

# Intelligence and Other Predisposing Factors in Exposure to Trauma and Posttraumatic Stress Disorder

## *A Follow-up Study at Age 17 Years*

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**Context:** Prospective data on standardized measures of early predispositions would allow a strong test of hypotheses about suspected risk factors of posttraumatic stress disorder (PTSD) and exposure to traumatic events.

**Objective:** To prospectively examine the extent to which intelligence, anxiety disorders, and conduct problems in childhood influence the risk for PTSD and for exposure to traumatic events.

**Design:** A longitudinal study of a randomly selected sample assessed at age 6 years and followed up to age 17 years.

**Setting:** Samples were randomly selected from the 1983-1985 newborn discharge lists of 2 major hospitals in south-east Michigan (N=823).

**Participants:** Cohort members with follow-up data at age 17 years (n=713; 86.6% of the initial sample).

**Main Outcome Measures:** Cumulative exposure up to age 17 years of qualifying traumatic events; *DSM-IV* PTSD among participants who have experienced 1 or more traumatic events.

**Results:** Youth with teacher ratings of externalizing problems above the normal range at age 6 years were at increased risk for exposure to assaultive violence (adjusted odds ratio, 2.6; 95% confidence interval, 1.4-4.9). Youth aged 6 years with an IQ greater than 115 had decreased risk for exposure to traumatic events (adjusted odds ratio for assaultive violence, 0.3; 95% confidence interval, 0.2-0.7); a decreased risk for non-assaultive trauma (adjusted odds ratio, 0.6; 95% confidence interval, 0.3-0.9); and a decreased conditional risk for PTSD (adjusted odds ratio, 0.2; 95% confidence interval, 0.1-0.9). The conditional risk for PTSD was increased for youth with anxiety disorders and teacher ratings of externalizing problems above the normal range at 6 years of age.

**Conclusions:** The results of this prospective community study highlight the role of intelligence in avoidance of exposure to traumatic experiences and their PTSD effects. They underscore the need for investigating cognitive processes in persons' responses to traumatic experiences and the involvement of general intelligence in these processes.

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CURRENT CONCEPTIONS OF posttraumatic stress disorder (PTSD) underscore the role of preexisting vulnerabilities in the etiology of the disorder. The emphasis on predispositions is a reversal from the initial formulation of PTSD in *DSM-III* that postulated that trauma characteristics—especially trauma magnitude—are the central or sole determinants of PTSD.<sup>1,2</sup> This reversal is not a fresh start; it is instead a return to earlier conceptions that have waxed and waned through the history of psychiatry.<sup>3,4</sup> Further, general community studies have demonstrated that traumatic events do not occur randomly. Males and members of racially disadvantaged minorities residing in inner cities are at higher risk for exposure to traumatic events, compared with fe-

males and residents of middle-class suburbs.<sup>5</sup> With respect to exposure to traumatic events, there is evidence that personal predispositions might influence the risk, as they do for PTSD.<sup>6</sup> The extent to which personal predispositions place individuals at risk for exposure to trauma and increase their risk for the PTSD effects of exposure remains unclear, owing to inconsistencies across studies and the retrospective nature of nearly all the available data. In this prospective study, we examine the extent to which intelligence, anxiety disorders, and conduct problems in childhood influence the risk for PTSD and exposure to traumatic events.

The association between intelligence and the risk for PTSD has been examined in samples of Vietnam War veterans in case-control designs, using contemporaneous

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measurement of PTSD and IQ and archival data on IQ tests given at the time of enlistment before deployment.<sup>7,8</sup> These studies reported that combat veterans with PTSD had lower test scores than veterans without PTSD. Evidence of the role of intelligence in children's psychiatric responses to family adversity was reported for a range of disorders that did not include PTSD.<sup>9,10</sup> With respect to PTSD, a cross-sectional study of a small clinical sample of children reported a negative association between IQ and the risk of PTSD.<sup>11</sup> The relationship of IQ with exposure to PTSD-level traumatic events has not been examined.

Elevated rates of anxiety disorders and major depression in persons diagnosed with PTSD have been reported in Vietnam veterans and civilian samples.<sup>12-16</sup> The lifetime association has been explained in part by preexisting anxiety and depressive disorders, increasing victims' susceptibility to the PTSD effects of traumatic events. There also is evidence that preexisting anxiety and depression increase the risk of exposure to traumatic events, as they do to ordinary stressful life events.<sup>6,17</sup> Childhood conduct problems, antecedents to a wide range of psychiatric disorders in adulthood,<sup>18</sup> were reported in cross-sectional studies to be more frequent among Vietnam veterans with PTSD than among those without PTSD.<sup>12</sup>

Studies on early psychiatric disorders and conduct problems as risk factors for PTSD have relied solely on retrospective reports, which are subject to recall error and to contamination of participants' reports of childhood problems; the hypothesized antecedents may be tainted by their presumed consequence, PTSD in adulthood. We recently reported on early antecedents of PTSD, based on a prospective study of a cohort followed up from first grade to age 21 years.<sup>19</sup> Youth who had been rated by teachers as disruptive in the first grade were at greater risk for exposure to traumatic events. Youth who had reported emotional problems in the first grade were more likely to experience PTSD once exposed to traumatic events.<sup>19</sup> However, that study did not gather data on intelligence tests, childhood anxiety disorders, or standardized measures of behavior problems with established cut-off points that identify children above the normal range.

Our goal in this prospective study is to provide a strong test of the hypothesis that intelligence, conduct problems, and anxiety disorders in early childhood influence the risk for experiencing traumatic events and developing PTSD after exposure. Data on childhood factors were gathered at age 6 years. Data on exposure to traumatic events and PTSD were gathered at age 17 years and cover the participant's cumulative experience up to the time of the interview. Although PTSD-level traumatic events can occur across the lifespan of community residents, recent research has documented that occurrence up to age 6 years is rare, supporting the temporal priority of the hypothesized risk factors relative to exposure.<sup>5,20</sup>

## METHODS

### SAMPLE AND DATA

Data are from a longitudinal study of a randomly selected sample of all 1983-1985 low-birth-weight and normal-birth-weight newborn discharges of 2 major hospitals in southeast Michigan, rep-

resenting a disadvantaged urban community and a suburban middle-class community. In the analysis, we take into account the sampling design by incorporating the stratification variables (low birth weight vs normal birth weight; and urban vs suburban) in the statistical models. Children were assessed at ages 6, 11, and 17 years. Complete information on the population, sampling, and assessment is presented elsewhere<sup>21-24</sup> and is briefly summarized here.

We identified and assessed random samples of 6-year-old children from 2 socioeconomically disparate populations. We targeted the 1983-1985 birth-year cohorts of newborns who were 6 to 7 years of age from 1990 to 1992, the scheduled period of the initial fieldwork. Two major hospitals in southeast Michigan, 1 in the city of Detroit and the other in a middle-class suburb, were selected. In each hospital, for each year from 1983 to 1985, random samples of low-birth-weight and normal-birth-weight newborns (in equal numbers) were drawn from hospital discharge records. Of the 1095 in the target sample, 823 (75%) participated. The second assessment was conducted from 1995 to 1997, with children in each birth-year cohort assessed as they passed their 11th birthday. Of the initial sample of 823 children assessed at age 6 years, 87.1% participated at age 11 years. From 2000 to 2002, we assessed the sample a third time, with children in each birth-year cohort assessed as they passed their 17th birthday. A total of 713 persons were assessed, 86.6% of the initial cohort of 823. The institutional review boards of the participating institutions and Michigan State University, where the analysis of the data was conducted, approved the study. The current study focuses on data from the first and last assessments at ages 6 and 17 years.

A comparison of participants in the follow-up at age 17 years (when traumatic events and PTSD were assessed) with the complete cohort at age 6 years shows close similarities in sample composition and in the distribution of measures of childhood antecedents hypothesized to predict exposure to traumatic events and PTSD (**Table 1**). Although females, offspring of mothers with higher education, and children who scored in the normal range of internalizing problems were more likely to be followed up, the high follow-up completion (86.6%) assured that the subset of 17-year-olds remained representative of the initial sample.

## MEASUREMENT OF KEY VARIABLES

### Traumatic Events and PTSD

Exposure to traumatic events and PTSD was ascertained at age 17 years through a computerized version of the National Institute of Mental Health Diagnostic Interview Schedule.<sup>25</sup> The assessment opens with a list of 14 *DSM-IV*-qualifying events and, for each event type, respondents are asked if they have ever experienced an event of that kind. After all lifetime traumatic events were identified, the respondent was asked to select the event that caused the most distress, ie, the worst event. Questions regarding *DSM-IV*-PTSD-defining features and age at exposure were asked in relation to that event. Posttraumatic stress disorder was diagnosed using algorithms that implement the diagnostic criteria established in *DSM-IV*.<sup>26</sup>

### IQ, Behavior Problems, and *DSM-III-R* Anxiety Disorders at Age 6 Years

The Wechsler Intelligence Scale for Children-Revised was used to measure IQ at age 6 years.<sup>27</sup> The Wechsler Intelligence Scale for Children-Revised is age standardized and has a mean score of 100±15 in the general population. Children were assessed individually by psychometricians trained to a uniform standard. Test files were scored by 2 independent testers. Re-

**Table 1. Characteristics of the Initial Sample at Age 6 Years and of Follow-up Sample at Age 17 Years\***

Characteristic	No. (%)		
	Initial Sample (N = 823)	Age 17 years (n = 713)	Not Followed Up (n = 110)
Urban	413 (50.18)	364 (51.05)	49 (44.55)
Suburban	410 (49.82)	349 (48.95)	61 (55.45)
Low birth weight	473 (57.47)	405 (56.80)	68 (61.81)
Normal birth weight	350 (42.53)	308 (43.20)	42 (38.18)
Male	400 (48.60)	336 (47.12)	64 (58.18)
Female	423 (51.40)	377 (52.88)	46 (41.82)
Mother's education			
<High school	139 (16.89)	111 (15.57)	28 (25.45)
High school	226 (27.46)	191 (26.79)	35 (31.82)
Some college	307 (37.30)	271 (38.01)	36 (32.72)
College	151 (18.35)	140 (19.64)	11 (10.00)
Single mother	269 (32.93)	225 (31.73)	44 (40.74)
Married mother	548 (67.07)	484 (68.27)	64 (59.26)
Full-scale IQ†			
<85	124 (15.07)	103 (14.45)	21 (19.09)
86-100	231 (28.06)	195 (27.35)	36 (32.73)
101-115	286 (34.75)	247 (34.64)	39 (35.45)
>115	182 (22.11)	168 (23.56)	14 (12.72)
High externalizing problems‡	156 (19.48)	132 (19.02)	24 (22.42)
Low externalizing problems	645 (80.52)	562 (80.98)	83 (77.57)
High internalizing problems‡	151 (18.85)	122 (17.58)	29 (27.10)
Low internalizing problems	650 (81.15)	572 (82.42)	78 (72.90)
Any anxiety disorder§	112 (13.61)	101 (14.17)	11 (10.00)
No anxiety disorder	711 (86.39)	612 (85.83)	99 (90.00)

\*Comparisons of the follow-up sample with the subset not followed up revealed significant differences ( $P < .05$ ) on sex, internalizing problems, and maternal education.

†Measured by the Wechsler Intelligence Scale for Children-Revised at age 6 years.

‡Defined by a T score of 60 or greater on the Teacher Report Form at age 6 years.

§*Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition* generalized anxiety disorder, overanxious disorder, separation anxiety, or simple phobia as assessed by the parent version of the Diagnostic Interview Schedule for Children at age 6 years.

peated monitoring for testers' adherence to test administration rules, as specified in the official manual, was conducted throughout the assessment period.

Behavior problems at age 6 years were rated by teachers, using the Teacher Report Form.<sup>28</sup> The Teacher Report Form consists of 118 items rated on a scale from 0 to 2, with 0 = "Not true (as far as you know)," 1 = "Somewhat or sometimes true," and 2 = "Very true or often true," within the past 2 months. The scales are standardized by age and sex. They yield scores on 2 composite scales, externalizing and internalizing. The externalizing problems scale, with a total of 34 items, is the sum of 2 subscales (delinquent behavior and aggressive behavior) and is used here as a measure of conduct problems. The internalizing problems scale, with a total of 36 items, is the sum of 3 subscales (withdrawn, somatic complaints, and anxious/depressed). Test/retest reliability of the Teacher Report Form externalizing problems scale is 0.92, and 0.91 for the internalizing problems scale.<sup>28</sup> Internal consistency reliability for males and females stratified by age group, as indicated by Cronbach  $\alpha$ , ranges from 0.95 to 0.96 for externalizing problems, and 0.90 to 0.92 for internalizing problems.<sup>28</sup> Standardized scores of 60 and above identify children in the borderline and clinical range, as distinct from the normal range.

The *DSM-III-R* anxiety disorders (simple phobia, separation anxiety, overanxious disorder, and generalized anxiety disorder) were measured by the National Institute of Mental Health Diagnostic Interview Schedule for Children-Parent version 2.1 in interviews with mothers.<sup>29</sup> In this analysis, we use any anxiety disorder, which includes 1 or more of the 4 specific disorders. The Diagnostic Interview Schedule for Children is a fully structured interview that inquires about criterion symptoms, duration, frequency, impairment, and other modifiers used in the *DSM-III-R*.<sup>30</sup> Major depression, which has a very low prevalence in 6-year-old children, was not assessed. Of the entire sample, 112 children (13.6%) met *DSM-III-R* criteria for 1 or more of the 4 common childhood anxiety disorders (16.1% of females and 11.0% of males). The most common anxiety disorder was simple phobia (7.6%).

## STATISTICAL ANALYSIS

Initial analyses were used to describe sample characteristics (Table 1 and **Table 2**). To evaluate childhood risk factors for exposure, traumatic events were grouped into 2 categories, those involving assaultive violence and all other event types. Of all the

**Table 2. Cumulative Occurrence of Exposure to Traumatic Events up to Age 17 Years**

Event	Total (n = 713), %	Urban (n = 364), %	Suburban (n = 349), %	$\chi^2$	P Value	Male (n = 336), %	Female (n = 377), %	$\chi^2$	P Value
Assaultive violence	22.58	29.95	14.90	23.07	<.001	30.06	15.92	20.33	<.001
Rape/sexual assault	5.33	6.87	3.72			1.49	8.75		
Held captive/tortured/kidnapped	0.42	0.55	0.29			0.60	0.27		
Shot/stabbed	3.23	3.85	2.58			5.65	1.06		
Mugged/threatened with weapon	15.85	21.98	9.46			25.60	7.16		
Badly beaten up	6.45	7.97	4.87			8.63	4.51		
Other injury or shocking event	43.34	51.92	34.38	22.32	<.001	51.49	36.07	17.19	<.001
Serious accident	9.82	11.26	8.31			12.20	7.69		
Natural disaster	18.23	18.68	17.77			22.32	14.59		
Diagnosed with life-threatening illness	1.54	1.10	2.01			2.08	1.06		
Witnessed killing/serious injury	19.50	25.27	13.47			25.89	13.79		
Discovered dead body	3.37	6.04	0.57			3.27	3.45		
Break in/robbery	11.92	17.86	5.73			13.39	10.61		
Learned of trauma to others	29.59	34.34	24.64	8.04	.005	29.17	29.97	0.06	.81
Learned of sudden unexpected death	49.51	60.99	37.54	39.21	<.001	50.00	49.07	0.06	8.80
Other frightening experiences	12.48	11.81	13.18	0.30	.58	13.69	11.41	0.85	.36
Any traumatic event	75.88	85.99	65.33	41.55	<.001	79.17	72.94	3.76	.05

**Table 3. Risk of Exposure to Trauma and Trauma Categories up to Age 17 Years Across Sample Subgroups**

Characteristic	Odds Ratio (95% Confidence Interval)		
	Any Exposure (n = 541)	Assaultive Violence (n = 161)*	Other Traumas (n = 380)*
Urban	3.26 (2.25-4.71)†	4.97 (3.12-7.92)†	2.75 (1.87-4.04)†
Suburban	1.0	1.0	1.0
Low birth weight	1.23 (0.87-1.74)	1.19 (0.77-1.83)	1.25 (0.87-1.80)
Normal birth weight	1.0	1.0	1.0
Male	1.41 (1.00-2.00)	2.45 (1.58-3.81)†	1.12 (0.78-1.61)
Female	1.0	1.0	1.0
Maternal education			
<High school	5.50 (2.76-10.94)†	11.96 (5.11-27.98)†	3.98 (1.95-8.14)†
High school	2.44 (1.50-3.96)†	3.84 (1.91-7.72)†	2.11 (1.27-3.50)†
Some college	2.20 (1.42-3.42)†	3.28 (1.70-6.34)†	1.95 (1.23-3.09)†
College	1.0	1.0	1.0
Single mother	3.11 (1.99-4.86)†	4.83 (2.88-8.08)†	2.54 (1.60-4.04)†
Married mother	1.0	1.0	1.0
Full-scale IQ‡			
<100	1.0	1.0	1.0
101-115	0.61 (0.40-0.94)†	0.53 (0.32-0.88)†	0.65 (0.42-1.02)
>115	0.30 (0.20-0.47)†	0.16 (0.09-0.30)†	0.38 (0.24-0.60)†
High externalizing problems§	2.26 (1.33-3.85)†	4.19 (2.32-7.56)†	1.62 (0.92-2.84)
Low externalizing problems	1.0	1.0	1.0
High internalizing problems§	1.44 (0.88-2.34)	1.47 (0.81-2.66)	1.42 (0.85-2.37)
Low internalizing problems	Ref.	1.0	1.0
Any anxiety disorder	1.44 (0.84-2.45)	1.55 (0.82-2.93)	1.39 (0.80-2.42)
No anxiety disorder	1.0	1.0	1.0

\*From a series of multinomial logistic regressions estimating 3 categories of the outcome: assaultive violence, other trauma, and no exposure (as reference). †P<.05.

‡Measured by the Wechsler Intelligence Scale for Children-Revised at age 6 years.

§Defined by a T score of 60 or greater on the Teacher Report Form at age 6 years.

||Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition generalized anxiety disorder, overanxious disorder, separation anxiety, or simple phobia assessed by the parent version of the Diagnostic Interview Schedule for Children at age 6 years.

respondents who experienced 1 or more events involving assaultive violence (n=161), 92% also experienced other event types. We therefore classified into the assaultive violence category both those who have experienced assaultive violence plus other event types and those who have experienced only assaultive violence. The category of other traumatic events included persons who have never experienced assaultive violence but who have experienced other qualifying traumatic events.

Unadjusted relative risks for exposure to any traumatic event associated with subgroups of the population and with each of the hypothesized childhood factors were estimated in a series of logistic regressions (Table 3). In a second series, we used multinomial regressions in which the outcome variable was defined by 3 categorical responses: (1) never having experienced a traumatic event (n=172) (the reference group); (2) having experienced assaultive violence (with or without other event types) (n=161); and (3) having experienced only traumatic events that did not involve assaultive violence (n=380) (Table 3). In a multivariable model, we estimated adjusted relative risks for exposure to trauma (Table 4). The unadjusted relative risk for PTSD following the worst event associated with subgroups of the population and with each of the childhood predispositions was estimated in a series of logistic regressions (Table 5). In a multivariable model, we estimated adjusted relative risks for PTSD (Table 6). The equations include variables identified as potential risk factors in the bivariate analyses, as well as the sampling design features (low birth weight vs normal birth weight; and urban vs suburban). Because maternal education and single-mother status correlated highly with the urban vs suburban variables, we do not include them in the final multivariable models, displayed in Tables 4 and 6. Models that

**Table 4. Multivariable Model of Childhood Predictors of Exposure to Assaultive and Nonassaultive Traumas\***

	Adjusted Odds Ratio† (95% Confidence Interval)	
	Assaultive Violence	Other Traumas Only
Urban	3.58 (2.12-6.05)‡	2.21 (1.45-3.38)‡
Low birth weight	0.87 (0.54-1.41)	1.03 (0.70-1.52)
Male	2.78 (1.72-4.50)‡	1.21 (0.82-1.78)
Full-scale IQ§		
101-115	0.86 (0.49-1.51)	0.85 (0.53-1.36)
>115	0.33 (0.17-0.67)†	0.56 (0.34-0.93)‡
High externalizing problems	2.61 (1.40-4.87)‡	1.21 (0.68-2.16)

\*n = 713.

†Adjusted from a multinomial logistic regression estimating 3 categories of the outcome: assaultive violence, other trauma, or no exposure (as reference)

‡P<.05.

§Measured by the Wechsler Intelligence Scale for Children-Revised at age 6 years. An IQ of 100 points or less is reference.

||Defined by a T score of 60 or greater on the Teacher Report Form at age 6 years.

included maternal education and single-mother status yielded similar estimates to those displayed in Tables 4 and 6. Two-way interactions of the key variables with urban residence and sex were tested but none were detected at  $\alpha=0.15$ .

EXPOSURE TO TRAUMATIC EVENTS  
UP TO AGE 17 YEARS**Table 5. Conditional Probabilities of PTSD Following Exposure to Traumatic Events Across Sample Subgroups\***

Characteristic	No. (%) PTSD	Unadjusted OR (95% CI)
Urban	313 (10.54)	2.12 (1.07-4.20)†
Suburban	228 (5.26)	1.0
Low birth weight	314 (10.19)	1.87 (0.96-3.65)
Normal birth weight	227 (5.73)	1.0
Male	266 (5.64)	0.49 (0.26-0.93)†
Female	275 (10.91)	1.0
Maternal education		
<High school	99 (13.13)	4.08 (1.12-14.84)†
High school	150 (10.00)	3.00 (0.84-10.67)
Some college	208 (6.73)	1.95 (0.54-6.96)
College	84 (3.57)	1.0
Single mother	198 (13.13)	2.55 (1.37-4.75)†
Married mother	340 (5.59)	1.0
Full-scale IQ‡		
<100	250 (12.00)	1.0
101-115	188 (6.91)	0.54 (0.28-1.08)
>115	103 (1.94)	0.14 (0.03-0.62)†
High externalizing problems§	114 (14.04)	2.17 (1.13-4.15)†
Low externalizing problems	414 (7.00)	1.0
High internalizing problems§	99 (11.11)	1.45 (0.71-0.98)
Low internalizing problems	429 (7.93)	1.0
Any anxiety disorder	82 (14.63)	2.21 (1.09-4.49)†
No anxiety disorder	459 (7.19)	1.0

Abbreviations: CI, confidence interval; OR, odds ratio; PTSD, posttraumatic stress disorder.

\*n = 541.

†P < .05.

‡Measured by the Wechsler Intelligence Scale for Children-Revised at age 6 years.

§Defined by a T score of 60 or greater on the Teacher Report Form at age 6 years.

||*Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition* generalized anxiety disorder, overanxious disorder, separation anxiety, or simple phobia assessed by the parent version of the Diagnostic Interview Schedule for Children at age 6 years.

**Table 6. Multivariable Model of Childhood Predictors of PTSD Following Exposure\***

Characteristic	Adjusted OR† (95% CI)
Urban	1.35 (0.65-2.82)
Low birth weight	1.56 (0.78-3.12)
Male	0.50 (0.25-0.97)‡
Full-scale IQ§	
101-115	0.62 (0.30-1.26)
>115	0.21 (0.05-0.94)‡
High externalizing problems	1.86 (0.94-3.71)¶
Any anxiety disorder#	2.08 (1.01-4.32)‡

Abbreviations: CI, confidence interval; OR, odds ratio; PTSD, posttraumatic stress disorder.

\*n = 541.

†Adjusted from multiple logistic regression.

‡P < .05.

§Measured by the Wechsler Intelligence Scale for Children-Revised at age 6 years. An IQ less than 100 points is reference.

||Defined by a T score of 60 or greater on the Teacher Report Form at age 6 years.

¶P = .08.

#*Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition* generalized anxiety disorder, overanxious disorder, separation anxiety, or simple phobia assessed by the parent version of the Diagnostic Interview Schedule for Children at age 6 years.

Of the 713 participants interviewed at age 17 years, 541 (75.9%) had experienced 1 or more *DSM-IV* traumatic events (79.2% of males and 72.9% of females). The number of traumatic events experienced by trauma-exposed persons ranged from 1 to 9 (mean ± SD, 2.5 ± 1.6). The cumulative occurrence of exposure to any traumatic event was higher in the urban subset than in the suburban, 86.0% vs 65.3%, respectively ( $\chi^2 = 41.55$ ;  $P < .001$ ) (Table 2). The higher prevalence of exposure in urban than suburban youths applied to both sexes, with no sex × urban vs suburban interaction at  $\alpha = 0.15$ . Table 2 presents the cumulative occurrence of 13 specific types of traumatic event and a miscellaneous trauma category. The single most common traumatic event was learning of a sudden unexpected death of a close friend or relative, with 49.5% of the sample having experienced an event of this type. Personally experienced traumatic events, which are grouped under 2 classes—assaultive violence, and other injury or shocking event—have occurred more frequently in males than females and in urban than suburban youths, with no sex × urban vs suburban interaction at  $\alpha = 0.15$  (Table 2).

Learning about traumatic events experienced by a close friend or relative and learning about a sudden unexpected death of a close friend or relative was reported more frequently by urban than by suburban youths; estimates were similar in male and females (Table 2).

CHILDHOOD RISK FACTORS FOR EXPOSURE  
TO TRAUMATIC EVENTS

Unadjusted estimates of relative risk for exposure to traumatic events across subgroups of the sample are presented in Table 3. The first column presents estimates of risk for exposure to any traumatic event; the second and third columns present estimates for exposure to 2 categories of traumatic events, assaultive violence and other traumatic events in persons who have never experienced assaultive violence, respectively. Youth aged 6 years with an IQ above the population mean of 100 were at lower risk for exposure to any trauma (odds ratios [ORs], 0.61 and 0.30, for IQ of 101-115 and IQ > 115, respectively). Youth who at age 6 years had been rated above the cut-off that separates the normal range from the subclinical/clinical range of externalizing problems were at elevated risk for subsequent exposure to any traumatic event. Teachers' ratings of internalizing problems and mothers' reports of *DSM-III-R* anxiety disorders at age 6 years were unrelated to the risk for exposure (Table 3).

The relationship of externalizing problems to subsequent exposure varied by category of traumatic events (Table 3). Teachers' ratings of externalizing problems above the cut-off significantly increased the risk for exposure to assaultive violence (OR, 4.19; 95% confidence interval [CI], 2.32-7.56), but not for other event

types. IQ was related to both categories of traumatic events: children with IQs greater than 115 had a lower risk for exposure to assaultive violence (OR, 0.16; 95% CI, 0.09-0.30) and other traumas (OR, 0.38; 95% CI, 0.24-0.60) (Table 3).

To take into account the intercorrelations among childhood variables examined in this analysis, we used a multivariable model that included IQ and externalizing problems, predisposing variables identified in bivariate analyses, sex, and the 2 design variables—urban vs suburban, and low birth weight vs normal birth weight (Table 4). Adjusted ORs are from a multinomial logistic regression, with 3 outcomes: assaultive violence, other trauma, and no exposure (as reference). Adjusted OR for exposure to assaultive violence (but not for other trauma types) was associated with teachers' ratings of externalizing problems above the normal range. IQ scores greater than 115 were associated with a marked decrease in the risk for exposure to assaultive violence, independent of other variables in the model. (Using  $IQ \leq 85$  as a reference also showed that the negative association with the risk for exposure was significant only for  $IQ > 115$  [OR, 0.41;  $P < .05$ ].) IQs greater than 115 were associated with a lower risk for exposure to other trauma types, but the association was weaker than with assaultive violence. Adjusted ORs for assaultive violence associated with urban residence was significantly higher than for other trauma types (3.58 vs 2.21) ( $\chi^2 = 4.72$ ;  $P = .03$  for the difference between the 2 estimates).

#### CHILDHOOD RISK FACTORS FOR PTSD

Of the 541 youths who experienced traumatic events, 45 met *DSM-IV* criteria for PTSD following the worst event, yielding a conditional probability of 8.3%. The cumulative incidence of PTSD in the total sample of 713 youths followed up to age 17 years was 6.3%. Unadjusted ORs for PTSD across subsets of exposed persons appear in Table 5. Teachers' ratings of externalizing problems above the cut-off and any *DSM-III-R* anxiety disorder at age 6 years significantly increased the conditional risk for PTSD. High IQ scores ( $> 115$ ) decreased the likelihood of succumbing to PTSD following a traumatic event (Table 5). Females' risk of PTSD following exposure was approximately twice as high as males'. The risk of PTSD following exposure was higher in urban than suburban youths.

Adjusted estimates from a multiple logistic model appear in Table 6. Children with high ratings of externalizing problems at age 6 years had an increased risk for PTSD, controlling for other variables in the model, as did children with anxiety disorders at age 6 years. In each case, the increase was approximately 2-fold. Children with IQ scores of 1 SD above the population mean or higher had a markedly lower risk for PTSD than children with an IQ score of 100 or less (OR, 0.21; 95% CI, 0.05-0.94). Males' lower risk for PTSD was unchanged when other variables were controlled. The risk for PTSD associated with urban vs suburban community was not significant when adjusted for other variables (Table 6).

In additional models, we estimated the conditional probability of PTSD associated with IQ, anxiety disorders, and externalizing problems in the urban and sub-

urban subsamples separately. These analyses recovered the pattern seen in the total sample. For example, in the urban subset, the relative risk for PTSD associated with an IQ greater than 115 was 0.31; for those with an IQ of 101 to 115, relative risk was 0.66, using an IQ of 100 or less as a reference. In the suburban subset, the corresponding estimates were 0.14 and 0.52.

#### EXPLORING THE ROLE OF IQ IN PTSD

We examined whether high IQ protected trauma-exposed youth from experiencing any PTSD symptoms or instead only from developing *DSM-IV* PTSD. The OR for PTSD symptoms associated with an IQ greater than 115 in exposed youth with no PTSD ( $n = 106$ ) was not significant (OR, 0.99; 95% CI, 0.55-1.77), but for PTSD, OR was 0.14 (95% CI, 0.03-0.62), using an IQ of 100 or less as a reference. IQ scores of 101 to 115 were related to neither PTSD symptoms nor diagnosed PTSD, using an IQ of 100 or less as a reference. These data suggest that high IQ was unrelated to experiencing minor to moderate disturbance following exposure to trauma. High IQ protected exposed persons from succumbing to PTSD.

#### COMMENT

The key findings from this prospective study indicate the following: (1) youth who have been rated by their teachers as being above the normal range of externalizing problems at age 6 years were at increased risk for exposure to assaultive violence, but not to other trauma types, controlling for other risk factors for exposure; (2) youth with an IQ higher than 115 at age 6 years were at lower risk for exposure to both assaultive violence and other trauma types; the association with assaultive violence was significantly stronger; (3) given trauma exposure, *DSM-III-R* anxiety disorders and teachers' ratings of externalizing problems above the cut-off at age 6 years predicted increased risk for PTSD; and (4) youth with an IQ score greater than 115 at age 6 years were at a far lower risk for PTSD than youth at or below the population mean.

We observed in these data the sex-related pattern reported in previous studies, with males more likely to be exposed to trauma, and females more likely to experience PTSD following exposure.<sup>16,31-33</sup> As in previous studies, the cumulative incidence of exposure to traumatic events was higher in inner-city (urban) youth than in suburban youth.<sup>5</sup> When examined individually, low maternal education and single-mother status were associated with greater risk for exposure. However, both were highly correlated with urban or suburban residence and had little added influence on exposure or PTSD in models that included urban and suburban residence.

The cumulative occurrence of *DSM-IV* traumatic events up to age 17 years (75.9%) should be evaluated in light of the young age of the cohort. The peak age range of exposure to traumatic events is late adolescence<sup>5,20</sup> and members of the cohort had not yet passed that peak period. The conditional probability of PTSD given exposure (8.3%) corresponds closely to estimates from recent community samples with wider age ranges.<sup>5,16,20</sup>

Several study limitations should be considered. First, participation at age 17 years when data on PTSD were gathered, although exceptionally high (86.6%), was nonetheless incomplete. A comparison of the follow-up subset with the initial sample revealed only trivial differences on key variables. Differences on unmeasured variables cannot be ruled out, however. Second, in the analysis of childhood predispositions for PTSD following exposure, there were 45 cases of PTSD, which diminished the statistical power, relative to the analysis of exposure to traumatic events. In this regard, our study is similar to other community-based studies, reflecting the low conditional probability of PTSD in the community. Although the adjusted associations with risk factors were close to the unadjusted estimates (Tables 5 and 6), their CIs were wider. Estimates from community-based longitudinal cohorts with comparable childhood measures have not been reported. Our recent report,<sup>19</sup> which was based on a larger cohort, yielded a similar pattern of results, but lacked the standardized measures and diagnostic data from childhood available in this study. Third, the evidence in this study is based on respondents' reports of traumatic experiences and PTSD that had occurred up to the time of the interview at age 17 years. Respondents' accounts of past events—even traumatic events that might be expected to be memorable—are subject to recall errors. However, distortions would be less pronounced in this young cohort than in older samples. Because the occurrence of traumatic events in early childhood is rare and rises markedly only after 14 years of age, the respondents reported chiefly about events that had occurred in the 3-year period preceding the time of the interview.

Strengths of the study are noteworthy. These include the community-based sample and the prospective data on personal predispositions. Pretrauma measures of personal predisposition and PTSD symptoms following disaster have been previously reported.<sup>34,35</sup> However, these reports are based on PTSD symptoms, scales of anxiety-depression, and teachers' rating of academic achievement or years of schooling. In this study, data are on *DSM-IV* PTSD, childhood anxiety disorders, and standardized IQ tests. An additional strength is the use of independent informants for obtaining data on key risk factors for PTSD at age 6 years. Externalizing problems were rated by teachers, whereas *DSM-III-R* anxiety disorders were measured in structured interviews with mothers. In addition, the independence of these childhood measures from participants' reports of exposure to trauma and PTSD at age 17 years offers a considerable methodological advantage by avoiding contamination of data on risk factors by subjects' PTSD and exposure. The temporal separation achieved through the longitudinal design together with the use of independent informants enhances the validity of the results.

Of particular interest are the findings that IQ and conduct problems at age 6 years, each independently of the other, influenced the likelihood of exposure to traumatic events and conditional probability of PTSD. Disruptive behavior and low IQ in childhood interact with social environments in ways that amplify their adverse effects over time. Children with behavior problems might drift toward more disruptive and academically less com-

petent peers. Conversely, children with lower intelligence might decline academically relative to their peers as the school curriculum advances, a process that increases their chances of affiliating with disruptive peers.<sup>36</sup> The evidence of developmental processes by which low intelligence enhances disruptive behavior and disruptive behavior leads to gradual intellectual decline underscores the importance of obtaining early measures of these factors, when their separate effects might be more accurately detected. In this regard, the availability of early childhood measures in this study offers a considerable advantage.

The role of IQ in moderating the effect of adverse environments on childhood psychiatric disorders and the effect of trauma on the risk for PTSD have been reported in previous studies.<sup>7-11</sup> These reports have highlighted the risk associated with low IQ and the protection conferred by an average IQ, although the shape of the IQ-PTSD association, specifically, the possibility of a departure from linearity, was not noted. Our results suggest that an average IQ might not be sufficient to materially decrease the PTSD response to trauma; we found that it was an IQ greater than 1 SD above the population mean that made a reliable and material difference.

Previous studies have not reported on the association of IQ with the risk for exposure to traumatic events. We found that the risk for exposure, especially exposure to assaultive violence, was substantially decreased in youth aged 6 years with an IQ greater than 115. IQ within 1 SD above the population mean was associated with a slight (and not significant) advantage.

If replicated in future studies, these findings suggest that the pervasive real-life benefits of high IQ<sup>37,38</sup> might include the successful avoidance and prevention of traumatic experiences and their PTSD effects. In this study, the avoidance of exposure applied equally to residents of inner-city communities at high risk for victimization and to residents of suburban communities at lower risk. Further, the marked protection from the PTSD effects of trauma associated with high IQ applied to persons with history of early anxiety disorders or conduct problems, who are generally prone to psychiatric disorders, including PTSD.

The ways in which high IQ might protect from the PTSD effects of traumatic exposure are unclear. An exploratory analysis suggested that the advantage associated with high IQ might be in distinguishing those who experience minor or moderate disturbance from those who succumb to PTSD, that is, pervasive disturbance associated with impairment or distress. The findings underscore the importance of investigating cognitive processes in a person's responses to challenging and potentially traumatic experiences and the involvement of general intelligence in shaping them.

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