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Association of Fluid Intelligence and Psychiatric Disorders in a Population-Representative Sample of US Adolescents

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IMPORTANCE Despite long-standing interest in the association of psychiatric disorders with intelligence, few population-based studies of psychiatric disorders have assessed intelligence.

OBJECTIVE To investigate the association of fluid intelligence with past-year and lifetime psychiatric disorders, disorder age at onset, and disorder severity in a nationally representative sample of US adolescents.

DESIGN, SETTING, AND PARTICIPANTS National sample of adolescents ascertained from schools and households from the National Comorbidity Survey Replication–Adolescent Supplement, collected 2001 through 2004. Face-to-face household interviews with adolescents and questionnaires from parents were obtained. The data were analyzed from February to December 2016. *DSM-IV* mental disorders were assessed with the World Health Organization Composite International Diagnostic Interview, and included a broad range of fear, distress, behavior, substance use, and other disorders. Disorder severity was measured with the Sheehan Disability Scale.

MAIN OUTCOMES AND MEASURES Fluid IQ measured with the Kaufman Brief Intelligence Test, normed within the sample by 6-month age groups.

RESULTS The sample included 10 073 adolescents (mean [SD] age, 15.2 [1.50] years; 49.0% female) with valid data on fluid intelligence. Lower mean (SE) IQ was observed among adolescents with past-year bipolar disorder (94.2 [1.69]; $P = .004$), attention-deficit/hyperactivity disorder (96.3 [0.91]; $P = .002$), oppositional defiant disorder (97.3 [0.66]; $P = .007$), conduct disorder (97.1 [0.82]; $P = .02$), substance use disorders (alcohol abuse, 96.5 [0.67]; $P < .001$; drug abuse, 97.6 [0.64]; $P = .02$), and specific phobia (97.1 [0.39]; $P = .001$) after adjustment for a wide range of potential confounders. Intelligence was not associated with posttraumatic stress disorder, eating disorders, and anxiety disorders other than specific phobia, and was positively associated with past-year major depression (mean [SE], 100 [0.5]; $P = .01$). Associations of fluid intelligence with lifetime disorders that had remitted were attenuated compared with past-year disorders, with the exception of separation anxiety disorder. Multiple past-year disorders had a larger proportion of adolescents less than 1 SD below the mean IQ range than those without a disorder. Across disorders, higher disorder severity was associated with lower fluid intelligence. For example, among adolescents with specific phobia, those with severe disorder had a mean (SE) of 4.4 (0.72) points lower IQ than those without severe disorder ($P < .001$), and those with alcohol abuse had a mean (SE) of 5.6 (1.2) points lower IQ than those without severe disorder ($P < .001$).

CONCLUSIONS AND RELEVANCE Numerous psychiatric disorders were associated with reductions in fluid intelligence; associations were generally small in magnitude. Stronger associations of current than past disorders with intelligence suggest that active symptoms of psychiatric disorders interfere with cognitive functioning. Early identification and treatment of children with mental disorders in school settings is critical to promote academic achievement and long-term success.

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Supplemental content

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Many psychiatric disorders involve disruptions in cognitive functioning. These encompass attention, memory, language processing, and executive functions.[1-7] Given these patterns, there has been longstanding interest in the association of psychiatric disorders with intelligence.

Intelligence is a complex construct that has inspired a voluminous literature regarding its definition, measurement, and implications. Modern conceptualizations typically acknowledge a general intelligence factor (often referred to as *g*) as well as narrower, more specific abilities (eg, processing speed, visuospatial reasoning, working memory).[8(pp34-52),9] The specific abilities encompassing intelligence continue to be debated,[10,11] but a widely accepted model of cognitive abilities distinguishes between fluid and crystallized intelligence as 2 primary components.[12] Fluid intelligence reflects reasoning and the ability to solve novel problems; crystallized intelligence reflects knowledge and skills that are the result of experience and learning.[13(pp87-120)] Analysis of the structure of cognitive abilities underlying intelligence suggests that fluid reasoning loads most strongly onto the generalized intelligence factor[14(pp115-142)] and is indistinguishable from *g*.[15]

To what extent are psychiatric disorders associated with fluid intelligence? Modern examination of intelligence and psychiatric disorders has been primarily limited to relatively small, clinical samples. Poor performance on intelligence tests has been documented in individuals with attention-deficit/hyperactivity disorder (ADHD),[16-20] conduct disorder and oppositional defiant disorder (ODD),[21-28] and posttraumatic stress disorder (PTSD).[5,6,29] Associations of intelligence with depression and anxiety disorders are inconsistent across studies.[21,30-33] The degree to which intelligence is associated with most psychiatric disorders remains an open question, given inherent biases in studies composed of clinical samples and the lack of population-based studies that measure intelligence.

One important question is whether associations of intelligence with psychiatric disorders reflect that low intelligence is a risk factor for psychiatric disorders or that changes in cognitive functioning are a consequence of developing a psychiatric disorder. While prospective data are optimal to adjudicate between these possibilities, to date such evidence exists only for disruptive behavior problems, indicating that low intelligence prospectively predicts life-course-persistent antisocial behavior, particularly for males.[24,34] If low intelligence associated with other psychiatric disorders reflects a consequence rather than risk factor for psychiatric disorders, we would expect associations of intelligence to be stronger among individuals who currently meet criteria for a disorder as compared with those who have met criteria in the past but do not currently. In contrast, if low IQ is a risk factor for psychiatric disorders, we should observe associations of similar magnitude for both current and past disorders with IQ.

In the present report, we investigate the association of fluid intelligence with a wide range of psychiatric disorders in a nationally representative sample of US adolescents. We present intelligence estimates for adolescents who currently meet criteria for fear, distress, behavior, and substance use disorders, as well as for those who met criteria in the past but not currently, and further examine associations between fluid intelligence and psychiatric disorders by age at onset and severity of disorder.

Key Points

Question What is the association between fluid intelligence and psychiatric disorders among adolescents?

Findings Fluid intelligence was lower among adolescents who met criteria for the following psychiatric disorders at the time of intelligence testing: bipolar disorder, attention-deficit/hyperactivity disorder, oppositional disorder, conduct disorder, substance use disorders, and specific phobia. Those with severe disorders had the strongest association with IQ.

Meaning Active symptoms of psychiatric disorders may interfere with cognitive functioning, and early identification and treatment of children with mental disorders in school settings are critical to promote academic achievement and long-term success.

Methods

Sample

Data were drawn from the National Comorbidity Survey Adolescent Supplement (NCS-A), a nationally representative, face-to-face survey of 13- to 18-year-olds sampled from the continental United States in 2001 to 2004.[35] The sample was selected through a dual-frame design, with adolescents recruited from both schools and households.[36-38] The sample included 10 148 English-speaking adolescents, 10 073 (99.3%) with valid outcome data that were analyzed in the present study. Sample weights were created based on the 2000 Census. More details on NCS-A sampling and weighting procedures are available elsewhere.[37-39]

Written informed consent from adults and assent from adolescents were obtained. Each participant received $50 for participation. The Human Subjects Committees of Harvard Medical School and the University of Michigan approved recruitment and consent procedures; the Institutional Review Board of Columbia University approved the present analysis.

Measures

Kaufman Brief Intelligence Test

Adolescents completed the fluid intelligence portion of the Kaufman Brief Intelligence Test (K-BIT),[40,41] which assesses fluid reasoning with 48 items. This task uses abstract matrices similar to those developed by Raven,[42] which are prototypical measures of fluid reasoning and general intelligence.[43] The K-BIT Matrices test involves a series of progressively more challenging items. Test administration was discontinued when an adolescent responded incorrectly to all items in a set (sets include 5 items initially and 4 items for the last 2 sets). The K-BIT (and its revision, the KBIT-2) is widely used among children,[40,44-50] adolescents,[51-53] and adults[54-56]; the items on the K-BIT have well-documented reliability across these

samples, and results across samples correlate with reassessments, suggesting that the interpretation of results across samples has strong validity. Hereafter, we refer to fluid intelligence on the K-BIT as IQ.

The K-BIT norms were created specifically for the NCS-A by the test developer (A.S.K.), as the NCS-A is considerably larger than the original normative sample for the K-BIT; in addition, the K-BIT was published in 1990, so its norms were outdated. Raw scores were generated based on the K-BIT manual for 91.3% of tests, which were administered and scored exactly as prescribed. An additional 8.4% of tests could be scored despite deviations in test administration. For example, some respondents were only asked the most difficult item in each set. In these cases, the K-BIT score was imputed based on the number of correct items and the level at which they met discontinuation criteria. A small percentage of cases (0.3%) were excluded because of invalid test administration. No items were scored for 397 participants; their score was imputed as the mean of the 6-month age group. Scores were normed within 6-month age groups to a mean of 100 and standard deviation of 15. The K-BIT Matrices test demonstrated good internal consistency (Cronbach α = .90), comparable to the value of 0.88 reported in the K-BIT manual for ages 13 to 19 years.[40] Exploratory factor analyses indicated that a 1-factor model adequately fit the data.

Psychiatric Diagnoses

An adolescent version of the Composite International Diagnostic Interview for DSM-IV was used to assess psychiatric disorders.[35,36,39] Disorders were grouped into 5 empirically defined clusters[57]: (1) fear disorders (specific phobia, agoraphobia, social phobia, panic disorder); (2) distress disorders (separation anxiety disorder, PTSD, major depressive episode/dysthymia, generalized anxiety disorder); (3) behavior disorders (ADHD, ODD, conduct disorder, eating disorders); (4) substance use disorders (alcohol and drug abuse, with or without dependence); and (5) bipolar disorder. Attention-deficit/hyperactivity disorder is based on parent-report only. Oppositional defiant disorder and depression combined parent- and child-report of symptoms using an "or" rule.[58,59] Children and parents who endorsed symptoms of each psychiatric disorder were asked about the age symptoms began. Clinical reappraisal of children comparing Composite International Diagnostic Interview diagnoses to those assessed with a clinical interview showed good concordance.[39]

Disorder Severity

Respondents who met criteria for a diagnosis completed the Sheehan Disability Scales[60] assessing the extent to which symptoms of the disorder interfered with home life, school or work, family relationships, and social life on a 0-to-10 Likert scale. Consistent with prior research,[61,62] severe impairment was operationalized as a score of 7 or higher in any 1 of the 4 domains.

Covariates

Parental education (less than high school, high school graduate, some college, college degree or more), parental income (<1.5, 1.5-3.0, 3.1-6.0, >6.0 times the poverty level), race/ethnicity (non-Hispanic white, non-Hispanic black, Asian, other), age, nativity (US born vs not), number of siblings, and birth order were adjusted for in all models. The mean (SE) K-BIT score when all covariates were at their reference level was 102.2 (1.75). In addition, lifetime disorders other than the focal disorder being examined were adjusted for using dichotomous indicators of any fear disorder, any distress disorder, any behavior disorder, any substance use disorder, and bipolar disorder.

Statistical Analysis

We examined mean levels of fluid intelligence among those meeting criteria for past-year and lifetime psychiatric disorders using linear regression. Effect sizes were estimated using the Cohen *d*. We examined the distribution of low (<1 SD below the mean), average (within 1 SD of the mean), and high (>1 SD above the mean) fluid intelligence across disorder groups, and estimated associations with past-year and lifetime psychiatric disorders using generalized logit models. Sample sizes for each disorder group (past year, lifetime but not current, and by age at onset), as well as the no-disorder group, are provided in **Table 1**; cells with insufficient sample size (<10) were not analyzed. In eTable 1 in the Supplement, we provide cell sizes for those with a current disorder that began in the past year and for those with a current disorder that began prior to the past year. Finally, we examined whether sex and parent income moderated the associations of mental disorders with fluid intelligence and found no evidence of effect modification. All analyses were estimated with survey design weights; standard errors, estimated with Taylor series linearization implemented in SAS, version 9.4 for Windows (IBM). A false discovery rate correction for multiple comparisons was applied to all analyses given the large number of statistical tests.[63]

Results

Fluid Intelligence and Past-Year Psychiatric Disorders

Table 2 presents adjusted means and standardized β for the association between fluid intelligence and past-year psychiatric disorder, as well as lifetime (but not past-year) disorder (eTable 2 in the Supplement presents unadjusted means). Past-year bipolar disorder was associated with the lowest average fluid intelligence (mean [SE], 94.2 [1.69]; $P = .004$) followed by behavior disorders, with ADHD (mean [SE], 96.3 [0.91]; $P = .002$), conduct disorder (mean [SE], 97.1 [0.82]; $P = .02$), and ODD (mean [SE], 97.3 [0.66]; $P = .007$) each falling significantly below the population mean. Past-year substance use disorders were also associated with low IQ (mean [SE] for alcohol abuse, 96.5 [0.67]; $P < .001$; drug abuse, 97.6 [0.64]; $P = .02$). Of the fear and distress disorders, only past-year specific phobia (mean [SE], 97.1 [0.39]; $P = .001$) was associated with low fluid intelligence. Past-year major depression was associated with slightly higher fluid intelligence (mean [SE], 100 [0.5]; $P = .01$) compared with those with no distress disorders. Fluid intelligence decreased as the number of current

Table 1. Sample Sizes for Each Disorder Group Used in the Analysis

Disorder	Past 12 mo Disorders, All Ages				Prior to Past 1 mo but Not Current Disorder, All Ages				Age at Onset, y		
	Total (N = 10 073)	Fluid Intelligence			Total (N = 10 073)	Fluid Intelligence					
		Low	Middle	High		Low	Middle	High	4-8	9-12	13-17
Fear disorders											
Specific phobia	1621	365	1058	198	357	58	253	46	1628	315	35
Agoraphobia	217	55	126	36	73	18	45	10	125	117	48
Social phobia	1273	256	848	169	147	35	89	23	556	640	224
Panic disorder	191	35	136	20	44	12	28	4	78	86	71
No lifetime fear disorder	7164	1249	4824	1091	7164	1249	4824	1091	...	...	...
Distress disorders											
Separation anxiety disorder	162	42	107	13	44	142	387	72	484	187	92
Posttraumatic stress disorder	288	50	194	44	95	24	59	12	107	102	174
Major depressive episode/dysthymia	949	182	638	129	408	70	278	60	207	495	655
Generalized anxiety disorder	176	41	111	24	121	25	80	16	66	98	133
No lifetime distress disorder	4473	818	3036	619	4473	818	3036	619	...	...	...
Behavior disorders											
Attention-deficit/hyperactivity disorder	247	70	149	28	183	45	121	17	327	78	23
Oppositional defiant disorder	488	113	328	47	554	117	352	85	294	430	318
Conduct disorder	333	90	216	27	249	65	158	26	184	384	297
Eating disorders	311	76	195	40	241	51	159	31	42	194	316
No lifetime behavior disorder	8103	1401	5483	1219	8103	1401	5483	1219	...	...	...
Substance use disorders											
Alcohol abuse	504	110	344	50	170	36	116	18	4	51	619
Drug abuse	548	107	376	65	328	64	234	30	4	81	791
No lifetime substance use disorder	8912	1620	5951	1341	8912	1620	5951	1341	...	...	...
Other disorders											
Bipolar disorder	113	32	69	12	22	6	15	1	20	47	68
No lifetime bipolar disorder	8831	1591	5905	1335	8831	1591	5905	1335	...	...	...

Abbreviation: Ellipses, not applicable.

disorders increased. Effect sizes for these associations are provided in eTable 3 in the Supplement. In eTable 4 in the Supplement, we separate current disorders into those that began in the past 12 months vs those that began earlier. There were no significant associations between IQ and psychiatric disorders for disorders that began in the past 12 months (however, sample sizes were small).

Fluid Intelligence and Lifetime Psychiatric Disorders

Adjusted means of fluid intelligence for those meeting criteria for a lifetime but not current disorder are in Table 2 (eTable 5 in the Supplement presents adjusted means for lifetime disorders, regardless of past-year status). Associations with fluid intelligence were uniformly attenuated compared with past-year disorders, with 1 exception: past separation anxiety disorder was associated with low IQ (mean [SE], 97.2 [0.61]; $P = .01$). No association was observed between fluid intelligence and number of lifetime disorders.

Distribution of Fluid Intelligence by Psychiatric Disorder

Table 3 describes the proportion of adolescents with high, medium, and low IQ by psychiatric disorder status. Adjusted multinomial odds ratios for these distributions are in **Table 4**. Multiple past-year disorders had a larger proportion of adolescents in the low IQ range than those without a disorder, including bipolar disorder, all behavior disorders, alcohol abuse, separation anxiety disorder, specific phobia, and agoraphobia. The pattern was largely similar for lifetime but not past-year disorders, but was significant only for separation anxiety disorder, conduct disorder, and drug abuse. In eTable 6 in the Supplement, we provide distributions of high, middle, and low IQ separating current disorders into those beginning in the past year vs earlier.

Fluid Intelligence by Psychiatric Disorder Severity

Table 5 shows associations between disorder severity and fluid intelligence. Greater disorder severity was associated with lower IQ across a wide range of disorders including all fear disorders, generalized anxiety disorder, ODD, eating disorders, alcohol abuse, and bipolar disorder.

Fluid Intelligence by Psychiatric Disorder Age at Onset

eTables 7 to 9 in the Supplement provide unadjusted mean differences in IQ, IQ distributions, and adjusted associations as a function of disorder age at onset. Few differences emerged by disorder age at onset.

Table 2. Variation in Fluid Intelligence[a] as a Function of Psychiatric Disorders in a Population-Representative Sample of 10 073 Adolescents

	Past 12 mo Disorders			Lifetime, but Not Past 12 mo Disorders		
Disorder	IQ, Mean (SE)	β	*P* Value[b]	IQ, Mean (SE)	β	*P* Value[b]
Fear disorders						
Specific phobia	97.1 (0.39)	−1.31	.001	99.1 (0.76)	−0.11	.89
Agoraphobia	98.8 (0.98)	−0.45	.65	98.2 (1.66)	−1.12	.50
Social phobia	98.6 (0.43)	−0.51	.25	97.4 (1.17)	−1.67	.15
Panic disorder	98.4 (1.04)	−0.90	.39	97 (2.10)	−2.34	.27
None	99.1 (0.22)			99.1 (0.22)		
Distress disorders						
Separation anxiety disorder	96.8 (1.13)	−1.89	.10	97.2 (0.61)	−1.56	.01
Posttraumatic stress disorder[c]	99.7 (0.88)	0.94	.29	96.8 (1.46)	−1.92	.19
Major depressive episode/dysthymia	100 (0.50)	1.32	.01	99.7 (0.72)	1.07	.14
Generalized anxiety disorder	97.6 (1.11)	−1.12	.32	96.7 (1.30)	−2.05	.12
None	98.8 (0.25)			98.8 (0.25)		
Behavior disorders						
Attention-deficit/hyperactivity disorder	96.3 (0.91)	−2.91	.002	97.2 (1.05)	−2.02	.05
Oppositional defiant disorder	97.3 (0.66)	−1.81	.007	98.6 (0.62)	−0.50	.42
Conduct disorder	97.1 (0.82)	−1.94	.02	97.6 (0.91)	−1.44	.12
Eating disorders	97.9 (0.82)	−1.28	.12	98.4 (0.91)	−0.81	.37
None	99.1 (0.21)			99.1 (0.21)		
Substance use disorders						
Alcohol abuse	96.5 (0.67)	−2.60	<.001	97.6 (1.10)	−1.49	.18
Drug abuse	97.6 (0.64)	−1.44	.02	97.9 (0.81)	−1.18	.14
None	99.1 (0.21)			99.1 (0.21)		
Other disorders						
Bipolar disorder	94.2 (1.69)	−4.97	.004	98.3 (3.05)	−0.90	.77
No bipolar disorder	99.2 (0.21)			99.2 (0.21)		
Total No. of disorders						
1	98.2 (0.42)	−0.99	.02	99.7 (0.51)	0.88	.09
2	98.2 (0.54)	−0.97	.08	97.5 (1.08)	−1.25	.24
≥3	97.8 (0.43)	−1.36	.002	95.9 (1.76)	−2.93	.10
0	98.8 (0.21)			98.8 (0.21)		

[a] Scores were first normed in the sample by 6-month age groups for mean of 100 and SD of 15. Predicted means were estimated from linear regression models controlling for parental education, race/ethnicity, age, nativity (US born vs not), number of siblings, birth order, and nonfocal disorder groups.

[b] *P* values are for the comparison between each disorder category and a reference group of no disorder in that category. For example, mean IQ among those with specific phobia is compared with those with no fear disorder. All *P* values are false discovery rate adjusted.

[c] Among those with a lifetime exposure to a potentially traumatic event (N = 6160 [61.2% of the total sample]).

Discussion

To our knowledge, the present study represents the first population-based study examining association of fluid intelligence with psychiatric disorders in US youth. Our analysis generates 3 central conclusions.

First, past-year bipolar disorder, disruptive behavior disorders, and substance abuse were most strongly associated with low fluid intelligence. Lower IQ has been documented among youths with these disorders in clinical samples.[16-28,64,65] Our population estimates indicate that mean IQ was approximately one-third of a standard deviation (approximately 5 points) lower than average among youths with bipolar disorder, behavior disorders, and substance abuse.

The associations of behavior disorders with IQ were stronger for current disorders than for disorders that had remitted. This could reflect either that behavior disorder symptomatology interferes with cognitive functioning, producing low IQ primarily for those with active symptoms, or that low IQ is observed among adolescents with behavior disorders that are chronic and involve more severe symptoms. Few adolescents had behavior disorder onsets in the past year, indicating that current disorders primarily reflect chronic cases, and low IQ was most consistently observed for adolescents with the most severe disorders. Prospective studies have documented low IQ as a precursor of behavior disorder onset.[24,34] Our finding that adolescents with more chronic, severe forms of behavior disorder are most likely to have lower IQ is in line with these findings, although it does not rule out the possibility that IQ changes after onset of disorder explain at least a portion of the observed associations.

Second, most fear and distress disorders were not associated with low IQ, with the exception of specific phobia and

Table 3. Proportion of Adolescents With Fluid Intelligence in Low, Middle, and High Range as a Function of Psychiatric Disorders in a Population-Representative Sample of 10 073 Adolescents (Unadjusted)

Disorder	%[a]							
	Past 12 mo Disorders				Prior to Past 12 mo but Not Current Disorder			
	Low (n = 1852)	Middle (n = 6757)	High (n = 1464)	*P* Value[b]	Low (n = 1852)	Middle (n = 6757)	High (n = 1464)	*P* Value[b]
Fear disorders								
Specific phobia	22.5	65.3	12.2	.001	16.3	70.9	12.9	.36
Agoraphobia	25.4	58.1	16.6	.03	24.7	61.6	13.7	.36
Social phobia	20.1	66.6	13.3	.21	23.8	60.5	15.7	.36
Panic disorder	18.3	71.2	10.5	.26	27.3	63.6	9.1	.36
Any fear disorder	21.1	66.2	12.8	.001	20.7	66.5	12.8	.005
No fear disorder	17.4	67.3	15.2		17.4	67.3	15.2	
Distress disorders								
Separation anxiety disorder	25.9	66.1	8.0	.02	23.6	64.4	12.0	.03
Posttraumatic stress disorder[c]	17.4	67.4	15.3	.37	25.3	62.1	12.6	.61
Major depressive episode/dysthymia	19.2	67.2	13.6	.61	17.2	68.1	14.7	.84
Generalized anxiety disorder	23.3	63.1	13.6	.37	20.7	66.1	13.2	.84
Any distress disorder	18.1	67.1	14.7	.37	20.5	66.1	13.4	.06
No distress disorder	17.8	67.4	14.8		17.8	67.4	14.8	
Behavior disorders								
Attention-deficit/hyperactivity disorder	28.3	60.3	11.3	.001	24.6	66.1	9.3	.053
Oppositional defiant disorder	23.2	67.2	9.6	.001	21.1	63.5	15.3	.20
Conduct disorder	27.0	64.9	8.1	.001	26.1	63.5	10.4	.01
Eating disorders	24.4	62.7	12.9	.02	21.2	66.0	12.9	.42
Any behavior disorder	24.6	64.6	10.8	.001	22.9	64.7	12.4	.01
No behavior disorder	17.3	67.7	15.0		17.3	67.7	15.0	
Substance use disorders								
Alcohol abuse	21.8	68.3	9.9	.01	21.2	68.2	10.6	.23
Drug abuse	19.5	68.6	11.9	.18	19.5	71.3	9.2	.04
Any substance disorder	20.5	68.6	10.9	.01	20.0	69.4	10.6	.009
No substance use disorder	18.2	66.8	15.1		18.2	66.8	15.1	
Other disorders								
Bipolar disorder	28.3	61.0	10.6	.02	27.3	68.2	4.6	.29
No bipolar disorder	18.3	67.2	14.6		18.3	67.2	14.6	
Total No. of disorders								
1	19.1	68.3	12.5	.64	16.9	67.6	14.6	.76
2	16.2	69.9	13.9	.64	22.5	68.8	8.7	.76
≥3	22.5	66.1	11.5	.22	25.4	65.1	9.5	.76
Any	20.1	67.6	12.3	.22	18.3	67.6	14.0	.88
0	18.4	67.0	14.6		18.4	67.0	14.6	

[a] Numerators for all percentages are provided in Table 1.

[b] *P* values are for χ^2 comparisons between each disorder category and a reference group of no disorder in that category. For example, mean IQ among those with specific phobia is compared with those with no fear disorder. All *P* values are false discovery rate adjusted.

[c] Among those with a lifetime exposure to a potentially traumatic event (N = 6160 [61.2% of the total sample]).

separation anxiety disorder, which are among the earliest-onset fear and distress disorders.[57] Specific phobia, in particular, has been shown to explain a meaningful proportion of later-onset mental disorders.[66] These disorders thus appear to represent an early liability to internalizing psychiatric disorders; our results suggest that this liability may be associated with low IQ. Past-year specific phobia was associated with IQ, but lifetime disorder was not. Specific phobia is often a persistent condition,[66,67] and this pattern could reflect an association of low IQ with persistent, but not transient, phobia. Alternatively, it may be that current symptoms of phobia interfered with performance due to test anxiety. In contrast, separation anxiety was related to IQ when experienced prior to the past year but not currently. Given the high prevalence of these disorders,[66,68] greater research is needed on neuropsychological correlates of early-onset fear and distress disorders.

We found no association between PTSD and IQ. This diverges from prior research, which has consistently demonstrated that low IQ is a risk factor for PTSD onset after trauma.[29,69-71] However, most prior work has been conducted

Table 4. Multinomial Logistic Regression Models Measuring the Odds of High, Medium, or Low Fluid Intelligence by Age at Onset of Each Disorder[a]

	Odds Ratio (95% CI)[b] (N = 10 073)			
	Past 12 mo and Lifetime Disorders		Lifetime but Not Past 12 mo Disorder	
Disorder	Low	Middle	Low	Middle
Fear disorders				
Specific phobia	1.20 (1.0-1.5)	1.06 (0.9-1.3)	1.08 (0.7-1.6)	1.21 (0.9-1.7)
Agoraphobia	0.70 (0.4-1.1)	0.59 (0.4-0.9)	1.22 (0.5-2.7)	0.90 (0.4-1.8)
Social phobia	1.02 (0.8-1.3)	1.02 (0.8-1.2)	1.17 (0.7-2.0)	0.79 (0.5-1.3)
Panic disorder	1.11 (0.6-2.0)	1.25 (0.8-2.0)	2.14 (0.7-6.9)	1.45 (0.5-4.2)
Distress disorders				
Separation anxiety disorder	1.70 (0.9-3.3)	1.46 (0.8-2.7)	1.38 (1.0-1.9)	1.04 (0.8-1.4)
Posttraumatic stress disorder[c]	0.73 (0.5-1.1)	0.81 (0.6-1.1)	1.21 (0.6-2.5)	0.93 (0.5-1.8)
Major depressive episode/dysthymia	0.86 (0.7-1.1)	0.94 (0.8-1.2)	0.81 (0.6-1.2)	0.93 (0.7-1.2)
Generalized anxiety disorder	1.40 (0.8-2.4)	0.92 (0.6-1.5)	1.35 (0.7-2.6)	1.05 (0.6-1.8)
Behavior disorders				
Attention-deficit/hyperactivity disorder	1.79 (1.1-2.9)	1.06 (0.7-1.6)	1.62 (0.9-2.9)	1.33 (0.8-2.2)
Oppositional defiant disorder	1.52 (1.1-2.2)	1.26 (0.9-1.7)	1.06 (0.8-1.4)	0.85 (0.7-1.1)
Conduct disorder	1.69 (1.1-2.7)	1.23 (0.8-1.9)	1.38 (0.8-2.3)	1.05 (0.7-1.6)
Eating disorders	1.10 (0.7-1.7)	0.90 (0.6-1.3)	1.11 (0.7-1.8)	0.99 (0.7-1.5)
Substance use disorders				
Alcohol abuse	1.98 (1.4-2.9)	1.69 (1.2-2.3)	1.59 (0.9-2.9)	1.47 (0.9-2.5)
Drug abuse	1.39 (1.0-2.0)	1.36 (1.0-1.8)	1.72 (1.1-2.7)	1.72 (1.2-2.6)
Other disorders				
Bipolar disorder	2.30 (0.9-5.9)	1.20 (0.5-3.0)	3.76 (0.4-34.6)	3.10 (0.4-25.0)
Total No. of disorders				
1	1.11 (0.9-1.4)	1.12 (0.9-1.3)	0.87 (0.7-1.1)	0.94 (0.8-1.2)
2	1.08 (0.8-1.4)	1.10 (0.9-1.4)	1.90 (1.0-3.5)	1.63 (0.9-2.8)
≥3	1.42 (1.1-1.8)	1.19 (1.0-1.5)	2.20 (0.8-5.8)	1.51 (0.6-3.6)

[a] Models were adjusted for parental education, race/ethnicity, age, nativity (US born vs not), number of siblings, birth order, and nonfocal disorder groups.

[b] In comparison with adolescents with high fluid intelligence as the reference group.

[c] Among those with a lifetime exposure to a potentially traumatic event (n = 6160 [61.2% of the total sample]).

in military samples returning from active combat. Military samples are not representative of the general population, nor are they composed of adolescents in our age range. Furthermore, considerable disagreement exists regarding the validity of the association between IQ and PTSD in military samples[72,73] because IQ may select service members into degree of combat exposure. Our results are not consistent with theories that low IQ is a vulnerability factor for the development of PTSD after trauma, at least among youth.

Third, past-year depression was associated with slightly higher mean IQ, although we should note that the effect size was small, but statistically significant due to the high prevalence of major depression in adolescence.[74] It has frequently been argued that children with very high IQ may exhibit higher rates of bipolar disorder,[75-77] as well as social withdrawal and avoidance.[78] We find no support for a link between high IQ and bipolar disorder at the population level, but the observed association with depression warrants further exploration because children with higher IQ may present with unique mental health concerns.

Intelligence quotient was ascertained at the time of the interview, precluding an assessment of the reciprocal relation between mental disorders and cognitive ability. Although some of the variance in IQ is stable over early development,[79,80] there is also substantial plasticity in IQ.[42,79,81,82] While we cannot establish temporality, the associations of IQ with past-year disorders were consistently stronger than for lifetime disorders that had remitted. Although this could reflect a stronger influence of current symptoms on IQ than the reverse, the most plausible interpretation of this pattern is that current symptoms reflect the most persistent disorders, suggesting that lower IQ is associated with chronic psychiatric disorders rather than transient disorders. Future studies should examine this possibility, as measures of disorder duration were substantially co-linear with age at onset, given the young age of NCS-A participants.

Taken together, these findings indicate that children and adolescents with psychiatric disorders face challenges in learning, memory, and reasoning. This underscores the need for early identification of children with mental disorders to provide academic accommodations and treatment to promote long-term success. Although accommodations are often made for children with ADHD and behavior problems, our findings suggest that children with early-onset fear and distress disorders and adolescents with substance use disorders may also require individualized education plans and support. These findings also provide fruitful hypotheses for future research. For example, children with psychiatric disorders face lower educational and

Table 5. Variation in Fluid Intelligence[a] as a Function of Severity of Psychiatric Disorders in a Population-Representative Sample of Adolescents

Disorder	IQ, Mean (SE) Disorder Severity (N = 10 073) Low	High	β	*P* Value[b]
Fear disorders				
Specific phobia	99.0 (0.20)	94.5 (0.72)	−4.44	<.001
Agoraphobia	98.9 (0.20)	95.2 (1.04)	−3.71	<.001
Social phobia	98.9 (0.20)	96.9 (0.62)	−2.05	.001
Panic disorder	98.9 (0.20)	96.3 (1.03)	−2.58	.01
Distress disorders				
Separation anxiety disorder	98.8 (0.20)	96.4 (1.75)	−2.48	.16
Posttraumatic stress disorder[c]	98.8 (0.20)	99.2 (1.21)	0.38	.75
Major depressive episode/dysthymia	98.8 (0.20)	99.6 (0.60)	0.82	.18
Generalized anxiety disorder	98.9 (0.20)	96.3 (0.92)	−2.55	.006
Behavior disorders				
Attention-deficit/hyperactivity disorder	98.8 (0.20)	99.2 (2.36)	0.34	.89
Oppositional defiant disorder	98.9 (0.20)	96.4 (0.98)	−2.50	.01
Conduct disorder	98.6 (0.32)	97.9 (0.45)	−0.73	.13
Eating disorders	98.8 (0.20)	91.1 (3.29)	−7.71	.02
Substance use disorders				
Alcohol abuse	98.9 (0.20)	93.3 (1.15)	−5.56	<.001
Drug abuse	98.8 (0.20)	97.2 (1.37)	−1.65	.23
Other disorders				
Bipolar disorder	98.9 (0.20)	96.5 (0.74)	−2.43	.001

[a] Scores were first normed in the sample by 6-month age groups for a mean of 100 and SD of 15. Predicted means were estimated from linear regression models controlling for parental education, race/ethnicity, age, nativity (US born vs not), number of siblings, birth order, and nonfocal disorder groups.

[b] *P* values are for the comparison between each disorder category and a reference group of no disorder in that category. For example, mean IQ among those with specific phobia is compared with those with no fear disorder. All *P* values are false discovery rate adjusted.

[c] Among those with a lifetime exposure to a potentially traumatic event (n = 6160 [61.2% of the total sample]).

occupational functioning; these results suggest that fluid intelligence may be a mechanism in this pathway, given that higher IQ is associated with better school performance.[82,83] This remains to be examined in future studies.

Limitations

In addition to the limitation of a single time point of measurement of IQ, other limitations should be considered. The K-BIT was administered by lay interviewers, which may have increased the frequency of protocol deviations in test administration. Such deviations could have led to worse performance among children with test-taking difficulties (eg, ADHD or test anxiety). However, the K-BIT has been validated in children with intellectual disability and other challenges,[49,52,53] and the reliability of K-BIT Matrices was comparable for the present sample and the standardization sample. Furthermore, the K-BIT is a "Level B" test, which permits examiners without high qualifications to administer and interpret it. Psychosis was not assessed in NCS-A given low prevalence in this age group, precluding evaluation of associations with IQ. Finally, given the cross-sectional assessment, recall bias in reports of past disorders likely contributed to underreporting of past disorders, particularly those that were low in severity. This would make the IQ associations with lifetime disorders overestimates because they reflect more severe cases. Longitudinal data are needed to determine the extent to which early-onset psychiatric disorders that remit influence IQ.

Conclusions

To our knowledge, the present study is the largest assessment of IQ in US children ever conducted, and results demonstrate robust associations of IQ with a broad range of psychiatric disorders, most notably for bipolar disorder and behavior disorders—including ADHD, ODD, and conduct disorder, as well as specific phobia, separation anxiety, and substance use disorders. Although associations of IQ with bipolar disorder and behavior disorders are consistent with prior research from clinical samples, those with fear and distress disorders reveal novel relationships not observed in prior studies and call into question others, including the lack of association with PTSD. Together, these findings reflect the potential role of cognitive factors in the etiology of diverse forms of psychiatric disorders, as well as how mental disorders may influence cognitive ability. Most importantly, this work highlights the critical importance of early identification and treatment of mental disorders in youth and the potential utility of accommodations in school settings for children with a wide range of psychiatric disorders to promote long-term success.

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