

Impact of Conjoined Exposure to the World Trade Center Attacks and to Other Traumatic Events on the Behavioral Problems of Preschool Children

Claude M. Chemtob, PhD; Yoko Nomura, PhD, MPH; Robert A. Abramovitz, MD

Objectives: To examine the long-term behavioral consequences of exposure to the World Trade Center (WTC) attacks in preschool children and to evaluate whether conjoined exposure to disaster and to other traumatic events has additive effects.

Design: Retrospective cohort study.

Setting: Lower Manhattan, New York.

Participants: A total of 116 preschool children directly exposed to the WTC attacks.

Main Exposures: High-intensity WTC attack-related trauma exposure indexed by the child experiencing 1 or more of the following: seeing people jumping out of the towers, seeing dead bodies, seeing injured people, witnessing the towers collapsing, and lifetime history of other trauma exposure.

Main Outcome Measure: Clinically significant behavioral problems as measured using the Child Behavioral Checklist.

Results: Preschool children exposed to high-intensity WTC attack-related events were at increased risk for the sleep problems and anxious/depressed behavioral symptom clusters. Conjoined exposure to high-intensity WTC attack-related events and to other trauma was associated with clinically significant emotionally reactive, anxious/depressed, and sleep-related behavioral problems. Children without a conjoined lifetime history of other trauma did not differ from nonexposed children. Risk of emotionally reactive, anxious/depressed, and attention problems in preschool children exposed to conjoined high-intensity WTC attack-related events and other trauma increased synergistically.

Conclusions: Conjoined other trauma exposure seems to amplify the impact of high-intensity WTC attack-related events on behavioral problems. Preschool children exposed to high-intensity events who had no other trauma exposure did not have increased clinically significant behavioral problems. The additive effects of trauma exposure are consistent with an allostatic load hypothesis of stress. More vigorous outreach to trauma-exposed preschool children should become a postdisaster public health priority.

Arch Pediatr Adolesc Med. 2008;162(2):126-133

Author Affiliations:

Departments of Psychiatry (Drs Chemtob and Nomura) and Pediatrics (Dr Chemtob), Mount Sinai School of Medicine, and Jewish Board of Family and Children's Services (Dr Abramovitz), New York, New York.

EXPOSURE TO TRAUMATIC events is associated with adverse psychological sequelae¹⁻⁷ in children. Although very young children may be particularly vulnerable to trauma,⁸ little is known about the impact of terrorism on preschool children.^{9,10} The only study¹¹ of preschool children exposed to the World Trade Center (WTC) attacks focused on parental help seeking. To our knowledge, the present study is the first to explore the psychological vulnerability of preschool children to terrorism exposure. Specifically, we asked (1) whether among preschool children directly exposed to the WTC attacks, those who experienced high-intensity WTC attack-related events (hereafter referred to as high-intensity WTC events) were more

likely to have clinically significant caregiver-reported behavioral problems and (2) whether, as would be consistent with the McEwen allostatic load hypothesis of the effects of trauma exposure,^{12,13} exposure to high-intensity WTC events conjoined with a lifetime history of exposure to other types of traumatic events synergistically increased the likelihood of preschool children having clinically significant behavioral problems.

To address these questions, we assessed the presence or absence of clinically significant behavioral problems in directly exposed non-help-seeking preschool children. Children were divided on the basis of high- and low-intensity exposure to the WTC events as well as presence or absence of a lifetime history of exposure to other trauma. We hypoth-

esized that preschool children exposed to high-intensity WTC events would be more likely than other directly exposed preschool children to have clinically significant behavioral problems. We also hypothesized that preschoolers with high-intensity exposure to disaster-related events and a history of other lifetime trauma exposure, compared with those who had either or none of these characteristics, would be the most likely to develop clinically significant behavioral problems. Finally, we explored whether, consistent with an allostatic load hypothesis, conjoined exposure to high-intensity WTC events and having a lifetime history of other trauma exposure would synergistically amplify the effects of exposure.

METHODS

PROCEDURES

This study was reviewed and approved by the Mount Sinai School of Medicine institutional review board. It was conducted between March 1, 2003, and December 31, 2005 (a mean of 35 months [range, 18-54 months] after the WTC attacks), with the aim of assessing the longer-term impact of the WTC attacks on preschool children who were 5 years or younger on the day of the attacks and who were exposed to the attacks. Families with children born between September 11, 1996, and September 11, 2002, were included in the study if they met the following inclusion criteria: (1) the family lived in Lower Manhattan on September 11, 2001 (the day of the WTC attacks) or (2) the child attended preschool or day care in Lower Manhattan. **Figure 1** illustrates the proximity of the preschools to the WTC site.

Families were recruited using outreach to various preschools, day care centers, Head Start programs, and community-based sites in Lower Manhattan. In addition, study brochures and flyers were posted in many Lower Manhattan pediatric practices. Interested individuals were invited to call a confidential hotline number for more information about participation. Staff members held tabling days at various preschools and day care centers during which project information was shared. When a parent or caregiver expressed a desire to participate in the study, a study staff member met with her or him individually to fully explain the study and review whether inclusion and exclusion criteria were met. Once parent comprehension was assured, consent was obtained. Parents or caregivers filled out a battery of questionnaires about their child that included demographic information, level of exposure to the WTC attacks, other trauma event exposure, and emotional and behavioral information (see the "Measures" section). Parents were compensated \$30.

PARTICIPANTS

A total of 170 families with 200 children agreed to participate and signed informed consent forms for research. Among these 200 children were siblings who were excluded because they were older than 5 years (ie, not of preschool age) on the day of the WTC attacks, 22 whose families withdrew before completing the study, and 30 who had missing information on exposure status to WTC or other trauma events, leaving 116 children. Children included did not differ from those excluded on major demographic variables, such as age, sex, race, and socioeconomic status.



Figure 1. Approximate locations of preschool and day care sites (diamonds) in relation to the World Trade Center (WTC).

MEASURES

Demographic Variables

Date of birth, sex, and ethnicity of the child were reported by the parent. Age of the child was calculated based on the date of the assessment and the date of birth. Maternal educational level was used as a proxy for socioeconomic status.^{14,15}

Index of Exposure to High-Intensity WTC Events

We assessed exposure to specific attack-related events that the children experienced on September 11, 2001, by parent report. Because all the participants were exposed to the WTC attacks, we created a dichotomous index of exposure to high-intensity events to contrast exposure intensity. Children were index positive if they directly witnessed 1 or more of the following events: either of the towers collapse, injured people, dead bodies, or people jumping out of the building. These 4 events were defined as high-intensity events because they involved very strong sensory impact¹⁶ and were directly related to threat of death and to injury, reflecting the exposure criteria for a diagnosis of posttraumatic stress disorder.¹⁷

Other Traumatic Experiences

The Traumatic Events Screening Inventory (TESI),¹⁸ modified for use with preschool children, was used to measure exposure to traumatic events other than the WTC attacks.¹⁹ The modified TESI assesses the child's lifetime trauma history for a wide range of events, including natural disasters, interpersonal losses, serious accidents, severe illnesses or injuries, animal attacks, exposure to war or terrorist acts, and exposure to suicide or attempted suicide. Items pertaining to physical abuse, sexual abuse, and domestic violence were omitted because preschool administrators and teachers were very concerned that these would be perceived as highly intrusive and distressing by families living in Lower Manhattan still recovering from the WTC attacks.

Child Behavioral Problems

The preschool version of the Child Behavioral Checklist (CBCL/1.5-5)²⁰ was used to obtain parental assessment of child behavior. The preschool version of the CBCL has good to high

Table 1. Exposure to High-Intensity WTC Attack-Related Events on September 11, 2001, and to Other Traumatic Events in 116 Children

	Children, No. (%)
Exposure to high-intensity WTC attack-related events on the day of the attacks	
Saw people jumping out of the building	6 (5.2)
Saw dead bodies	2 (1.7)
Saw injured people	11 (9.5)
Saw a tower collapse	23 (19.8)
Any of these events	28 (24.1)
Exposure to other traumatic events	
Somebody close arrested	5 (4.3)
Exposure to war or terrorism (other than the WTC attacks)	0
Watching scenes about war or terrorism on television (other than the WTC attacks)	30 (25.9)
Being in a serious accident	5 (4.3)
Seeing a serious accident	12 (10.3)
Being in a natural disaster	4 (3.4)
Somebody close having a serious illness	19 (16.4)
Death of somebody close	16 (13.8)
Having a serious medical procedure or being at the emergency department	17 (14.7)
Separated from a caregiver	18 (15.5)
Somebody close attempted suicide	1 (0.9)
Attacked by a dog	2 (1.7)
Other stressful events	24 (20.7)
Any of these events	62 (53.4)

Abbreviation: WTC, World Trade Center.

(range, 0.68-0.92) test-retest reliabilities,²⁰ and the internal consistency of most of the scales was good to excellent ($\alpha > .80$).²¹ The construct validity of the CBCL is supported by concurrent and predictive associations.²⁰ The 7 CBCL child behavioral problem scales are used in this study as the indices of behavioral problems.

Age- and sex-standardized T-scores were calculated for the 7 behavioral symptom clusters (emotionally reactive, anxious/depressed, somatic complaints, withdrawn behavior, sleep problems, attention problems, and aggressive behavior). Scores of 65 (90th percentile) or higher for the behavioral symptom scales are considered clinically significant levels of problems for research purposes²² and were used to define clinically significant levels of behavioral symptoms for each cluster.

Potential Confounders

The effects of the child's age at exposure, socioeconomic status, and time elapsed between the day of the attacks and assessment were controlled for statistically in all the analyses.

RESULTS

DEMOGRAPHICS

Approximately half (49.1%) of the children were girls. Mean (SD) age was 3.9 (1.0) years (range, 2-5 years). The participants were racially diverse: 30.7% were Asian, 23.9% were Hispanic, 20.4% were white, 10.6% were African American, and 14.4% reported "mixed" ethnicity.

EXPOSURE TO WTC TERRORISM-RELATED EVENTS

Although all the participants were exposed to the WTC attacks by virtue of being in or living in Lower Manhattan on the day of the WTC attacks, they differed in high-intensity WTC event exposure. **Table 1** provides the rates of exposure to each of the high-intensity events. Approximately 23% of the children were exposed to 1 or more of the high-intensity events. Children exposed to 1 or more of the high-intensity events were considered positive on the dichotomous index of high-intensity WTC exposure (see the "Measures" subsection of the "Methods" section). The group exposed to high-intensity WTC events was significantly older than the nonexposed group (4.4 vs 3.7 years; $F_{1,114}=12.6$; $P=.001$) but did not differ on sex or other demographic variables.

OTHER TRAUMA EXPOSURE

The bottom half of Table 1 provides the rates of exposure to various types of other traumatic events. Overall, approximately 53% of the preschool children had experienced at least 1 of the 13 traumatic events. There was no association between exposure to other trauma and exposure to the high-intensity WTC events ($\chi^2=0.034$; $P=.85$), suggesting that exposure to high-intensity WTC events took place independent of other trauma exposure.

BEHAVIORAL PROBLEMS IN CHILDREN EXPOSED TO HIGH-INTENSITY WTC EVENTS

Children exposed to high-intensity WTC events, relative to those who had not been exposed, were nearly 3 times more likely to be depressed/anxious ($P=.002$) and nearly 5 times more likely to have sleep problems ($P=.003$) (**Table 2**). We explored whether the number of high-intensity events (0-4) a child was exposed to increased the risk of clinically significant behavioral problems. Analyses demonstrated a significant or marginally significant dose-response increase in the anxious/depressed ($\chi^2=5.22$; $P=.02$), somatic complaints ($\chi^2=2.85$; $P=.09$), sleep problems ($\chi^2=15.2$; $P<.001$), attention problems ($\chi^2=8.9$; $P=.003$), and aggressive behavior ($\chi^2=3.0$; $P=.08$) behavioral symptom clusters.

RELATIVE IMPORTANCE OF THE EFFECT OF OTHER TRAUMA AND HIGH-INTENSITY WTC EVENTS

Table 3 addresses the relative importance of the 2 types of events (other trauma and high-intensity WTC events) on child behavioral problems. The contributions of both types of trauma to child outcome were evaluated simultaneously. The first column lists coefficients that indicate the improvement in model fit with the addition of exposure to other trauma and reflects the impact of other trauma on the prevalence of behavioral problems above and beyond the impact of the high-intensity WTC events. Similarly, the second column lists coefficients that indicate the improvement in model fit with the addition of exposure to high-intensity WTC events, reflecting the impact of high-

Table 2. Clinically Significant Behavioral Symptom Clusters by WTC Exposure Type in Preschool Children in Lower Manhattan^a

Behavioral Symptom Cluster	Rate, No. (%)		Odds Ratio (95% CI)		
	Exposed to High-Intensity WTC Attack-Related Events ^b (n=27)	Not Exposed to High-Intensity WTC Attack-Related Events ^c (n=89)	Unadjusted	Adjusted ^d	Adjusted ^e
	Emotionally reactive	6 (22)	9 (10)	2.5 (0.8-7.9)	3.4 (1.0-12.1)
Anxious/depressed	7 (26)	5 (6)	2.5 (1.7-20.5)	6.7 (1.7-27.3)	7.1 (1.5-33.6)
Somatic complaints	5 (19)	10 (11)	1.9 (0.6-6.1)	1.4 (0.4-5.0)	1.1 (0.3-3.9)
Withdrawn behavior	4 (15)	7 (8)	2.0 (0.6-7.6)	2.1 (0.5-8.5)	1.9 (0.4-8.2)
Sleep problems	8 (30)	7 (8)	4.9 (1.6-15.3)	1.5 (2.0-27.5)	7.2 (1.8-28.9)
Attention problems	5 (19)	6 (7)	3.3 (0.9-11.8)	3.6 (0.9-14.4)	5.9 (1.1-31.4)
Aggressive behavior	4 (15)	5 (6)	3.1 (0.8-12.3)	4.9 (1.0-23.4)	7.9 (1.2-53.9)

Abbreviations: CI, confidence interval; WTC, World Trade Center.

^aA cutoff score of 65 or higher was used as the clinically significant level of behavioral symptoms for each behavioral symptom cluster. The analysis was performed using logistic regression.

^bExposed is defined as witnessing at least 1 of the following high-intensity events: people jumping out of the building, dead bodies, injured people, or a tower collapse.

^cNot exposed is defined as not witnessing any of the high-intensity events.

^dAdjusted for socioeconomic status and age of child.

^eAdjusted for socioeconomic status, age of child, and time passed since the WTC attacks.

Table 3. Models Assessing the Relative Importance of Lifetime History of Trauma and Exposure to High-Intensity WTC Attack-Related Events in Predicting Child Behavioral Symptom Clusters

Behavioral Symptom Cluster	Hierarchical Model		Full Model			
	Other Trauma, χ^2 Change ^a	High-Intensity WTC Attack-Related Events, χ^2 Change ^b	Other Trauma		High-Intensity WTC Attack-Related Events ^a	
			OR (95% CI)	AOR (95% CI) ^d	OR (95% CI)	AOR (95% CI) ^d
Emotionally reactive	10.5	2.4	16.8 (2.1-135.4)	17.2 (2.1-139.9)	3.0 (0.9-10.5)	3.1 (0.7-14.2)
Anxious/depressed	4.5	8.7	6.0 (1.2-30.5)	5.8 (1.1-30.5)	6.9 (1.9-25.4)	6.2 (1.2-32.1)
Somatic complaints	0.9	0.8	2.7 (0.8-9.0)	3.5 (1.0-12.6)	1.9 (0.6-6.3)	1.0 (0.2-3.6)
Withdrawn behavior	0.4	1.0	0.7 (0.2-2.5)	0.7 (0.2-2.5)	2.0 (0.5-7.6)	2.0 (0.4-8.7)
Sleep problems	9.5	9.6	20.1 (2.4-169.2)	18.9 (2.1-165.4)	6.8 (1.9-24.2)	9.7 (1.9-50.2)
Attention problems	3.7	3.8	4.5 (0.9-22.2)	4.5 (0.9-23.6)	3.5 (0.9-12.9)	7.0 (1.2-42.0)
Aggressive behavior	4.6	2.2	8.1 (1.0-67.5)	8.0 (0.9-70.7)	3.3 (0.8-13.8)	9.0 (1.1-76.0)

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio; WTC, World Trade Center.

^aEvaluates the change in the likelihood ratio statistic, χ^2 , with the addition of the history of trauma variable in the logistic model including exposure to high-intensity WTC attack-related events.

^bHigh-intensity WTC attack-related events include witnessing people jumping out of the building, dead bodies, injured people, and the towers collapsing.

^cEvaluates the change in the likelihood ratio statistic, χ^2 , with the addition of high-intensity WTC attack-related events in the logistic model, including lifetime history of other trauma and exposure to other WTC attack-related events.

^dAdjusted for maternal educational level, age of child, and time between the WTC attacks and data collection.

intensity WTC events on the prevalence of behavioral problems above and beyond the impact of other trauma exposure. The last 2 columns indicate the odds ratios (ORs) and 95% confidence intervals generated from each of the main effects (history of exposure to other trauma and exposure to high-intensity WTC events) predicting each of the behavioral symptom clusters. Four of the 7 χ^2 coefficients generated from models adding lifetime history of other trauma showed significance beyond the .05 level. Four of the 7 coefficients generated from models adding the high-intensity WTC events were significant.

Taking into account other traumatic events that the children experienced very strongly improved the model for predicting clinically significant behavioral problems: emotionally reactive (adjusted OR [AOR]=17.2) and sleep problems (AOR=18.9). Similarly, having the

high-intensity WTC events in the model increased the ability to predict behavioral problems such as anxious/depressed (AOR=6.2) and sleep problems (AOR=9.7).

BEHAVIORAL PROBLEMS BY HIGH-INTENSITY WTC EXPOSURE STRATIFIED ON OTHER TRAUMA EXPOSURE

The 116 children were stratified on exposure to other trauma (yes vs no). **Figure 2** shows the prevalence rate of each behavioral symptom cluster in children exposed to high-intensity WTC events with and without a history of other trauma. In children who reported a history of other trauma, the risk of meeting the cutoff value for clinically significant levels of behavioral problems for the emotionally reactive (AOR=4.7; $P=.06$), anxious/

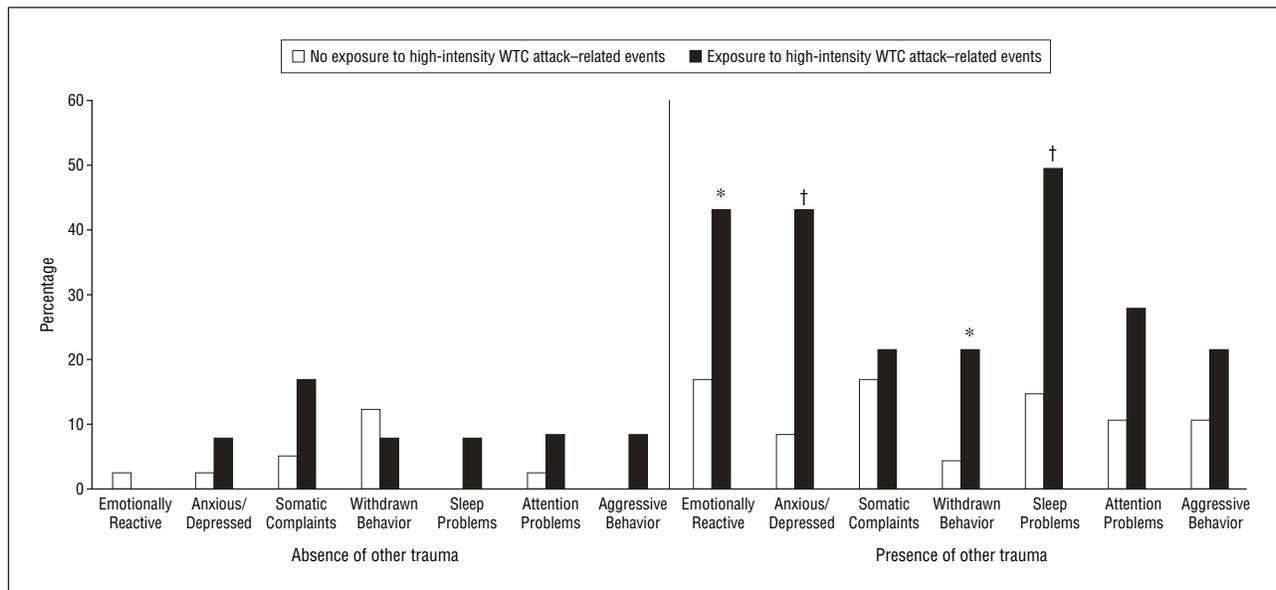


Figure 2. Percentage of clinically significant behavioral symptom clusters by lifetime history of other trauma exposure. WTC indicates World Trade Center. * $P < .05$. † $P < .001$.

Table 4. Risk (per 100) of Childhood Behavioral Symptoms by Exposure to High-Intensity WTC Attack-Related Events in Children With and Without a Lifetime History of Other Trauma^a

Behavioral Symptom Cluster	Absence of Other Trauma				Presence of Other Trauma			
	Exposure to High-Intensity WTC Attack-Related Events, No. (%)		OR (95% CI)	AOR (95% CI) ^b	Exposure to High-Intensity WTC Attack-Related Events, No. (%)		OR (95% CI)	AOR (95% CI) ^b
	No (n=41)	Yes (n=13)			No (n=48)	Yes (n=14)		
Emotionally reactive	1 (2)	0	NA	NA	8 (17)	6 (43)	3.8 (1.0-13.8)	4.7 (0.9-25.7)
Anxious/depressed	1 (2)	1 (8)	3.3 (0.2-57.4)	NA	4 (8)	6 (43)	8.3 (1.9-36.0)	7.5 (1.1-50.2)
Somatic complaints	2 (5)	2 (15)	3.9 (0.5-31.2)	2.8 (0.3-28.4)	8 (17)	3 (21)	1.4 (0.3-6.0)	0.9 (0.1-2.9)
Withdrawn behavior	5 (12)	1 (8)	0.6 (0.1-5.7)	0.6 (0.1-6.4)	2 (4)	3 (21)	6.3 (1.0-42.2)	7.0 (0.9-90.4)
Sleep problems	0	1 (8)	NA	NA	7 (15)	7 (50)	5.9 (1.6-21.9)	10.2 (1.7-63.1)
Attention problems	1 (2)	1 (8)	3.6 (0.2-62.9)	3.9 (0.2-272.2)	5 (10)	4 (29)	3.4 (0.8-15.2)	4.9 (0.7-36.0)
Aggressive behavior	0	1 (8)	NA	3.2 (0.5-19.3)	5 (10)	3 (21)	2.3 (0.5-11.4)	4.6 (0.5-44.5)

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; NA, not applicable; OR, odds ratio; WTC, World Trade Center.

^aThe Fisher exact test was used where at least 1 cell count was less than 5. High-intensity WTC events include the following: witnessing people jumping out of the building, dead bodies, injured people, and the tower collapsing. The analysis was performed using logistic regression.

^bAdjusted for age and time between the WTC attacks and data collection.

depressed (AOR=7.5; $P = .02$), withdrawn behavior (AOR=7.0; $P = .05$), and sleep problem (AOR=10.2; $P < .001$) clusters was higher in children who were also exposed to high-intensity WTC events compared with those who were not, even after controlling for potential confounders (**Table 4**). Because the prevalence rates were very low in children without other trauma exposure, we could not estimate the risk of emotional reactivity, sleep problems, or aggression.

Figure 3 illustrates the risk (OR) of elevated behavioral problems in the 4 groups. Compared with children who had neither a history of other trauma nor exposure to high-intensity WTC events (reference group), those who had conjoined exposure were at a 21-fold increased risk for meeting or exceeding the cutoff value for the emotion-

ally reactive (AOR=21.8; $P = .003$) and anxious/depressed (AOR=26.8; $P = .006$) clusters and had a 16-fold increased risk of doing so on the attention problems cluster (AOR=18.6; $P = .01$) after controlling for confounders.

Note that there is a high prevalence of sleep problems in children with exposure to high-intensity WTC events and a lifetime history of other trauma exposure (Figure 2). However, because the reference group of 41 children without either type of trauma exposure reported no sleep problems, we could not estimate the risk of sleep problems in other groups. Children with other trauma exposure who were not exposed to high-intensity WTC events had an increased risk of emotionally reactive behavior (OR=8.0; $P = .05$). Children exposed to high-intensity WTC events but to no other

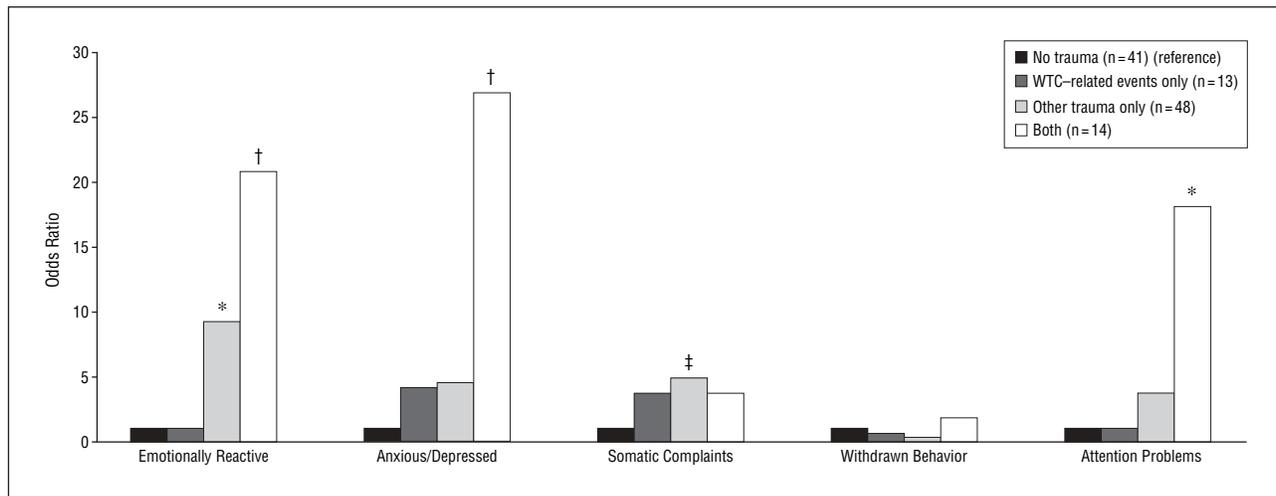


Figure 3. Effect of conjoined exposure to high-intensity World Trade Center (WTC) attack-related events and to other lifetime trauma exposure on child symptoms. Logistic regression analysis was used, with adjustment for child age, maternal educational level, and time between the WTC attacks and the assessment. * $P < .05$. † $P < .01$. ‡ $P < .10$.

traumatic events did not have a greater risk of clinically significant behavioral problems.

COMMENT

This exploratory study has 4 main findings: (1) children exposed to high-intensity WTC events were at greater risk for clinically significant behavioral problems as reported by caregivers than children directly exposed to the WTC attacks who did not experience high-intensity events; (2) exposure to high-intensity WTC events and a history of lifetime exposure to other traumatic events independently increased the risk of clinically significant child behavioral problems; (3) once children were stratified on presence vs absence of exposure to other trauma, the impact of high-intensity WTC events on child behavioral problems differed (a 3- to 8-fold increased risk of behavioral problems in children with other trauma and no increased risk in children without other trauma); and (4) compared with children exposed to neither high-intensity WTC events nor other trauma, those exposed to both, consistent with an allostatic load hypothesis, exhibited a synergistically elevated risk of clinically significant behavioral problems.

Given that the study criterion for clinical significance on each behavioral cluster was set to the CBCL cutoff score, we would expect 10% of each subgroup to reach the clinically significant criterion. Thus, it is remarkable that in the high-intensity exposure group with a conjoined lifetime history of other trauma exposure, 50.0% met the cutoff value for the sleep problems, 42.9% for the anxious/depressed, and 42.9% for the emotionally reactive symptom clusters.

One of the events included in the TESI is watching scenes of war and terrorism on television (other than the WTC attacks). Whether media exposure should be considered a trauma event remains controversial.²³⁻²⁵ To see whether these findings were affected by potential misclassification, due to reporting exposure to traumatic scenes on television, we performed the analyses again.

The results were not affected by taking into account media exposure as a trauma event or leaving it out.

As we hypothesized, conjoined child exposure to other trauma increased the risk of having clinically significant behavioral problems. Exposure to high-intensity WTC events had little impact on preschool children who did not have any other lifetime trauma exposure, but exposure to high-intensity WTC events conjoined with exposure to other trauma substantially increased the risk of having clinically significant behavioral symptom clusters, including emotional reactivity (OR=3.8; AOR=4.7), anxious/depressed (OR=8.3; AOR=7.5), withdrawn behavior (OR=6.3; AOR=7.0), and sleep problems (OR=5.9; AOR=1.2).

We explored the possibility of a synergistic risk of having the 2 types of trauma for child behavioral problems. We subdivided the sample into 4 groups: children who were not exposed to either high-intensity WTC events or other traumatic events, children exposed only to high-intensity WTC events, children exposed only to other traumatic events, and those with both types of trauma exposure. We found synergistically elevated risks of emotional reactivity, anxious/depressed, and attention problems in those exposed to both types relative to those with neither (Figure 3). Although consistent with an allostatic load hypothesis of adaptation to traumatic events, further research is required to identify the mechanisms that may specifically contribute to these conjoined exposure effects.

A review of the behavioral problems included in the behavioral clusters that most differentiated the exposure groups (emotional reactivity and anxious/depressed) suggests that they may index difficulties in emotional regulation. Future research with preschool children exposed to mass disaster and to other trauma would benefit from adding behavioral measures of emotional regulation, including parent-child dyadic regulation, to supplement caregiver reports of behavioral problems.²⁶ Similarly, given recent findings about the cognitive performance of disaster-exposed children,²⁷ consideration should be given to

examining the impact of conjoined disaster exposure and lifetime trauma exposure on neurodevelopment²⁸ and cognitive performance.²⁷

Finally, the impact of exposure to high-intensity WTC events may not be specific to terrorism or to community disasters. Seeing dead and injured bodies, for example, would be likely to affect young children universally because of their strong sensory and affective impact. Preschool children are not likely to have appraised these events as being terrorism related. However, it is not known whether the larger context of the WTC attacks on family and community reactions may have contributed to potentiating the impact of WTC exposure on young children when conjoined with other lifetime trauma exposure by creating a dysregulated psychological environment. The character and impact of trauma exposure on preschool children has received little investigation and merits considerable further research.

STUDY LIMITATIONS

This exploratory study's findings should be considered in light of several limitations. First, although we assessed approximately 7% (n=116) of the children counted by the 2000 census in the study area (N=1643), we cannot assume that this sample is representative of Lower Manhattan preschool children. Second, although we identified extremely low rates of service utilization in these preschoolers, we did not include an extensive survey of family patterns of service utilization before and after the WTC attacks. In a later phase of the study, 27 families were specifically queried about service utilization using additional structured queries. Only 1 of these 27 families had sought help for their preschool child. Third, items pertaining to exposure to sexual abuse, physical abuse, and domestic violence on the TESI were not included in the assessment of lifetime trauma exposure. Given the adverse effects of sexual and physical abuse and of exposure to domestic violence, our estimates of the impact of exposure to other trauma are probably conservative. Fourth, the CBCL data regarding child problems are based on the mother's report on her child. Although it is possible that a mother's own psychological problems could affect her report of the child symptom scores, this is a limitation of all clinical research on preschool children, including studies using more detailed clinical interviews.^{29,30} Smith et al³¹ used cross-sectional multi-informant data from children exposed to the war in Bosnia-Herzegovina to disentangle these effects. Their study suggested that traumatized parents can provide valid data on symptoms in their children. Finally, because these data are cross-sectional and are subject to retrospective recall bias, causality cannot be inferred. These limitations should stimulate follow-up research that asks related questions, ideally using prospective longitudinal research designs.

CLINICAL AND POLICY IMPLICATIONS

These data suggest that preschool children are vulnerable to the effects of high-intensity disaster exposure, particularly if they have a conjoined lifetime history of ex-

posure to other trauma events. Physicians seeking to assess the impact of terrorism and disaster on very young children should assess for disaster-related exposure and for other trauma.

The statistics available for New York State's extremely well-funded post-WTC attacks mental health outreach and services system (Project Liberty) show that children overall were underrepresented among recipients of the WTC attack-related mental health services relative to their proportion in census data,³² accounting for only 9% of 463 277 service encounters by 177 provider agencies. Preschool children accounted for only 0.28% (n=1298) of these service encounters, far less than the representation of preschool children (aged 0-5 years) in the New York City 2000 census. These data suggest that preschool children are a vulnerable group and argue for more vigorous postdisaster outreach to very young children, especially those with exposure to other trauma.

A possible explanation for the low rates of outreach and service to very young children may be the lack of outreach models for preschool children. Most child service encounters (41%) were provided in the school setting, perhaps reflecting the utility of providing postdisaster services to children in schools.³³ The present study sought to extend our earlier work using schools to identify and treat school-aged children³³ to preschool congregate care settings. However, not all parents use congregate child care settings. Moreover, we found that although preschools did facilitate access, parents use these settings to reduce their parenting burden. Not all parents were willing to take on the burden of study participation, although we offered free services to distressed children. Thus, preschool settings can be only part of a multipronged outreach strategy to preschool children and their families. One promising additional approach would draw on pediatricians in the aftermath of mass disasters to screen preschool children.

Pediatricians are a unique resource for identifying preschool children exposed to terrorism because very young children are routinely seen in pediatric practices^{34,35} for well-child care visits. It would be only a small psychological step for parents to bring their very young children to their pediatrician for a comprehensive postdisaster visit that would include assessing the child's behavioral functioning. The likelihood that pediatricians may be key resources in early identification of very young children at greater developmental risk by virtue of terrorism and trauma exposure adds support to calls for additional investment to increase the capacity of pediatric practices to participate in national terrorism and disaster preparedness.^{36,37}

Accepted for Publication: July 18, 2007.

Correspondence: Claude M. Chemtob, PhD, Departments of Psychiatry and Pediatrics, Mount Sinai School of Medicine, One Gustave L Levy Place, Campus Box 1230, New York, NY 10029 (claude.chemtob@mssm.edu).

Author Contributions: Dr Chemtob had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Chemtob and Nomura. *Acquisition of data:* Chemtob and Abramovitz. *Analysis and*

interpretation of data: Chemtob and Nomura. *Drafting of the manuscript:* Chemtob and Nomura. *Critical revision of the manuscript for important intellectual content:* Chemtob, Nomura, and Abramovitz. *Obtained funding:* Chemtob, Nomura, and Abramovitz. *Administrative, technical, and material support:* Chemtob and Abramovitz. *Study supervision:* Chemtob and Abramovitz.

Financial Disclosure: None reported.

Funding/Support: This study was partially supported by grant R24 MH063910-04 from the National Institute of Mental Health (Dr Chemtob) and by grants from the New York Times Foundation's September 11 Fund, National Philanthropic Trust/Sept 11th Children's Fund, United Jewish Communities, UJA Federation of New York, the UBS September 11 Fund, the Robin Hood Foundation, the Picower Foundation, an anonymous donor, the American Red Cross, Andor Capital Management, and Strook, Strook, and Lavan LLP.

Role of the Sponsors: The funders had no role in the design or conduct of the study.

Additional Contributions: Alicia Lieberman, PhD, Joy Osofsky, PhD, and Charles Zeanah, MD, contributed their expertise as advisors during the formative stages of this work. We thank the study staff and assessors, including Deborah Carroll, MSW, Kelly Dugan, MA, Adrian Guzman, BA, and Deena Schwartz, BA. Ms Schwartz also assisted in the preparation of this manuscript.

REFERENCES

1. Pelcovitz D, Kaplan S, Goldenberg G, Mandel F, Lehane J, Guarrerra J. Post traumatic stress disorder in physically abused adolescents. *J Am Acad Child Adolesc Psychiatry.* 1994;33(3):305-312.
2. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the Adverse Childhood Experiences (ACE) Study. *Am J Prev Med.* 1998;14(4):245-258.
3. Pfefferbaum B. Posttraumatic stress disorder in children: a review of the past 10 years. *J Am Acad Child Adolesc Psychiatry.* 1997;36(11):1503-1511.
4. Godeau E, Vignes C, Navarro F, et al. Effects of a large-scale industrial disaster on rates of symptoms consistent with posttraumatic stress disorders among schoolchildren in Toulouse. *Arch Pediatr Adolesc Med.* 2005;159(6):579-584.
5. Thabet AA, Abed Y, Vostanis P. Emotional problems in Palestinian children living in a war zone: a cross-sectional study. *Lancet.* 2002;359(9320):1801-1804.
6. Laor N, Wolmer L, Mayes LC, et al. Israeli preschoolers under Scud missile attacks: a developmental perspective on risk-modifying factors. *Arch Gen Psychiatry.* 1996;53(5):416-423.
7. Fremont WP. Childhood reactions to terrorism induced trauma: a review of the past 10 years. *J Am Acad Child Adolesc Psychiatry.* 2004;43(4):381-392.
8. Osofsky JD. The effects of violence exposure on young children. *Am Psychol.* 1995;50(9):782-788.
9. Gurwitsch RH, Sullivan MA, Long PJ. The impact of trauma and disaster on young children. *Child Adolesc Psychiatr Clin N Am.* 1998;7(1):19-32.
10. Pine DS, Costello J, Masten A. Trauma, proximity, and developmental psychopathology: the effects of war and terrorism on children. *Neuropsychopharmacology.* 2005;30(10):1781-1792.
11. DeVoe ER, Bannon WM, Klein TP. Post-9/11 helpseeking by New York City parents on behalf of highly exposed young children. *Am J Orthopsychiatry.* 2006;76(2):167-175.
12. McEwen BS, Biron CA, Brunson KW, et al. The role of adrenocorticoids as modulators of immune function in health and disease: neural, endocrine and immune interactions. *Brain Res Brain Res Rev.* 1997;23(1-2):79-133.
13. McEwen BS. Protective and damaging effects of stress mediators. *N Engl J Med.* 1998;338(3):171-179.
14. Liberatos P, Link BG, Kelsey JL. The measurement of social class in epidemiology. *Epidemiol Rev.* 1988;10:87-121.
15. Bollen KA, Glanville JL, Stecklov G. Socio-economic status, permanent income, and fertility: a latent-variable approach. *Popul Stud (Camb).* 2007;61(1):15-34.
16. Dyregrov A, Raundalen M. The impact of the Gulf War on the children of Iraq. Paper presented at: International Society for Traumatic Stress Studies World Conference; June 1992; Amsterdam, the Netherlands.
17. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision.* Arlington, VA: American Psychiatric Association; 2000.
18. Ford JD, Rogers K. Empirically-based assessment of trauma and PTSD with children and adolescents. In: Proceedings from the International Society for Traumatic Stress Studies Annual Meeting; November 1997; Montreal, Quebec, Canada.
19. Ghosh-Ippen C, Ford J, Racusin R, et al. *Trauma Events Screening Inventory-Parent Report Revised.* San Francisco, CA: Child Trauma Research Project of the Early Trauma Network and the National Center for PTSD Dartmouth Child Trauma Research Group; 2002.
20. Achenbach TM, Rescorla LA. *Manual for ASEBA Preschool Forms and Profiles.* Burlington: University of Vermont, Research Center for Children, Youth, and Families; 2000.
21. Döpfner M, Schmeck K, Berner W, Lehmkuhl G, Poustka F. Reliability and factorial validity of the Child Behavior Checklist: an analysis of a clinical and field sample [in German]. *Z Kinder Jugendpsychiatr.* 1994;22(3):189-205.
22. Rescorla LA. Assessment of young children using the Achenbach System of Empirically Based Assessment (ASEBA). *Ment Retard Dev Disabil Res Rev.* 2005;11(3):226-237.
23. Pfefferbaum B, Seale TW, Brandt EN Jr, Pfefferbaum RL, Doughty DE, Rainwater SM. Media exposure in children one hundred miles from a terrorist bombing. *Ann Clin Psychiatry.* 2003;15(1):1-8.
24. Wang Y, Nomura Y, Pat-Horenczyk R, et al. Association of direct exposure to terrorism, media exposure to terrorism, and other trauma with emotional and behavioral problems in preschool children. *Ann N Y Acad Sci.* 2006;1094:363-368.
25. Pfefferbaum B, Pfefferbaum RL, North CS, Neas BR. Does television viewing satisfy criteria for exposure in posttraumatic stress disorder? *Psychiatry.* 2002;65(4):306-309.
26. Dennis T. Emotional self-regulation in preschoolers: the interplay of child approach reactivity, parenting, and control capacities. *Dev Psychol.* 2006;42(1):84-97.
27. Smilde-van den Doel DA, Smit C, Wolleswinkel-van den Bosch JH. School performance and social-emotional behavior of primary school children before and after a disaster. *Pediatrics.* 2006;118(5):e1311-e1320.
28. Carrion VG, Weems CF, Reiss AL. Stress predicts brain changes in children: a pilot longitudinal study on youth stress, posttraumatic stress disorder, and the hippocampus. *Pediatrics.* 2007;119(3):509-516.
29. Scheeringa MS, Zeanah CH, Myers L, Putnam FW. New findings on alternative criteria for PTSD in preschool children. *J Am Acad Child Adolesc Psychiatry.* 2003;42(5):561-570.
30. Scheeringa MS, Peebles CD, Cook CA, Zeanah CH. Toward establishing procedural, criterion, and discriminant validity for PTSD in early childhood. *J Am Acad Child Adolesc Psychiatry.* 2001;40(1):52-60.
31. Smith P, Perrin S, Yule W, Rabe-Hesketh S. War exposure and maternal reactions in the psychological adjustment of children from Bosnia-Herzegovina. *J Child Psychol Psychiatry.* 2001;42(3):395-404.
32. Covell NH, Allen G, Essock SM, et al. Service utilization and event reaction patterns among children who received Project Liberty counseling services. *Psychiatr Serv.* 2006;57(9):1277-1282.
33. Chemtob CM, Nakashima JP, Hamada RS. Psychosocial intervention for post-disaster trauma symptoms in elementary school children: a controlled community field study. *Arch Pediatr Adolesc Med.* 2002;156(3):211-216.
34. Laraque D, Boscarino JA, Battista A, et al. Reactions and needs of tristate-area pediatricians after the events of September 11th: implications for children's mental health services. *Pediatrics.* 2004;113(5):1357-1366.
35. Fairbrother G, Stuber J, Galea S, Pfefferbaum B, Fleischman AR. Unmet need for counseling services by children in New York City after the September 11th attacks on the World Trade Center: implications for pediatricians. *Pediatrics.* 2004;113(5):1367-1374.
36. Hagan JF Jr; American Academy of Pediatrics, Committee on Psychosocial Aspects of Child and Family Health; Task Force on Terrorism. Psychosocial implications of disaster or terrorism on children: a guide for the pediatrician. *Pediatrics.* 2005;116(3):787-795.
37. Centers for Disease Control and Prevention; National Advisory Committee on Children and Terrorism. NACCT (recommendations to the Secretary of the Department of HHS). June 2003. <http://www.bt.cdc.gov/children/>. Accessed November 15, 2007.