Psychopathology Among New York City Public School Children 6 Months After September 11

Christina W. Hoven, DrPH; Cristiane S. Duarte, PhD; Christopher P. Lucas, MD, MPH; Ping Wu, PhD; Donald J. Mandell, PhD, MPH; Renee D. Goodwin, PhD; Michael Cohen, PhD; Victor Balaban, PhD; Bradley A. Woodruff, MD, MPH; Fan Bin, MD; George J. Musa, BA; Lori Mei, PhD; Pamela A. Cantor, MD; J. Lawrence Aber, PhD; Patricia Cohen, PhD; Ezra Susser, MD, DrPH

Context: Children exposed to a traumatic event may be at higher risk for developing mental disorders. The prevalence of child psychopathology, however, has not been assessed in a population-based sample exposed to different levels of mass trauma or across a range of disorders.

Objective: To determine prevalence and correlates of probable mental disorders among New York City, NY, public school students 6 months following the September 11, 2001, World Trade Center attack.

Design: Survey.

Setting: New York City public schools.

Participants: A citywide, random, representative sample of 8236 students in grades 4 through 12, including oversampling in closest proximity to the World Trade Center site (ground zero) and other high-risk areas.

Main Outcome Measure: Children were screened for probable mental disorders with the Diagnostic Interview Schedule for Children Predictive Scales.

Results: One or more of 6 probable anxiety/depressive disorders were identified in 28.6% of all children. The most prevalent were probable agoraphobia (14.8%), probable separation anxiety (12.3%), and probable posttraumatic stress disorder (10.6%). Higher levels of exposure correspond to higher prevalence for all probable anxiety/depressive disorders. Girls and children in grades 4 and 5 were the most affected. In logistic regression analyses, child’s exposure (adjusted odds ratio, 1.62), exposure of a child’s family member (adjusted odds ratio, 1.80), and the child’s prior trauma (adjusted odds ratio, 2.01) were related to increased likelihood of probable anxiety/depressive disorders. Results were adjusted for different types of exposure, sociodemographic characteristics, and child mental health service use.

Conclusions: A high proportion of New York City public school children had a probable mental disorder 6 months after September 11, 2001. The data suggest that there is a relationship between level of exposure to trauma and likelihood of child anxiety/depressive disorders in the community. The results support the need to apply wide-area epidemiological approaches to mental health assessment after any large-scale disaster.

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able mental disorders and their relationship to levels of exposure to the World Trade Center (WTC) attack in a large representative sample of New York City public school children 6 months following this disaster.

METHODS

SAMPLE

More than 1.1 million students in grades kindergarten through 12 are enrolled in New York City public schools. The sampling plan targeted the universe (excluding special education schools) of New York City public school students enrolled in grades 4 through 12 (estimated to be approximately 716,189 youth when the sampling plan was carried out) 6 months after September 11, 2001.

Each of the 1193 public schools was first assigned to 1 of 3 sampling strata (Figure 1). Stratum 1, the ground zero area, comprised 15 elementary, middle, and high schools located in the immediate vicinity of the WTC. Stratum 2, high-risk areas, included schools whose students could be at elevated risk because of family exposure, geography, or other events. This stratum consisted of other schools in Manhattan below 14th Street; schools in Brooklyn along the East River facing the WTC; schools in Staten Island where a disproportionate number of police, fire, and emergency workers live; schools in Belle Harbor, Queens, where American Airlines flight 587 to the Dominican Republic crashed on November 12, 2001; and schools in Washington Heights, where more than 85,500 Dominican Republic expatriates reside, as well as the relatives of many of those who died on flight 587. Stratum 3 comprised the schools in all other New York City areas. Mainstreamed special education students were eligible for selection.

Schools were sampled separately in each of the 3 strata (Figure 2). In the ground zero area stratum, all eligible schools were invited to participate. In the high-risk (oversampled) and other areas strata, each school was weighted according to the number of eligible students, and schools were then selected with probability proportional to size.

A total of 102 schools were targeted: 15 ground zero area, 28 high risk, and 59 other area. A total of 94 schools participated. Six refusals were in ground zero area schools (most not wanting to perpetuate a focus on September 11). Participating and nonparticipating ground zero area schools did not differ in proximity to the WTC, but all of the schools with large enrollments participated. Nonparticipating schools enrolled younger elementary school-aged students.

Participating ground zero area schools (primarily high schools) drew most (82%) of their student bodies from outside the immediate geographical area, whereas the nonparticipating ground zero area schools (primarily elementary schools) enrolled local populations. In strata 2 and 3, 3 classrooms were randomly selected in each school, while in the ground zero area

Figure 1. New York City Department of Education Survey Strata. Created by George J. Musa, Child Psychiatric Epidemiology Group, Mailman School of Public Health, Columbia University, March 1, 2003. Projection: New York–Long Island state plane (NAD83). Sources: New York City Department of City Planning and New York City Department of Education.
all eligible schools were selected and the method was simple random selection of classrooms (Figure 2).

In each stratum, all students in selected classrooms were solicited for recruitment. Among 10,469 eligible students, 667 parents or students refused participation prior to data collection and an additional 217 students refused participation on the day of data collection. Of the 10,469 eligible students, 1,326 (11%) were absent on the day of the survey, a rate identical to that reported by the New York City Department of Education among 4th through 12th graders in 2001-2002. By grade, compliance ranged from 69.02% among 4th and 5th graders (64.97%, including absentees) to 95.83% among 6th through 8th graders (87.24%, including absentees). The lowest compliance rate by both stratum and grade was 39.05% among 4th and 5th graders in the ground zero area stratum (57.94%, including absentees). The final sample consisted of 8,236 students aged 9 to 21 years.

MEASURES

Mental Disorder

To assess probable mental disorder, we used the Diagnostic Interview Schedule for Children (DISC) Predictive Scales (DPS), a screening measure derived from the National Institute of Mental Health’s DISC Version IV, a structured diagnostic interview. The DPS includes only the DISC items that are most predictive of DSM-IV DISC diagnoses. Eight probable mental disorders were assessed: PTSD, major depression, generalized anxiety disorder, separation anxiety disorder, panic, agoraphobia, conduct disorder, and alcohol problems (abuse/dependence). The decision of which disorders to include was based, in part, on postdisaster literature and expert opinion. There was particular interest in internalizing disorders. It was also based on an understanding of the unique features of New York City and the principal investigator’s conjectures about the potential September 11 consequences on children’s mental health. For example, agoraphobia was assessed because approximately 750,000 public school children were known to take public transportation on a daily basis, including subways, boats, and buses, passing over bridges and waterways and through tunnels.

Psychometrics of the DPS were determined by the Stamford Schools Study (C.P.L., S. Greenwald, PhD, A. Matteo, PhD, and Miller Brotman, PhD, unpublished data, 2000-2003), a 2-stage community survey using the DPS and the DISC. The DPS scales were administered as a self-report telephone questionnaire to parents and adolescents in a nonreferred community sample. These individuals subsequently participated in a face-to-face interview based on the DISC Version IV. Sensitivity of the DPS ranged from 60% to 83.3% and specificity from 79.9% to 88.1% for probable diagnoses. Testing demonstrated that the DPS required modification for this study; the psychometric performance of 2 of them was also ascertained using data from the Stamford Schools Study: probable major depression (with questions substituted for suicide) (sensitivity, 90%; specificity, 93%) and probable conduct disorder (with questions substituted for criminal behavior) (sensitivity, 63%; specificity, 95%). For probable PTSD, a sample from Boystown, Juvenile Detention (Omaha, Neb) and San Diego Services (San Diego, Calif) (N=2173) provided psychometric information (sensitivity, 85%; specificity, 98.4%). The probable PTSD questions were worded to refer to the WTC attack as the anchoring traumatic event.

Exposure

To assess exposure to the WTC attack, we designed specific questions (WTC Questionnaire, available on request) to measure: (1) attendance in a ground zero area school; (2) direct exposure, defined as 2 or more of the following: personally witnessed the attack, hurt in the attack, in or near the cloud of dust and smoke, evacuated to safety, or being extremely worried about the safety of a loved one; (3) family exposure, defined as having a family member (mother, father, stepmother, stepfather, foster mother, foster father, sister, brother, grandmother, grandfather, aunt, uncle, or other family member) killed or injured in the attack, or witnessing the attack but escaping unharmed.

Direct and family exposures were combined to define levels of exposure: severe exposure, defined as the presence of 2 or more direct and/or 1 or more family exposures; moderate exposure consisted of 1 direct and no family exposure; and mild exposure as neither direct nor family exposure. Media exposure was measured, with high media exposure defined as having spent “a lot of time” watching television coverage of the attack.

In addition, exposure to trauma not related to September 11 was assessed. Included was previous exposure to traumatic situations, defined as having had a severe injury in violent circumstances or having lived through war or another major pre-September 11 disaster. Exposure to the American Airlines flight 907 crash, 2 months after September 11 (defined as having a relative who died on the flight or living in the Belle Harbor crash site area of New York City), was also assessed.

Other Measures

The demographic information included grade, sex, and ethnicity. Children reported if their mother had completed high school and their family composition.

The variable “mental health service use” was considered as having occurred if a child reported that she or he had talked about the September 11 attack with a mental health professional in the school environment (school guidance counselor or school social worker) or outside the school environment (a health professional outside of school, like a doctor, therapist, social worker, psychologist, psychiatrist, nurse, or other professional).
PROCEDURES

Active parental consent was required for participation of 4th and 5th graders, and parental notification was required for 6th through 12th graders. Students completed questionnaires within 1 class period. The questionnaire was slightly shorter for 4th and 5th graders and was read aloud to them by survey personnel as students filled in their responses. The 6th through 12th graders read and completed their own questionnaires. Prior to fielding, the questionnaire was piloted in 3 nonselected New York City public schools.

To maximize the range of information obtained while not exceeding the allotted administration time, a planned missing data 3-form design was used. Each questionnaire consisted of a core, as well as 2 of 3 possible noncore sections. Hence, each student received the core and two thirds of the noncore questionnaire.

This study was conducted in full compliance with the institutional review boards of Columbia University–New York State Psychiatric Institute (New York City) and the New York City Department of Education and the New York State Office of Mental Health Committee for WTC-Related Research (Albany).

STATISTICAL ANALYSIS

Individual respondent weights were used, reflecting the sampling design for grade level and stratum. Individually omitted items (unplanned missings) were imputed from other data (items on scales, write-ins, demographics, or school variables) or by using multiple imputation in the case of sex, maternal education, family composition, and probable psychiatric disorders (SAS MI procedure). Multiple imputation was also used for variables that were not part of the core section of the questionnaire (planned missings). Approximately 12 variables, conceptually and empirically correlated with each variable with missing information, were used for imputation (planned and unplanned missings). For probable disorders, where needed, each symptom was individually imputed, and recommended symptom-count cutoffs were applied to determine probable disorder. Unplanned missing values ranged from 1% to 3.3%, and planned missing values ranged from 3.4% (for major depressive disorder and generalized anxiety disorder, which were noncore only for 4th-5th graders) to 34.3%, including the remaining 4 disorders, which were noncore for the entire sample. To verify the impact of imputation on the results, parameter estimates and standard errors were calculated for the original (unimputed) and fully imputed data (unplanned and planned missing values imputed) and compared; considering the individual disorders that were part of the main outcome variable (any anxious/depressive disorder), after full imputation, parameter estimates never varied more than 0.6% compared with the original, unimputed values. Variations in the estimated odds ratio and adjusted odds ratio (AOR), measuring the association between demographics and exposure with “any anxious/depressive disorder,” were never more than 0.22. We assessed the association between dose of exposure and prevalence of 8 probable disorders. To further evaluate this association, 6 of the disorders were grouped as probable anxiety/depressive disorders, probable alcohol problems (abuse/dependence), probable social phobia, probable agoraphobia, probable PTSD, probable separation anxiety, and probable alcohol abuse/dependence. Table 2 also presents the prevalence of probable disorder by level of exposure to the WTC attack. Each probable anxiety/depressive disorder had a higher prevalence at higher levels of exposure (dose-response). Probable conduct disorder and probable alcohol abuse/dependence exhibited the same, though weaker, pattern. Further evidence for a dose-response pattern is provided by statistically significant linear relationships between number of symptoms and exposure level (P values for linear trend ≤.008, Cochran Mantel-Haenszel χ² test; test values not shown in tables).

Also in Table 2 are comparison rates of probable psychiatric disorders in children from pre-WTC community studies from available studies in New York State and surrounding areas, as well as Puerto Rico. In our study, among those with mild exposure, prevalence was within the range of pre-WTC non-New York City community rates, except for probable agoraphobia and probable alcohol abuse/dependence.

Table 3 presents prevalence of probable disorders and exposure by sex and grade level. The probable anxiety/depressive disorders were more frequent in girls. Rates of probable PTSD, probable separation anxiety, and probable agoraphobia were higher in younger children (4th-5th graders). As might be expected, probable conduct dis-

ROLE OF THE FUNDING SOURCE

The US Department of Education School Emergency Response to Violence Project funded the data collection but had no other role in the study. The Epidemiology Department, Mailman School of Public Health, Columbia University; the New York State Psychiatric Institute; and the Centers for Disease Control and Prevention (Atlanta, Ga) provided personnel and material support pro bono.

**Table 1** presents the selected sociodemographic characteristics of the sample. The sex and ethnic distribution closely reflected the New York City public school population, grades 4 through 12, at the time of the survey. Latino children were the largest group (40.1%), followed by African American children (27.9%). Table 1 also displays data on exposure to the WTC attack. Ground zero area children had more direct exposure than did children in the rest of the city (80.8% vs 23.8%; χ² = 543.81; P < .001, not shown). However, they had less family exposure (8.6% vs 12.6%; χ² = 16.77; P < .001). They also had less prior exposure to traumatic events (22.1% vs 30.6%; χ² = 15.55; P < .001).

As presented in **Table 2**, 28.6% of all children had 1 or more of the 6 probable anxiety/depressive disorders. The most prevalent were probable agoraphobia (14.8%), probable separation anxiety (12.3%), and probable PTSD (10.6%). Additionally, 12.8% had probable conduct disorder and 4.5% of those in grades 6 through 12 had probable alcohol problems (abuse/dependence).

Table 2 also presents the prevalence of probable disorder by level of exposure to the WTC attack. Each probable anxiety/depressive disorder had a higher prevalence at higher levels of exposure (dose-response). Probable conduct disorder and probable alcohol abuse dependence exhibited the same, though weaker, pattern. Further evidence for a dose-response pattern is provided by statistically significant linear relationships between number of symptoms and exposure level (P values for linear trend < .008, Cochran Mantel-Haenszel χ² test; test values not shown in tables).

Also in Table 2 are comparison rates of probable psychiatric disorders in children from pre-WTC community studies from available studies in New York State and surrounding areas, as well as Puerto Rico. In our study, among those with mild exposure, prevalence was within the range of pre-WTC non-New York City community rates, except for probable agoraphobia and probable alcohol abuse/dependence.
order was more frequent in boys and in older children. Direct and family exposure were more frequent in younger children (4th-5th graders). Older children (9th-12th graders) were more likely to attend ground zero area schools and to have had prior exposures compared with the younger age groups.

### Table 1. Sociodemographics and Exposures for 8236 Sample Children: New York City School Survey Post–September 11th, Grades 4 Through 12

<table>
<thead>
<tr>
<th>Grade group</th>
<th>Sample Size (Unweighted)</th>
<th>Unweighted Percentage (SE)</th>
<th>Weighted Percentage (SE)</th>
<th>New York City Public School Students Grades 4-12 (2001-2002), %*</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-5</td>
<td>1245</td>
<td>15.1 (4.7)</td>
<td>25.3 (9.6)</td>
<td>24.0</td>
</tr>
<tr>
<td>6-8</td>
<td>2924</td>
<td>35.5 (6.9)</td>
<td>33.7 (9.1)</td>
<td>34.4</td>
</tr>
<tr>
<td>9-12</td>
<td>4067</td>
<td>49.4 (6.6)</td>
<td>41.0 (10.0)</td>
<td>41.5</td>
</tr>
<tr>
<td>Female</td>
<td>4316</td>
<td>52.4 (1.8)</td>
<td>53.1 (2.8)</td>
<td>50.6</td>
</tr>
<tr>
<td>Race/ethnicity†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>1855</td>
<td>22.5 (3.3)</td>
<td>27.9 (5.3)</td>
<td>34.6</td>
</tr>
<tr>
<td>Latino</td>
<td>2936</td>
<td>35.6 (3.3)</td>
<td>40.1 (4.4)</td>
<td>36.3</td>
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<tr>
<td>White</td>
<td>1489</td>
<td>18.1 (3.0)</td>
<td>13.4 (3.3)</td>
<td>15.8</td>
</tr>
<tr>
<td>Asian</td>
<td>1552</td>
<td>18.8 (2.2)</td>
<td>12.8 (3.2)</td>
<td>13.0</td>
</tr>
<tr>
<td>Mixed/other</td>
<td>404</td>
<td>4.9 (0.5)</td>
<td>5.7 (0.8)</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Exposure

- **Attendance in ground zero area school**: 2042 (24.8 (1.3) 1.3 (0.1)
- **Direct exposure**: 3226 (39.2 (1.9) 24.6 (2.3)
- **Any family exposure**: 957 (11.6 (0.6) 12.5 (1.0)
- **Prior exposure**: 2376 (28.8 (1.2) 30.6 (2.1)
- **High media exposure**: 5292 (64.2 (1.3) 63.3 (2.5)
- **Belle Harbor plane crash**: 258 (3.1 (0.7) 2.9 (0.6)
- **Mental health service use**: 1586 (19.3 (0.9) 18.8 (1.2)

*Source: New York City Department of Education.24
†The New York City Department of Education used US census 1990 race/ethnicity categories that do not include “mixed race.” The “other” group reported by the Department of Education is Native American (0.3%). The study reported herein used US census 2000 race/ethnicity categories and allows for mixed race.

### Table 2. 6 Months’ Post-September 11 Prevalence of Probable Mental Disorder by Exposure Level, Compared With Pre–September 11 US Community Rates, for 8236 New York City Public School Children in Grades 4-12*

<table>
<thead>
<tr>
<th>Probable Disorders‡</th>
<th>NYC-DOE WTC School Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated No. of Students</td>
</tr>
<tr>
<td>PTSD</td>
<td>75916</td>
</tr>
<tr>
<td>Major depression</td>
<td>58011</td>
</tr>
<tr>
<td>Generalized anxiety</td>
<td>73767</td>
</tr>
<tr>
<td>Separation anxiety</td>
<td>88091</td>
</tr>
<tr>
<td>Panic disorder</td>
<td>62308</td>
</tr>
<tr>
<td>Agoraphobia</td>
<td>105996</td>
</tr>
<tr>
<td>Any anxiety/depressive disorder†</td>
<td>204829</td>
</tr>
<tr>
<td>Conduct disorder</td>
<td>91672</td>
</tr>
<tr>
<td>Alcohol abuse/dependence (grades 6-12)</td>
<td>24461</td>
</tr>
</tbody>
</table>

*Source: New York City Department of Education.24
†Reported rates are with impairment, except for alcohol abuse/dependence and conduct disorder.
‡Overall χ² test. Results of paired χ² tests on exposure level. All comparisons are significant at P<.05, except for conduct disorder and alcohol abuse/dependence, major depressive disorder (moderate vs mild and moderate vs severe), and generalized anxiety disorder (moderate vs mild).
§Overall χ² test. Results of paired χ² tests on exposure level. All comparisons are significant at P<.05, except for conduct disorder and alcohol abuse/dependence, major depressive disorder (moderate vs mild and moderate vs severe), and generalized anxiety disorder (moderate vs mild).
¶Bird et al25; DSM-III; 4 to 16 years; DISC Version 2.0 (2-stage sampling design; first stage [N = 777]; second stage [N = 386]).
#Cohen et al26; DSM-III-R; 9 to 18 years; DISC Version 1.0 (N = 776).
**Shaffer et al27; DSM-III-R; 9 to 17 years; DISC Version 2.3 (N = 356).
††Any is limited to PTSD, major depression, generalized anxiety, separation anxiety, panic, and agoraphobia.

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This study has 6 main findings. First, 6 months after the WTC attack, a high proportion of New York City public school children had a probable mental disorder. A projected 205,000 students (28.6%) in grades 4 through 12 had 1 or more of the 6 probable anxiety/depressive disorders. The validity of these prevalence findings are supported, in part, by being consistent with observations from other studies as to the sex and age distribution of those with mental disorders in the general population.25,27 Studies conducted after disasters have the major limitation of not having assessed representative samples of a given population but rather having concentrated on subgroups subjected to specific exposures of interest. Consequently, comparing rates across studies can be misleading. A recent literature review28 revealed that after natural disasters, PTSD-related syndromes varied from 3% in children exposed to a tornado29 to 90% in children after exposure to a hurricane.7

The second main finding is that the severity of exposure to September 11 was related to the likelihood of hav-
ing 1 or more of the 8 probable disorders assessed. Generally, among children with neither direct nor family exposure to the WTC attack, the prevalence of these probable disorders was not elevated and appeared quite similar in magnitude to previous community studies. Based on the association between increased prevalence and greater exposure, it appears that the elevated prevalence of probable PTSD, as well as the other probable anxiety and depressive disorders, is related to exposure to the WTC attack. This observation must be made with caution, as prevalence in the same population is not available. However, when our study prevalence is compared with another urban population study (Stamford, Conn), conducted just prior to September 11, based on the same measures of probable psychopathology and targeting the same age group, the prevalence of probable anxiety/depressive disorders in Stamford was only slightly lower than that in New York City’s children with mild exposure. The higher prevalence of probable alcohol abuse/dependence and conduct disorder among the most severely exposed compared with those less exposed may also be related to the WTC attack. However, because these probable disorders do not exhibit as clear an association with dose of exposure, the present study cannot be considered as providing strong evidence for such a relationship.

The third main finding was that a wide range of probable mental disorders was elevated, in addition to PTSD. Because children with the types of mental disorders identified herein are not likely to be easily identified without active screening, nor likely to seek treatment, the variety of probable disorders identified by this survey highlights the importance of comprehensive population-based screening for psychiatric problems in children after a major disaster so that interventions can be properly targeted.

The fourth main finding was that family exposure to the WTC attack was associated with probable mental disorder, even more strongly than direct exposure. This suggests that some children may experience greater emotional impact from having a family member exposed than from being directly exposed themselves. The mechanism of this association is not known. This result may alert primary care professionals, first responders, school counselors, and other public health authorities of the potential that parental traumatization may in itself have an effect on child mental health. For children, postdisaster intervention may need to be broadly focused, including parental/family experience and loss.

The fifth main finding was that going to a school near the place of the attack was associated with lower rates of probable mental disorder. This somewhat surprising finding may possibly be explained by a combination of factors, such as worldwide attention to their situation, increased social support, and the fact that students in the ground zero area schools were the recipients of significant mental health intervention immediately after September 11, 2001. Although the following characteristics did not explain lower risk of psychopathology when added to multiple logistic regression models, students sampled from the ground zero area schools were more likely to be Asian, on average older, more likely to have received mental health services, and to live in households with 2 parents than were New York City students in general. While the complete explanation remains unclear, the broad geographic distribution of children with probable mental disorders throughout New York City indicates that those in need of mental health intervention after this disaster were not confined to the immediate area of the attack. Consequently, future postdisaster interventions should probably not be confined exclusively to children in close proximity to a disaster but should incorporate the disaster’s reach, both physically and psychologically.

The sixth main finding was that exposure to trauma prior to the WTC attack was a major risk factor for a post–September 11 probable mental disorder. Thinking prospectively, this finding is of considerable public health significance since a significant proportion of New York City children have now experienced a major trauma (September 11), rendering them more vulnerable to mental disorders in the future, especially following any new disaster. Interventions to mitigate the effects of prior trauma, including September 11, have now, therefore, become substantially more important.

The findings presented herein should be considered in light of the study’s limitations. The diagnostic assessment measure used, the DPS, was designed for screening, not diagnosis; therefore, the prevalence reported herein refers to probable, not definite, cases. Because this was an urgent assessment, following a unique situation, many of the measures of exposure used were not previously validated. Regarding the assessment of media exposure, more detailed information might have proven particularly useful in understanding the results. The mode of survey administration for the 2 grade groups differed, and individual compliance for those in grades 4 and 5 was less than for those in grades 6 through 12, which may have influenced these findings. While we approximated a representative sample of New York City public school children in grades 4 through 12, we did not include children attending parochial and private schools and were also unable to assess grades kindergarten through 3 and separate special education schools. The seemingly anomalous results related to group zero area students might be associated with information not measured in the current study, such as specific types of postdisaster interventions received (including mental health services). Finally, it may be inappropriate to generalize from the widely dispersed effects found in this study to children affected by some other traumatic events. The elevated probable mental disorder prevalence identified throughout New York City after the WTC attack may, in fact, be due in part to the high visibility of this particular event, directly witnessed by millions of New Yorkers, indeed the world, as well as to the subsequent threats (eg, anthrax) and the war in Afghanistan.

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Author Affiliations: Department of Epidemiology, Mailman School of Public Health (Drs Hoven, Duarte, Wu, Mandell, Goodwin, F. Cohen, and Susser) and Department of Psychiatry, College of Physicians and Surgeons (Drs Hoven, Duarte, Lucas, Wu, P. Cohen, and Susser), Columbia University–New York State Psychiatric Institute (Drs Hoven, Duarte, Lucas, Wu, Mandell, P. Co-
hen, Bin, and Susser and Mr Musa), The Michael Cohen Group, LLC (Dr M. Cohen), New York City Department of Education (Dr Mei), Children’s Mental Health Alliance (Dr Cantor), Department of Psychology, New York University (Dr Aber), New York; National Center for Injury Prevention and Control and National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Ga (Drsi Balaban and Woodruff).

Correspondence: Christina W. Hoven, DrPH, Child Psychiatric Epidemiology Group, Columbia University–New York State Psychiatric Institute, 1051 Riverside Dr, New York State Psychiatric Institute, 1051 Riverside Dr, New York, NY 10032 (ch42@columbia.edu).

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REFERENCES