talking to a therapist for ADHD, years (S.E.)[a]	18.65 (0.78)
Mean first age taking medication for ADHD, years (S.E.)[a]	20.63 (1.07)

ADHD, Attention deficit hyperactivity disorder; CI, confidence interval; S.E., standard error.

[a] Among individuals who sought treatment.

Faraone *et al.* 2009) and reward dependence (Faraone *et al.* 2009). Although the association with cluster B personality disorders may be partly due to overlapping diagnostic criteria, the disorders may also co-occur because of common temperamental traits (Anckarsater *et al.* 2006), or exposure to common environmental risk factors such as adverse early experiences with fear or anger (Lara *et al.* 2006). The high rates of GAD may be a consequence of the increasing difficulties adapting to the psychosocial environment due to impairments in executive functions (Faraone *et al.* 2000). Furthermore, individuals with ADHD are exposed to higher risks of accidents and major life events (Barkley, 2002; Barkley *et al.* 2006), which in turn may explain the high rates of PTSD.

After adjusting for co-morbidity, individuals with ADHD did not have higher rates of substance-use disorders (SUDAAN, version 9.0; Research Triangle Institute, USA). Prior studies that have assessed the effect of psychiatric co-morbidity of the association between ADHD and substance-use disorders, with highly variable methods and sample sizes, focused mostly on oppositional defiant and conduct disorders (Barkley *et al.* 1990; Biederman *et al.* 2001, 2008*b*; Burke *et al.* 2001; August *et al.* 2006; Elkins *et al.* 2007; Molina *et al.* 2007). Results have been contradictory, leaving unanswered the question of whether the association of ADHD with subsequent substance-use disorders is independent or mediated by co-morbidity with oppositional defiant or conduct disorders. Our results seem to support the hypothesis that the association between ADHD and substance-use disorders is mediated by co-morbidity with other externalizing disorders, such as oppositional defiant or conduct disorders. It also provides new evidence suggesting

that, at least in some cases, the association between ADHD and substance-use disorders may be mediated by anxiety disorders, which were highly co-morbid with ADHD in our sample.

The mediating effect of co-morbidity on the association between ADHD and substance-use disorders may have important clinical implications. Pharmacological treatment of ADHD appears to reduce the risk of developing substance-use disorders (Faraone & Wilens, 2003; Wilens *et al.* 2003). This may be due to the improvement of ADHD symptoms or possibly through other mechanism, such as improvement of mood (Candy *et al.* 2008), suggesting the potential efficacy of medications other than stimulants, or even psychotherapy, in preventing the development of substance-use disorders in individuals with ADHD. The association between substance-use disorders and different ADHD subtypes and symptoms may be mediated by different co-morbid disorders (Lee *et al.* 2011). Alternatively, different co-morbid conditions may predict substance-use disorders based on their shared risk factors (i.e. disruptive parental style, trauma history) (Lee *et al.* 2011). Future studies should seek to examine the pathways linking different conditions to the development of substance-use disorders associated with ADHD in order to tailor subjective preventive interventions. Because it is possible that our results from the general population may differ from those in clinical samples, which typically ascertain patients with greater severity, future work in clinical samples needs to determine if the association between ADHD and substance-use disorders can be accounted for by co-morbid conditions.

Individuals with ADHD were more likely than those without ADHD to engage in a variety of impulsive behaviors such as spending too much money and experiencing gambling problems (Faregh & Derevensky, 2011), reckless driving (Barkley *et al.* 1993; Fried *et al.* 2006) or quitting a job without knowing what to do next. Because the results held after adjusting for co-morbidity, they indicate that these impulsive behaviors are independently associated with ADHD. ADHD shares with impulse control disorders difficulties delaying rewards (Sonuga-Barke *et al.* 2003), as well as decision-making styles predisposing to risk-taking choices. The high rates of impulsive behaviors (Barkley, 2002), lack of attention (Barkley *et al.* 2002), or deficient inhibitory control among individuals with ADHD may also help explain their greater risk of trauma.

Our study found that less than half of individuals with ADHD ever sought treatment, and only about one-quarter ever received medication. These rates are slightly lower than those reported by the NCS-A, which focused on adolescents (Merikangas *et al.* 2010),

but consistent with the 12-month treatment rates from the National Comorbidity Survey Replication, which also focused on adults (Kessler *et al*. 2006). Overall, these results document important unmet needs for individuals with ADHD. An important, novel finding of our study was that the mean age among those who sought treatment was over 18 years. ADHD is traditionally thought of as a disorder of childhood and adolescence generally treated by child psychiatrists and psychologists (Faraone *et al*. 2006*a*). Because our findings suggest that symptoms of ADHD often persist beyond adolescence, they suggest a need for primary-care doctors and mental health professionals working with adults to become familiar with the diagnoses and current treatments for ADHD. Many of these professionals may be currently unfamiliar with the evidence-based assessment and treatment of patients with ADHD (Epstein *et al*. 2008).

Our study has the limitations common to most large-scale surveys. First, the diagnosis of ADHD was endorsed directly by the subject, without additional support from a caregiver, spouse or parent. Studies that rely on information provided by informants are associated with significantly higher ADHD prevalence rates than those based on information provided only by the patient (Polanczyk *et al*. 2007). This may help explain, at least partially, the lower ADHD prevalence of the present study compared with the 4.4% estimated prevalence of the National Comorbidity Survey Replication (Kessler *et al*. 2006). Second, ADHD was assessed only at wave 2. Therefore, longitudinal studies are needed to examine prospectively the course of ADHD in the general population. Third, because the NESARC sample included only civilian households, information was unavailable on individuals in prison, who have higher rates of ADHD (Rosler *et al*. 2004). Fourth, the NESARC did not include assessment of eating disorders, which have been associated with ADHD (Cortese *et al*. 2007). Fifth, the NESARC sample includes individuals with ADHD onset as late as at 18 years of age, which is not in strict agreement with the DSM-IV definition, although the group revising ADHD diagnostic criteria will probably increase the age at onset into adolescence (Kieling *et al*. 2010). Furthermore, age of onset may moderate some of the associations examined (e.g. with measures of quality of life and co-morbid disorders).

In summary, our results indicate that ADHD is common and associated with a broad range of psychiatric disorders, impulsive behaviors, and greater number of traumas, even after adjusting for additional co-morbidity. Less than half of individuals with ADHD seek treatment during their lifetime and when treatment is sought, it is often in late adolescence or early adulthood. Improving the diagnoses and treatment of ADHD may help decrease its burden on individuals, their families and society at large.

Note

Supplementary material accompanies this paper on the Journal's website (http://journals.cambridge.org/psm).

References

Able SL, Johnston JA, Adler LA, Swindle RW (2007). Functional and psychosocial impairment in adults with undiagnosed ADHD. *Psychological Medicine* **37**, 97–107.

Agresti A (2002). *Categorical Data Analysis*. John Wiley & Sons: Hoboken, NJ.

Anckarsater H, Stahlberg O, Larson T, Hakansson C, Jutblad SB, Niklasson L, Nyden A, Wentz E, Westergren S, Cloninger CR, Gillberg C, Rastam M (2006). The impact of ADHD and autism spectrum

disorders on temperament, character, and personality development. *American Journal of Psychiatry* 163, 1239–1244.

August GJ, Winters KC, Realmuto GM, Fahnhorst T, Botzet A, Lee S (2006). Prospective study of adolescent drug use among community samples of ADHD and non-ADHD participants. *Journal of the American Academy of Child and Adolescent Psychiatry* 45, 824–832.

Barkley RA (1997). Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychological Bulletin* 121, 65–94.

Barkley RA (2002). Major life activity and health outcomes associated with attention-deficit/hyperactivity disorder. *Journal of Clinical Psychiatry* 63 (Suppl. 12), 10–15.

Barkley RA, Fischer M, Edelbrock CS, Smallish L (1990). The adolescent outcome of hyperactive children diagnosed by research criteria: I. An 8-year prospective follow-up study. *Journal of the American Academy of Child and Adolescent Psychiatry* 29, 546–557.

Barkley RA, Fischer M, Smallish L, Fletcher K (2006). Young adult outcome of hyperactive children: adaptive functioning in major life activities. *Journal of the American Academy of Child and Adolescent Psychiatry* 45, 192–202.

Barkley RA, Guevremont DC, Anastopoulos AD, DuPaul GJ, Shelton TL (1993). Driving-related risks and outcomes of attention deficit hyperactivity disorder in adolescents and young adults: a 3- to 5-year follow-up survey. *Pediatrics* 92, 212–218.

Barkley RA, Murphy KR, Dupaul GI, Bush T (2002). Driving in young adults with attention deficit hyperactivity disorder: knowledge, performance, adverse outcomes, and the role of executive functioning. *Journal of the International Neuropsychological Society* 8, 655–672.

Bernstein DP, Cohen P, Skodol A, Bezirganian S, Brook JS (1996). Childhood antecedents of adolescent personality disorders. *American Journal of Psychiatry* 153, 907–913.

Biederman J, Faraone SV, Spencer TJ, Mick E, Monuteaux MC, Aleardi M (2006*a*). Functional impairments in adults with self-reports of diagnosed ADHD: a controlled study of 1001 adults in the community. *Journal of Clinical Psychiatry* 67, 524–540.

Biederman J, Makris N, Valera EM, Monuteaux MC, Goldstein JM, Buka S, Boriel DL, Bandyopadhyay S, Kennedy DN, Caviness VS, Bush G, Aleardi M, Hammerness P, Faraone SV, Seidman LJ (2008*a*). Towards further understanding of the co-morbidity between attention deficit hyperactivity disorder and bipolar disorder: a MRI study of brain volumes. *Psychological Medicine* 38, 1045–1056.

Biederman J, Mick E, Faraone SV, Burback M (2001). Patterns of remission and symptom decline in conduct disorder: a four-year prospective study of an ADHD sample. *Journal of the American Academy of Child and Adolescent Psychiatry* 40, 290–298.

Biederman J, Monuteaux MC, Mick E, Spencer T, Wilens TE, Silva JM, Snyder LE, Faraone SV (2006*b*). Young adult outcome of attention deficit hyperactivity disorder: a controlled 10-year follow-up study. *Psychological Medicine* 36, 167–179.

Biederman J, Newcorn J, Sprich S (1991). Comorbidity of attention deficit hyperactivity disorder with conduct, depressive, anxiety, and other disorders. *American Journal of Psychiatry* 148, 564–577.

Biederman J, Petty CR, Dolan C, Hughes S, Mick E, Monuteaux MC, Faraone SV (2008*b*). The long-term longitudinal course of oppositional defiant disorder and conduct disorder in ADHD boys: findings from a controlled 10-year prospective longitudinal follow-up study. *Psychological Medicine* 38, 1027–1036.

Burke JD, Loeber R, Lahey BB (2001). Which aspects of ADHD are associated with tobacco use in early adolescence? *Journal of Child Psychology and Psychiatry* 42, 493–502.

Candy M, Jones L, Williams R, Tookman A, King M (2008). Psychostimulants for depression. *Cochrane Database of Systematic Reviews*. Issue 2. Art. No.: CD006722. DOI: 10.1002/14651858.CD006722.

Canino G, Bravo M, Ramirez R, Febo VE, Rubio-Stipec M, Fernandez RL, Hasin D (1999). The Spanish Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS): reliability and concordance with clinical diagnoses in a Hispanic population. *Journal of Studies on Alcohol* 60, 790–799.

Centers for Disease Control and Prevention (2010). Increasing prevalence of parent-reported attention-deficit/hyperactivity disorder among children – United States, 2003 and 2007. *Morbidity and Mortality Weekly Report* 59, 1439–1443.

Chatterji S, Saunders JB, Vrasti R, Grant BF, Hasin D, Mager D (1997). Reliability of the alcohol and drug modules of the Alcohol Use Disorder and Associated Disabilities Interview Schedule – Alcohol/Drug-Revised (AUDADIS-ADR): an international comparison. *Drug and Alcohol Dependence* 47, 171–185.

Cohen S, Doyle WJ, Skoner DP, Rabin BS, Gwaltney Jr JM (1997). Social ties and susceptibility to the common cold. *Journal of the American Medical Association* 277, 1940–1944.

Cohen S, Williamson G (1988). Perceived stress in a probability sample of the United States. In *The Social Psychology of Health: Claremont Symposium on Applied Social Psychology* (ed. S. Spaceapam and S. Oskamp), pp. 31–67. Sage: Newbury Park, NJ.

Compton WM, Conway KP, Stinson FS, Colliver JD, Grant BF (2005). 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. *Journal of Clinical Psychiatry* 66, 677–685.

Cortese S, Bernardina BD, Mouren MC (2007). Attention-deficit/hyperactivity disorder (ADHD) and binge eating. *Nutrition Reviews* 65, 404–411.

Cottler LB, Grant BF, Blaine J, Mavreas V, Pull C, Hasin D, Compton WM, Rubio-Stipec M, Mager D (1997). Concordance of DSM-IV alcohol and drug use disorder criteria and diagnoses as measured by AUDADIS-ADR, CIDI and SCAN. *Drug and Alcohol Dependence* 47, 195–205.

Doyle AE, Wilens TE, Kwon A, Seidman LJ, Faraone SV, Fried R, Swezey A, Snyder L, Biederman J (2005). Neuropsychological functioning in youth with bipolar disorder. *Biological Psychiatry* 58, 540–548.

Elkins IJ, McGue M, Iacono WG (2007). Prospective effects of attention-deficit/hyperactivity disorder, conduct disorder, and sex on adolescent substance use and abuse. *Archives of General Psychiatry* **64**, 1145–1152.

Epstein JN, Langberg JM, Lichtenstein PK, Mainwaring BA, Luzader CP, Stark LJ (2008). Community-wide intervention to improve the attention-deficit/hyperactivity disorder assessment and treatment practices of community physicians. *Pediatrics* **122**, 19–27.

Faraone SV, Biederman J, Mick E (2006*a*). The age-dependent decline of attention deficit hyperactivity disorder: a meta-analysis of follow-up studies. *Psychological Medicine* **36**, 159–165.

Faraone SV, Biederman J, Monuteaux MC (2001). Attention deficit hyperactivity disorder with bipolar disorder in girls: further evidence for a familial subtype? *Journal of Affective Disorders* **64**, 19–26.

Faraone SV, Biederman J, Spencer T, Mick E, Murray K, Petty C, Adamson JJ, Monuteaux MC (2006*b*). Diagnosing adult attention deficit hyperactivity disorder: are late onset and subthreshold diagnoses valid? *American Journal of Psychiatry* **163**, 1720–1729.

Faraone SV, Biederman J, Spencer T, Wilens T, Seidman LJ, Mick E, Doyle AE (2000). Attention-deficit/hyperactivity disorder in adults: an overview. *Biological Psychiatry* **48**, 9–20.

Faraone SV, Kunwar A, Adamson J, Biederman J (2009). Personality traits among ADHD adults: implications of late-onset and subthreshold diagnoses. *Psychological Medicine* **39**, 685–693.

Faraone SV, Wilens T (2003). Does stimulant treatment lead to substance use disorders? *Journal of Clinical Psychiatry* **64** (Suppl. 11), 9–13.

Faregh N, Derevensky J (2011). Gambling behavior among adolescents with attention deficit/hyperactivity disorder. *Journal of Gambling Studies* **27**, 243–256.

Fayyad J, De Graaf R, Kessler R, Alonso J, Angermeyer M, Demyttenaere K, De Girolamo G, Haro JM, Karam EG, Lara C, Lepine JP, Ormel J, Posada-Villa J, Zaslavsky AM, Jin R (2007). Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *British Journal of Psychiatry* **190**, 402–409.

Fried R, Petty CR, Surman CB, Reimer B, Aleardi M, Martin JM, Coughlin JF, Biederman J (2006). Characterizing impaired driving in adults with attention-deficit/hyperactivity disorder: a controlled study. *Journal of Clinical Psychiatry* **67**, 567–574.

Froehlich TE, Lanphear BP, Epstein JN, Barbaresi WJ, Katusic SK, Kahn RS (2007). Prevalence, recognition, and treatment of attention-deficit/hyperactivity disorder in a national sample of US children. *Archives of Pediatrics and Adolescent Medicine* **161**, 857–864.

Grant B, Dawson D, Hasin D (2007*a*). The Alcohol Use Disorder and Associated Disabilities Interview Schedule–DSM-IV Version. National Institute of Alcohol Abuse and Alcoholism, Rockville, MD, 2001.

Grant B, Dawson D, Hasin D (2007*b*). The Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV Version, Wave 2. National Institute of Alcohol Abuse and Alcoholism, Rockville, MD, 2004.

Grant BF, Dawson DA, Stinson FS, Chou PS, Kay W, Pickering R (2003). The Alcohol Use Disorder and Associated Disabilities Interview Schedule-IV (AUDADIS-IV): reliability of alcohol consumption, tobacco use, family history of depression and psychiatric diagnostic modules in a general population sample. *Drug and Alcohol Dependence* **71**, 7–16.

Grant BF, Goldstein RB, Chou SP, Huang B, Stinson FS, Dawson DA, Saha TD, Smith SM, Pulay AJ, Pickering RP, Ruan WJ, Compton WM (2009). Sociodemographic and psychopathologic predictors of first incidence of DSM-IV substance use, mood and anxiety disorders: results from the Wave 2 National Epidemiologic Survey on Alcohol and Related Conditions. *Molecular Psychiatry* **14**, 1051–1066.

Grant BF, Harford TC, Dawson DA, Chou PS, Pickering RP (1995). The Alcohol Use Disorder and Associated Disabilities Interview schedule (AUDADIS): reliability of alcohol and drug modules in a general population sample. *Drug and Alcohol Dependence* **39**, 37–44.

Grant BF, Hasin DS, Blanco C, Stinson FS, Chou SP, Goldstein RB, Dawson DA, Smith S, Saha TD, Huang B (2005). The epidemiology of social anxiety disorder in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Clinical Psychiatry* **66**, 1351–1361.

Grant BF, Hasin DS, Stinson FS, Dawson DA, Chou SP, Ruan WJ, Pickering RP (2004*a*). Prevalence, correlates, and disability of personality disorders in the United States: results from the national epidemiologic survey on alcohol and related conditions. *Journal of Clinical Psychiatry* **65**, 948–958.

Grant BF, Hasin DS, Stinson FS, Dawson DA, Goldstein RB, Smith S, Huang B, Saha TD (2006). The epidemiology of DSM-IV panic disorder and agoraphobia in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Clinical Psychiatry* **67**, 363–374.

Grant BF, Stinson FS, Dawson DA, Chou SP, Ruan WJ, Pickering RP (2004*b*). Co-occurrence of 12-month alcohol and drug use disorders and personality disorders in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Archives of General Psychiatry* **61**, 361–368.

Hasin D, Carpenter KM, McCloud S, Smith M, Grant BF (1997). The alcohol use disorder and associated disabilities interview schedule (AUDADIS): reliability of alcohol and drug modules in a clinical sample. *Drug and Alcohol Dependence* **44**, 133–141.

Hasin D, Paykin A (1999). Alcohol dependence and abuse diagnoses: concurrent validity in a nationally representative sample. *Alcoholism, Clinical and Experimental Research* **23**, 144–150.

Hasin DS, Goodwin RD, Stinson FS, Grant BF (2005). Epidemiology of major depressive disorder: results from the National Epidemiologic Survey on Alcoholism and Related Conditions. *Archives of General Psychiatry* **62**, 1097–1106.

Hasin DS, Grant B, Endicott J (1990). The natural history of alcohol abuse: implications for definitions of alcohol use disorders. *American Journal of Psychiatry* **147**, 1537–1541.

Hasin DS, Schuckit MA, Martin CS, Grant BF, Bucholz KK, Helzer JE (2003). The validity of DSM-IV alcohol dependence: what do we know and what do we need to know? *Alcoholism, Clinical and Experimental Research* **27**, 244–252.

Jacob CP, Romanos J, Dempfle A, Heine M, Windemuth-Kieselbach C, Kruse A, Reif A, Walitza S, Romanos M, Strobel A, Brocke B, Schafer H, Schmidtke A, Boning J, Lesch KP (2007). Co-morbidity of adult attention-deficit/hyperactivity disorder with focus on personality traits and related disorders in a tertiary referral center. *European Archives of Psychiatry and Clinical Neuroscience* **257**, 309–317.

Kessler RC, Adler L, Barkley R, Biederman J, Conners CK, Demler O, Faraone SV, Greenhill LL, Howes MJ, Secnik K, Spencer T, Ustun TB, Walters EE, Zaslavsky AM (2006). The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *American Journal of Psychiatry* **163**, 716–723.

Kessler RC, Lane M, Stang PE, Van Brunt DL (2009). The prevalence and workplace costs of adult attention deficit hyperactivity disorder in a large manufacturing firm. *Psychological Medicine* **39**, 137–147.

Kieling C, Kieling RR, Rohde LA, Frick PJ, Moffitt T, Nigg JT, Tannock R, Castellanos FX (2010). The age at onset of attention deficit hyperactivity disorder. *American Journal of Psychiatry* **167**, 14–16.

Lara DR, Pinto O, Akiskal K, Akiskal HS (2006). Toward an integrative model of the spectrum of mood, behavioral and personality disorders based on fear and anger traits: I. Clinical implications. *Journal of Affective Disorders* **94**, 67–87.

Lee SS, Humphreys KL, Flory K, Liu R, Glass K (2011). Prospective association of childhood attention-deficit/hyperactivity disorder (ADHD) and substance use and abuse/dependence: a meta-analytic review. *Clinical Psychology Review* **31**, 328–341.

Leibson CL, Katusic SK, Barbaresi WJ, Ransom J, O'Brien PC (2001). Use and costs of medical care for children and adolescents with and without attention-deficit/hyperactivity disorder. *Journal of the American Medical Association* **285**, 60–66.

Mannuzza S, Klein RG, Bessler A, Malloy P, LaPadula M (1993). Adult outcome of hyperactive boys. Educational achievement, occupational rank, and psychiatric status. *Archives of General Psychiatry* **50**, 565–576.

Merikangas KR, He JP, Burstein M, Swanson SA, Avenevoli S, Cui L, Benjet C, Georgiades K, Swendsen J (2010). Lifetime prevalence of mental disorders in U.S. adolescents: results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). *Journal of the American Academy of Child and Adolescent Psychiatry* **49**, 980–989.

Merikangas KR, He JP, Burstein M, Swendsen J, Avenevoli S, Case B, Georgiades K, Heaton L, Swanson S, Olfson M (2011). Service utilization for lifetime mental disorders in U.S. adolescents: results of the National Comorbidity Survey–Adolescent Supplement (NCS-A). *Journal of the American Academy of Child and Adolescent Psychiatry* **50**, 32–45.

Meyers JL, Classi PM, Wietecha LA, Candrilli SD (2010). Economic burden and comorbidities of attention-deficit/hyperactivity disorder among pediatric patients hospitalized in the United States. *Child and Adolescent Psychiatry and Mental Health* **4**, 31.

Miller CJ, Flory JD, Miller SR, Harty SC, Newcorn JH, Halperin JM (2008). Childhood attention-deficit/hyperactivity disorder and the emergence of personality disorders in adolescence: a prospective follow-up study. *Journal of Clinical Psychiatry* **69**, 1477–1484.

Molina BS, Pelham WE, Gnagy EM, Thompson AL, Marshal MP (2007). Attention-deficit/hyperactivity disorder risk for heavy drinking and alcohol use disorder is age specific. *Alcoholism, Clinical and Experimental Research* **31**, 643–654.

Nierenberg AA, Miyahara S, Spencer T, Wisniewski SR, Otto MW, Simon N, Pollack MH, Ostacher MJ, Yan L, Siegel R, Sachs GS (2005). Clinical and diagnostic implications of lifetime attention-deficit/hyperactivity disorder comorbidity in adults with bipolar disorder: data from the first 1000 STEP-BD participants. *Biological Psychiatry* **57**, 1467–1473.

Petry NM, Stinson FS, Grant BF (2005). Comorbidity of DSM-IV pathological gambling and other psychiatric disorders: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Clinical Psychiatry* **66**, 564–574.

Polanczyk G, de Lima MS, Horta BL, Biederman J, Rohde LA (2007). The worldwide prevalence of ADHD: a systematic review and metaregression analysis. *American Journal of Psychiatry* **64**, 942–948.

Pull CB, Saunders JB, Mavreas V, Cottler LB, Grant BF, Hasin DS, Blaine J, Mager D, Ustun BT (1997). Concordance between ICD-10 alcohol and drug use disorder criteria and diagnoses as measured by the AUDADIS-ADR, CIDI and SCAN: results of a cross-national study. *Drug and Alcohol Dependence* **47**, 207–216.

Room R, Janca A, Bennett LA, Schmidt L, Sartorius N (1996). WHO cross-cultural applicability research on diagnosis and assessment of substance use disorders: an overview of methods and selected results. *Addiction* **91**, 199–220.

Rosler M, Retz W, Retz-Junginger P, Hengesch G, Schneider M, Supprian T, Schwitzgebel P, Pinhard K, Dovi-Akue N, Wender P, Thome J (2004). Prevalence of attention deficit-/hyperactivity disorder (ADHD) and comorbid disorders in young male prison inmates. *European Archives of Psychiatry and Clinical Neuroscience* **254**, 365–371.

Ruan WJ, Goldstein RB, Chou SP, Smith SM, Saha TD, Pickering RP, Dawson DA, Huang B, Stinson FS, Grant BF (2008). The alcohol use disorder and associated disabilities interview schedule-IV (AUDADIS-IV): reliability of new psychiatric diagnostic modules and risk

factors in a general population sample. *Drug and Alcohol Dependence* **92**, 27–36.

Singh MK, DelBello MP, Kowatch RA, Strakowski SM (2006). Co-occurrence of bipolar and attention-deficit hyperactivity disorders in children. *Bipolar Disorder* **8**, 710–720.

Sonuga-Barke EJ, Dalen L, Remington B (2003). Do executive deficits and delay aversion make independent contributions to preschool attention-deficit/hyperactivity disorder symptoms? *Journal of the American Academy of Child and Adolescent Psychiatry* **42**, 1335–1342.

Swanson JM (2003). Role of executive function in ADHD. *Journal of Clinical Psychiatry* **64** (Suppl. 14), 35–39.

Swensen A, Birnbaum HG, Ben HR, Greenberg P, Cremieux PY, Secnik K (2004). Incidence and costs of accidents among attention-deficit/

hyperactivity disorder patients. *Journal of Adolescent Health* **35**, 346–349.

Ware J, Kosinski M, Turner Bowker D, Gandek B (2002). *How to Score Version 2 of the SF-12 Health Survey*. Quality Metrics: Lincoln, RI.

Wilens TE, Faraone SV, Biederman J, Gunawardene S (2003). Does stimulant therapy of attention-deficit/ hyperactivity disorder beget later substance abuse? A meta-analytic review of the literature. *Pediatrics* **111**, 179–185.

Williams RB, Marchuk DA, Gadde KM, Barefoot JC, Grichnik K, Helms MJ, Kuhn CM, Lewis JG, Schanberg SM, Stafford-Smith M, Suarez EC, Clary GL, Svenson IK, Siegler IC (2003). Serotonin-related gene polymorphisms and central nervous system serotonin function. *Neuropsychopharmacology* **28**, 533–541.