Effect of Maternal Psychopathology on Behavioral Problems in Preschool Children Exposed to Terrorism

Use of Generalized Estimating Equations to Integrate Multiple Informant Reports

Yoko Nomura, PhD, MPH; Claude M. Chemtob, PhD

Objective: To examine whether the number of maternal psychopathologies is associated with increased clinically significant behavioral problems in preschool children exposed to disaster, using child behavior ratings from multiple informants.

Design: Cross-sectional study.

Setting: Lower Manhattan, New York, New York.

Participants: One hundred two preschool child-mother dyads directly exposed to the World Trade Center attacks.

Exposures: Maternal disorders: 2 (posttraumatic stress disorder [PTSD] and depression), 1 (depression or PTSD), or none.

Main Outcome Measures: Maternal depression and PTSD were self-reported. Child behavioral problems were rated by mothers and teachers using a standardized behavioral checklist. For each informant, we created separate dichotomous variables that indicated whether the child’s behavioral problems were severe enough to be clinically significant. We then used an analytic technique (generalized estimating equations) that integrates the child behavioral problem ratings by the mother and teachers to derive a more reliable indicator of clinically significant child behavioral problems.

Results: The rate of clinically significant child behavioral problems increased linearly relative to the number of maternal psychopathologies. The number of maternal psychopathologies was associated with a linear increase in functional impairment. Compared with children of mothers without psychopathologies, children of mothers with depression and PTSD were at greater risk for several clinically significant problems, notably, aggressive behavior (relative risk, 13.0), emotionally reactive behavior (11.2), and somatic complaints (10.5). Boys were more likely to have clinically significant behavior problems than girls.

Conclusion: Concurrent maternal depression and PTSD was associated with dramatic increases in the rate of clinically significant behavioral problems in preschool children, particularly boys, 3 years after the World Trade Center attacks.


Although evidence exists that preschool children are highly vulnerable to the effects of armed conflict,1,2 little is known about the effects of terrorism on preschool children.3-7 Very young children are likely to be affected by direct exposure to terrorism and to be affected indirectly by the consequences of their mother’s exposure to terrorism. Preschool children directly exposed to terrorism plus other trauma are much more likely to have clinically significant behavioral problems than are children exposed to terrorism only, to other trauma only, or to neither. This is consistent with McEwen’s theory of allostatic load.9 Although the effect of parental depression on child behavioral problems and psychopathology has been well established,10-13 to our knowledge, only a limited number of studies to date have evaluated the effects of maternal posttraumatic stress disorder (PTSD) on child psychopathology.14-18 Posttraumatic stress disorder and depression occur frequently in adults exposed to a disaster.19 However, to our knowledge, very few studies have examined the effects of maternal PTSD and depression on psychopathology among young children exposed to disaster.

A recent prospective investigation of trauma-exposed youth16 suggests that factors such as cumulative lifetime trauma exposure may account for increased youth posttraumatic distress when simultaneously entered into regression models with parent PTSD or depression. Thus, it

Author Affiliations:
Departments of Psychiatry and Pediatrics, Mount Sinai School of Medicine, New York, New York.
is possible that maternal increase in symptoms of PTSD or depression is a proxy for previous trauma exposure. To our knowledge, no studies have examined the effects of terrorism-related maternal PTSD and depression together with child and mother exposure to terrorism and other trauma on child behavioral problems.

Guided by the concept of allostatic load, we reasoned that a maternal disorder would represent indirect exposure to the effects of terrorism in very young children because of its effects on maternal symptoms and impairment. We predicted that the number of disorders a mother experiences would be associated with a linear increase in maternal impairment.20,21 Further, we predicted that the number of maternal disorders would be associated with a greater adverse effect on children’s behavioral problems after terrorism exposure. Specifically, we hypothesized that children whose mothers have 2 disorders (PTSD and depression) in the aftermath of exposure to the World Trade Center (WTC) attacks would be at greater risk of behavioral problems compared with children whose mothers had only 1 disorder (either PTSD or depression) and children whose mothers had neither disorder.

METHODS

This study was approved by the Mount Sinai School of Medicine Institutional Review Board. It was conducted between March 1, 2003, and December 31, 2005, a mean (range) of 35 (18-54) months after the WTC attacks, to assess the longer-term effect of WTC-attack exposure on preschool children. Families with children born between September 11, 1996, and September 11, 2002, were included if the children lived in lower Manhattan or attended preschool or daycare in lower Manhattan on the day of the WTC attacks.

Families were recruited using extensive outreach in the lower Manhattan area. Procedure details are described elsewhere.18 The study sample comprised 102 child-mother dyads for whom both parent and teacher ratings were available. Participants who dropped out of the study did not differ in age, sex, race/ethnicity, or socioeconomic status (SES) from those who completed the study.

MEASURES

Demographic Data

Age, ethnicity of the child, and maternal educational achievement level were reported by the mother.

Child Behavioral and Emotional Problems

We used the preschool version of the Child Behavior Checklist for Ages 1.5-5 (CBCL/1.5-5)22 to measure children’s problems. The preschool CBCL is an established psychometric measure.22 The 7 CBCL scales were our indices of child behavioral problems. Age- and sex-standardized T scores were calculated for each scale (emotionally reactive, anxious/depressed, somatic complaints, withdrawn, sleep problems, attention problems, and aggressive behavior). A problem score equal to or higher than 65 (reflecting a score at or above the 93rd percentile) is considered clinically significant and was used as our cutoff point.

Teachers completed the preschool version of the Caregiver-Teacher Report Form (C-TRF),24 a behavior rating checklist that consists of 6 of 7 CBCL behavioral problem scales. The sleep problem cluster is not rated by teachers and was excluded from our analyses. The C-TRF uses many of the same behavioral problem items as the CBCL but substitutes group situation items for family situation items. It has high test-retest reliability (mean, r = 0.81) and good correlations with the CBCL (mean, r = 0.40).22

Maternal Psychopathology

The Center for Epidemiologic Studies-Depression Scale (CES-D)23 was used to measure probable maternal depression. This 20-item scale assesses the frequency of depression symptoms rated on a 4-point Likert scale with excellent internal consistency.23,24 Probable maternal depression was dichotomized using the clinical cutoff score of 16.25 Reliability of the CES-D has been demonstrated in clinical26 and epidemiologic studies.27,28 It has good sensitivity (80%) and specificity (68%) for identifying psychiatric illness.29,30

The Posttraumatic Stress Diagnostic Scale (PDS)32 was used to assess probable maternal PTSD. The PDS parallels the Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition) (DSM-IV) PTSD diagnostic criteria.33 The PDS has a test-retest reliability k value of 0.74 for PTSD diagnosis. It has a k value of 0.65 with the Structured Clinical Interview (SCID) for the Diagnostic and Statistical Manual of Mental Disorders (Third Revised Edition) (DSM-III-R), with 82% agreement between the 2 measures.34 The sensitivity and specificity of the PDS with respect to diagnosis using the SCID for the DSM-III-R are 0.89 and 0.75, respectively.35 Mothers were considered to have PTSD if they met all 6 diagnostic criteria: exposure to a traumatic event, persistent reexperiencing of symptoms, persistent avoidance of the stimuli associated with the trauma, persistent arousal, duration of the disturbance for longer than 1 month, and clinically significant functional impairment.

POTENTIAL CONFOUNDERS

Mother and Child Exposure to High-Intensity WTC Attack–Related Events

Maternal WTC attack exposure was measured by the mother’s dichotomous responses to 6 questions about direct exposure to high-intensity WTC attack–related events (personally saw a plane hit a tower, saw the tower collapse, saw injured people, saw dead bodies, saw people jumping out of the building, and were caught in the debris or smoke). Responses were summed to denote exposure level. Mothers reported the extent to which their children had been directly exposed to the same WTC attack–related events. The same continuous index was created for children.32

Child and Mother Exposure to Other Traumatic Experiences

Children’s exposure to trauma other than the WTC attacks was measured with a modified version of the Traumatic Events Screening Inventory (TESI),37 which measures exposure to events such as 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. Physical and sexual abuse and domestic violence items were considered too sensitive by preschool administrators and teachers to use in the post-WTC attack environment and were omitted.38 Maternal exposure to trauma was assessed using the PDS trauma event checklist.32 This checklist includes such events as serious accidents, natural disasters, nonsexual or sexual assault by a stranger or family member, military combat or involvement in a war zone, imprisonment, torture, life-threatening events, and an open-ended “other” category.
Age of Child, Time Since WTC Attacks, and SES

Children's age and time since the WTC attacks were calculated based on the date of assessment, the child's date of birth, and September 11, 2001, respectively. Socioeconomic status was measured by maternal education achievement level, a reliable and valid index of SES.16-17

STATISTICAL ANALYSIS

We evaluated the rate of each behavioral problem on the basis of mother and teacher reports. This was followed by regression analysis using generalized estimating equations (GEEs)38-40 to estimate the effect of maternal psychopathology on children's behavioral problems as rated by mothers and teachers. This statistical approach enables use of information from multiple informants effectively because it provides regression coefficients and their standard errors, taking the correlation of ratings between mother and teacher reports into account. In our model, we included an interaction term between informant and maternal psychopathology risk, which determines whether data from multiple informants can be combined to yield a single more precise estimate of the effect of the risk factor. Thus, the potential bias owing to mother or teacher report is accounted for by the interaction term, and estimates are more accurate. We used the unstructured correlation as the covariance structure, which has no preset assumption on the structure, between mother and teacher reports. To estimate the effect of maternal psychopathologies as cumulative risk to children, we constructed a 3-category variable indicating whether mothers had no disorder (neither PTSD nor depression), 1 disorder (either depression or PTSD), or 2 disorders (PTSD and depression).

Rates of clinically significant child behavioral problems in each maternal psychopathology group (no, 1, or 2 disorders) and overall group difference without any confounders and then with adjustment of confounders were calculated. Confounders were entered in a group in the following order. Step 1 included demographic and other confounders such as age and sex of the child, SES, and time since the WTC attacks. Step 2 included child exposure variables such as exposure to trauma and the WTC attacks. Step 3 included mother exposure variables such as exposure to other trauma and the WTC attacks. The same set of analyses were repeated after stratifying on sex to evaluate whether there was sex-specific vulnerability in externalizing (for boys) and internalizing (for girls) problems.

Furthermore, the exponential terms of the parameter estimates that represent odds ratios (ORs) were obtained first with the group with mothers with and without PTSD and depression as well as interaction terms between informants and each maternal psychopathology (PTSD and depression). A 3-category maternal psychopathology group (neither PTSD nor depression, either PTSD or depression, or both) was used in place for each individual maternal psychopathology. Estimated ORs were converted to relative risk (RR) because problems in children's behaviors in this sample were not rare occurrences and could substantially inflate the estimate of the risk. We used the converting formula of Zhang and Yu41 (\[RR = OR/[(1 - P_i) + (P_i \times OR)]\)) in which \(P_i\) indicates the incidence of the outcome of interest in the nonexposed group (ie, children of mothers with neither depression nor PTSD). Accordingly, 95% confidence intervals were also converted. We entered potential confounders in stages as we did before, enabling us to observe how different sets of potential confounders influenced the estimates. Because some children were from the same family (n = 13), the assumption of independent observations underlying standard errors and confidence intervals may be violated. Consequently, all GEE analyses were conducted while adjusting for possible nonindependence of outcomes.

RESULTS

PARTICIPANTS

Table 1 gives demographic data for the participants. No difference was noted in demographic distribution. Insofar as exposure to trauma, there was no difference in the level of exposure to the WTC attack–related trauma in children (\(P = .11\)) and mothers (\(P = .08\)). However, mothers with PTSD and depression and their children were more likely to have experienced other traumatic events.

MATERNAL PSYCHOPATHOLOGY GROUPS AND FUNCTIONAL IMPAIRMENT

Mothers with 2 disorders reported substantially higher rates of functional impairment across multiple domains including family relationships (78.6%), general life satisfaction (85.7%), work (61.1%), friends (44.4%), household chores and duties (35.7%), fun and leisure activities (35.7%), and sex life (35.7%). The mean (SD) number of impairments endorsed across the 7 domains was highest (3.89 [2.25]) in mothers with 2 disorders, second highest (2.22 [2.2]) in mothers with 1 disorder, and lowest (0.60 [1.15]) in mothers with neither PTSD nor depression (\(P < .001\)). As expected, there was also a significant difference in the level of PTSD (\(P < .001\)) and depression symptoms (\(P < .001\)), with the highest scores in the group with 2 disorders.

MATERNAL PSYCHOPATHOLOGY EVENTS AFTER WTC ATTACKS

Degree of child exposure to high-intensity WTC attack–related events was positively associated with both maternal PTSD (\(P = .02\)) and maternal depression (\(P = .001\)). The mean (SD) number of high-intensity events experienced by the child was 1.2 (1.4) for mothers with PTSD and 0.6 (0.88) for mothers without PTSD. Similarly, the number of exposure events was 1.2 (1.2) in children of mothers with depression and 0.5 (0.89) in children of mothers without depression. Maternal exposure to WTC attack–related events was significantly associated with symptoms of depression (\(P = .01\)) and PTSD (\(P = .002\)). In our sample, 17 mothers (18.3%) met PTSD criteria and 36 (35.3%) met criteria for depression. Of 17 mothers with PTSD, 14 had comorbid depression and 3 had PTSD only. Of 36 mothers with depression, 22 had depression only. Thus, of 102 mothers, 14 (13.7%) had 2 disorders, 26 (25.5%) had 1 disorder, and 62 (60.8%) had neither PTSD nor depression.

RATES OF CHILD BEHAVIORAL PROBLEMS REPORTED BY MOTHERS AND TEACHERS AS A FUNCTION OF MATERNAL PTSD AND DEPRESSION

Table 2 gives rates of clinically significant behavioral problems. Except for somatic complaints, teachers generally identified more problems than did mothers. However, when both teacher and mother reports for chil-
Children were analyzed simultaneously using GEE with interaction terms between informants and maternal psychopathology, none of the interactions on child behavioral problems was significant, which suggests that maternal PTSD and depression status did not bias child behavior ratings.

RATE OF BEHAVIORAL PROBLEMS IN CHILDREN ACCORDING TO NUMBER OF MATERNAL PSYCHOPATHOLOGY RISKS

Considering teacher and mother reports of child problems simultaneously, we examined the children’s syndrome scores by number of maternal psychopathology risks. Table 3 gives the rate of clinically significant behavioral problems by maternal psychopathology group. Children of mothers with 2 disorders relative to children of mothers with neither PTSD nor depression had a substantially greater chance of having emotionally reactive behavior (50% vs 9.8%), aggressive behavior (49.9% vs 5.1%), anxious/depressed (32.9% vs 7.8%), somatic complaints (24.8% vs 3%), withdrawn behavior (20.8% vs 8%), and attention problems (17.6% vs 6.7%). The percentage of clinically significant behavioral problems for children of mothers with 1 disorder generally was between that of children of mothers with 2 disorders and that of children of mothers with neither PTSD nor depression. Except for withdrawn behavior and attention problems, rates of problem behaviors in children were significantly different in the 3 maternal psychopathology groups and remained significant after controlling for potential confounders.

The Figure shows the percentages of children with clinically significant behavioral problems according to maternal psychopathology group subdivided by sex. Boys of mothers with 2 disorders compared with boys of mothers with neither PTSD nor depression exhibited strikingly high rates of emotionally reactive behavior (64.9% vs 5.5%; \( P = .009 \)), somatic complaints (35.5% vs 0%; \( P = .001 \)), and aggressive behavior (67.7% vs 4.6%; \( P = .001 \)), whereas girls showed no difference in those behavioral problems in the 3 groups. However, girls whose mothers had 2 disorders exhibited heightened anxious/depressed (39.6%) compared with girls whose mothers had 1 disorder (14%) or neither PTSD nor depression (7.6%).

Table 1. Descriptive Statistics for Study Variables by Maternal Psychopathologic Disorder

<table>
<thead>
<tr>
<th>Variable a</th>
<th>Mean (SD)</th>
<th>Total Sample (N=102)</th>
<th>Neither PTSD or Depression (n=62)</th>
<th>PTSD or Depression (n=26)</th>
<th>PTSD Plus Depression (n=14)</th>
<th>Statistics</th>
</tr>
</thead>
</table>

Demographic data

Child

- Age, y (3.69 (0.94) 3.71 (1.03) 3.73 (0.87) 3.50 (0.64) \( F=0.6; P=.52 \))
- Female sex, No. (%) (49 (48) 31 (50) 13 (50) 5 (35.7) \( \chi^2=2.0; P=.37 \))

Exposures

- WTC attack–related trauma (0.43 (0.85) 0.26 (0.58) 0.67 (1.15) 0.70 (0.94) \( F=2.3; P=.11 \))
- Lifetime other trauma (1.31 (1.64) 0.85 (1.17) 1.54 (1.88) 2.93 (1.90) \( F=22.9; P<.001 \))

Mother

- Educational achievement level (4.2 (1.8) 4.2 (1.8) 3.9 (1.9) 4.7 (1.4) \( F=2.0; P=.13 \))
- WTC attack–related trauma (1.07 (1.11) 1.52 (1.47) 2.08 (1.70) 2.00 (1.81) \( F=2.6; P=.08 \))
- Lifetime other trauma (1.25 (1.44) 1.07 (1.36) 0.88 (1.19) 2.64 (1.42) \( F=18.51; P<.001 \))

Impairment, No. (%)

- Work (27 (27.0) 8 (13.3) 9 (11.1) 9 (61.1) \( \chi^2=17.3; P<.001 \))
- Household chores (15 (15.0) 5 (25.0) 5 (22.7) 5 (35.7) \( \chi^2=19.8; P<.001 \))
- Family (28 (28.0) 4 (20.0) 11 (55.5) 11 (78.6) \( \chi^2=35.5; P<.001 \))
- School work (2 (2.0) 0 (0.0) 2 (14.3) 2 (14.3) \( \chi^2=9.0; P=.01 \))
- Friends (14 (14.0) 4 (20.0) 4 (18.2) 4 (26.6) \( \chi^2=18.5; P<.001 \))
- Fun and leisure activities (15 (15.0) 5 (25.0) 4 (18.2) 4 (26.6) \( \chi^2=18.5; P<.001 \))
- Household chores (15 (15.0) 5 (25.0) 4 (18.2) 4 (26.6) \( \chi^2=18.5; P<.001 \))
- Overall problems (1.55 (2.08) 60 (1.15) 2.22 (2.20) 3.89 (2.25) \( F=29.7; P<.001 \))

Abbreviations: PTSD, posttraumatic stress disorder; WTC, World Trade Center.

a Number may vary because of missing values.

b Maternal educational achievement level was rated as follows: holding a professional degree was coded as 1, having some postgraduate education as 2, having a 4-year college degree as 3, having 2 to 3 years of college education as 4, having a high school diploma as 5, completing part of high school as 6, completing middle school as 7, and completing less than middle school as 8.

c From the impairment category, the problem areas counted were work, household chores, friends, fun and leisure activities, school work, family, and sex life.
UNADJUSTED AND ADJUSTED RISK OF BEHAVIORAL PROBLEMS ACCORDING TO MATERNAL PSYCHOPATHOLOGY

Table 4 gives the unadjusted and adjusted RRs. Children of mothers with 2 disorders demonstrated substantially increased risk of clinically significant behavioral problems. The increased risk remained statistically and clinically significant after controlling for potential confounders including age and sex of the child, SES, elapsed time to assessment, child trauma exposure (WTC attacks and other trauma), and maternal trauma exposure (WTC attacks and other trauma). The adjusted RRs demonstrate a greater than 13-fold increased risk of aggressive behavior \((P = .02)\), an 11-fold increased risk of emotionally reactive behavior \((P = .03)\), a greater than 8-fold increased risk of somatic complaints \((P = .02)\), and a greater than 7-fold increased risk of anxious/depressed \((P = .005)\). Risk for attention problems was substantially attenuated after controlling for child and mother exposures to terrorism and trauma.

The present study makes a methodologic contribution to research on the effect of maternal disorders on young children by using sophisticated analytic techniques to take advantage of the use of multiple informants in child behavior to create more reliable and valid outcome measures. The remarkably increased risk of aggressive behavioral problems, somatic complaints, and emotionally reactive behavior in children whose mothers had 2 disorders (PTSD and depression) is a particular public health concern. As hypothesized, children of mothers with 2 disorders exhibited strikingly greater risk of behavioral problems that index difficulties in child behavioral regulation.8,42 Our finding of an association between the number of maternal disorders and degree of maternal functional impairment suggests a possible mechanism, that is, parenting, through which child behavioral problems are affected. The effect of 2 disorders may reduce the ability...
of mothers to assist their very young children when they are most needed.

These results call for investigation of mother-child dyad interaction patterns to identify specific behavioral deficits through which maternal functioning affects the child’s emotional and behavioral regulation. For example, studies could examine the behavioral characteristics of children of mothers with comorbid PTSD and depression using laboratory measures of emotional regulation when threatened. Involving mothers in interacting with children during threat challenges in the laboratory may help identify aspects of maternal functioning associated with comorbid PTSD and depression in the context of threat.

When our sample was subdivided by sex, boys were more vulnerable than girls. Several case-control studies have found that girls were at increased risk of post-traumatic problems or anxiety symptoms after exposure to hurricanes, a dam collapse, a flood, being taken hostage, parental psychopathology such as maternal depression, and witnessing a parent’s victimization by community violence. However, most studies have focused on school-aged children. In addition, previous studies of sex differences examined child exposure to trauma without consideration of the indirect effects of maternal psychopathology. It is unclear whether the greater vulnerability of boys in our study is explained by their

Table 3. Percentages of 102 Children With Deviant CBCL Syndrome Scores According to Whether the Mother Has Neither, Either, or Both PTSD and Depression

<table>
<thead>
<tr>
<th>Child Behavioral Problems</th>
<th>Maternal PTSD and/or Depression</th>
<th>Group 1 (n=62)</th>
<th>Group 2 (n=26)</th>
<th>Group 3 (n=14)</th>
<th>Overall Difference</th>
<th>Adjusted Overall Difference</th>
<th>Adjusted Overall Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neither Disorder</td>
<td>Either Disorder</td>
<td>Both Disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% (SE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotionally reactive</td>
<td>9.81 (0.03)</td>
<td>15.52 (0.06)</td>
<td>50.00 (0.12)</td>
<td>10.57</td>
<td>2</td>
<td>.005</td>
<td>9.73</td>
</tr>
<tr>
<td>Anxious/depressed</td>
<td>7.81 (0.03)</td>
<td>17.71 (0.06)</td>
<td>32.88 (0.11)</td>
<td>6.40</td>
<td>2</td>
<td>.04</td>
<td>7.56</td>
</tr>
<tr>
<td>Somatic complaints</td>
<td>2.95 (0.02)</td>
<td>17.96 (0.05)</td>
<td>24.79 (0.11)</td>
<td>11.37</td>
<td>2</td>
<td>.002</td>
<td>8.18</td>
</tr>
<tr>
<td>Withdrawn behavior</td>
<td>7.95 (0.03)</td>
<td>11.29 (0.04)</td>
<td>20.75 (0.09)</td>
<td>2.01</td>
<td>2</td>
<td>.37</td>
<td>3.73</td>
</tr>
<tr>
<td>Aggressive behavior</td>
<td>5.14 (0.02)</td>
<td>15.87 (0.06)</td>
<td>40.88 (0.14)</td>
<td>10.01</td>
<td>2</td>
<td>.007</td>
<td>12.03</td>
</tr>
<tr>
<td>Attention problems</td>
<td>6.70 (0.03)</td>
<td>22.30 (0.07)</td>
<td>17.60 (0.09)</td>
<td>5.04</td>
<td>2</td>
<td>.08</td>
<td>1.73</td>
</tr>
</tbody>
</table>

Abbreviations: CBCL, Child Behavior Checklist; PTSD, posttraumatic stress disorder.

A score of 65 or higher on each CBCL cluster was used to indicate behavioral problem symptoms. Depression is defined as scores higher than 16 on the Center for Epidemiologic Studies Depression Scale; PTSD is defined as positive on all 6 symptom syndromes indicated by the Posttraumatic Stress Diagnostic Scale. When at least 1 of the cell counts was less than 5, the Fisher exact test was used. Numbers may vary because of missing values.

Adjusted for age and sex of the child, maternal educational achievement level, time since the World Trade Center (WTC) attacks, and levels of child exposure to the WTC-related trauma and other trauma.

Adjusted for age and sex of the child, maternal educational achievement level, time since the WTC attacks, levels of child exposure to the WTC-related trauma and other trauma, and levels of maternal exposure to the WTC-related trauma and other trauma.

Figure. Percentages of boys and girls with deviant Child Behavior Checklist syndrome scores in the 3 maternal psychopathology groups. NS indicates not significant.
The risk factor and child behavioral problems. We used staged statistical controls of common psychopathology (the risk factor) and child behavioral problems. The analytic techniques combining mother and teacher reports produce more reliable measures and lead to more precise estimates of the associations between maternal psychopathology (the risk factor) and child behavioral problems. We used staged statistical controls of common risk factors (age and sex of the child, SES, time since the WTC attacks, child exposure to terrorism and other trauma, and mother exposure to terrorism and other trauma) to more precisely examine the association of maternal psychopathology and children's problems.

### STUDY LIMITATIONS

Future research should seek to assess maternal disorders more comprehensively using structured clinical interviews. Our measure of child exposure to other trauma did not include exposure to sexual abuse or domestic violence. It is possible that, as a result, the count of other trauma exposure in our sample was underestimated in some cases. To evaluate this, we examined data from 68 dyads that participated in a second study phase during which they were asked by clinicians about child sexual abuse and domestic violence exposure. Only those children who reported exposure to other trauma also reported sexual abuse or domestic violence (C.M.C., Y.N., and Khushmand Rajendran, PhD, MSW, unpublished data 2009), which suggests that our results were not biased because we did not query these items. We did not have information on the level of disorder or the quality of functioning before the WTC attacks. Future studies examining the effect of maternal psychopathology on preschool children in the context of terrorism and disaster should use prospective longitudinal designs.

---

### Table 4. RR for Clinically Significant Behavioral Problems in Children of Mothers With Both PTSD and Depression, Either PTSD or Depression, and Neither PTSD Nor Depression

<table>
<thead>
<tr>
<th>Child Behavioral Problem b</th>
<th>No.</th>
<th>Unadjusted d</th>
<th>Adjusted e</th>
<th>Adjusted f</th>
<th>Adjusted g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotionally reactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both disorders</td>
<td>14</td>
<td>9.2 (3.3-11.0); .002</td>
<td>10.9 (8.4-11.2); .004</td>
<td>11.1 (4.5-11.3); .009</td>
<td>11.2 (2.1-11.3); .03</td>
</tr>
<tr>
<td>Either disorder</td>
<td>26</td>
<td>5.7 (1.4-9.9); .02</td>
<td>8.8 (2.3-11.1); .009</td>
<td>8.6 (1.0-11.3); .05</td>
<td>8.5 (0.4-11.2); .16</td>
</tr>
<tr>
<td>Neither disorder</td>
<td>62</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Anxious/depressed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both disorders</td>
<td>14</td>
<td>7.4 (2.4-11.1); .002</td>
<td>7.5 (2.73-11.2); .003</td>
<td>7.4 (1.9-11.4); .009</td>
<td>7.6 (2.1-11.4); .005</td>
</tr>
<tr>
<td>Either disorder</td>
<td>26</td>
<td>3.4 (0.8-8.1); .08</td>
<td>3.6 (0.9-8.3); .07</td>
<td>3.4 (0.6-9.0); .16</td>
<td>3.8 (0.6-9.7); .13</td>
</tr>
<tr>
<td>Neither disorder</td>
<td>62</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Somatic complaints</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both disorders</td>
<td>14</td>
<td>8.3 (1.8-17.4); .008</td>
<td>8.4 (1.8-19.3); .01</td>
<td>11.5 (1.7-22.6); .01</td>
<td>10.5 (1.6-22.2); .02</td>
</tr>
<tr>
<td>Either disorder</td>
<td>26</td>
<td>1.6 (0.4-5.8); .54</td>
<td>1.5 (0.3-5.8); .58</td>
<td>1.3 (0.3-4.9); .70</td>
<td>1.1 (0.2-4.5); .91</td>
</tr>
<tr>
<td>Neither disorder</td>
<td>62</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Withdrawn behavior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both disorders</td>
<td>14</td>
<td>3.2 (0.8-7.9); .10</td>
<td>3.2 (0.8-7.9); .10</td>
<td>3.2 (0.7-8.9); .17</td>
<td>3.3 (0.7-8.7); .14</td>
</tr>
<tr>
<td>Either disorder</td>
<td>26</td>
<td>2.8 (0.5-8.2); .23</td>
<td>2.8 (0.5-8.2); .23</td>
<td>2.4 (0.2-9.1); .41</td>
<td>3.1 (0.3-10.1); .31</td>
</tr>
<tr>
<td>Neither disorder</td>
<td>62</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Aggressive behavior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both disorders</td>
<td>14</td>
<td>14.6 (3.7-20.0); .002</td>
<td>15.2 (1.7-20.6); .02</td>
<td>14.6 (1.7-20.5); .02</td>
<td>13.0 (3.1-19.6); .02</td>
</tr>
<tr>
<td>Either disorder</td>
<td>26</td>
<td>11.1 (1.9-19.3); .01</td>
<td>8.7 (1.7-20.1); .02</td>
<td>7.9 (2.2-20.1); .01</td>
<td>8.2 (1.3-19.9); .03</td>
</tr>
<tr>
<td>Neither disorder</td>
<td>62</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Attention problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both disorders</td>
<td>14</td>
<td>4.3 (1.0-11.5); .05</td>
<td>4.4 (1.0-11.6); .05</td>
<td>0.7 (0.8-4.9); .74</td>
<td>1.0 (0.1-4.4); .97</td>
</tr>
<tr>
<td>Either disorder</td>
<td>26</td>
<td>1.5 (0.3-5.6); .87</td>
<td>1.4 (0.2-5.7); .72</td>
<td>0.2 (0.2-2.1); .22</td>
<td>0.5 (0.1-4.6); .61</td>
</tr>
<tr>
<td>Neither disorder</td>
<td>62</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; PTSD, posttraumatic stress disorder; RR, relative risk.

a Numbers may vary because of missing values.

b A score of 65 or higher on each Child Behavior Checklist cluster was used to indicate behavioral problem symptoms.

c Odds ratios were converted to RR using the formula of Zhang and Yu in which \( P_0 \) indicates the incidence of the outcome (ie, each behavioral problem) in the control group.

d Depression is defined as scores higher than 16 on the Center for Epidemiologic Studies Depression Scale; PTSD is defined as positive on all symptom clusters indicated by the Posttraumatic Stress Diagnostic Scale.

e Adjusted for maternal educational achievement level, age and sex of child, and time since the World Trade Center (WTC) attacks.

f Adjusted for maternal educational achievement level, age and sex of child, child exposure to the WTC attacks and other trauma, and time since the WTC attacks.

g Adjusted for maternal educational achievement level, age and sex of child, time since the WTC attacks, child exposure to the WTC attacks and other trauma, and maternal exposure to the WTC attacks and other trauma.
Our data indicate that the adverse effects of terrorism on very young children and their mothers can be persistent and long-lasting. Moreover, the number of maternal disorders seems to be strongly associated with preschool behavioral problems in the aftermath of terrorism exposure. We previously recommended screening of preschool children exposed to terrorism and disaster in the context of regular visits to their pediatricians. The present data suggest that mothers of young children should receive comprehensive screening for their psychological well-being and functioning as an additional means of mitigating the effects of terrorism-related maternal disorders on preschool children. This could occur in the context of disaster recovery-focused anticipatory guidance with mothers of very young children. Similarly, the use of interventions to support very young children might usefully include parent-focused information and skills training to support the capacity of parents to assist the recovery of young children exposed to traumatic events.

Given the central role of pediatric primary care in the lives of very young children, we recommend that consideration be given to co-location and integration of these post-disaster services for very young children in pediatric primary care.

Accepted for Publication: December 11, 2008.

Correspondence: Claude M. Chemtob, PhD, Departments of Psychiatry and Pediatrics, Mount Sinai School of Medicine, 1 Gustave L. Levy Pl, Box 1230, New York, NY 10029 (claude.chemtob@mssm.edu).

Author Contributions: Study concept and design: Nomura and Chemtob. Acquisition of data: Chemtob. Analysis and interpretation of data: Nomura and Chemtob. Drafting of the manuscript: Nomura and Chemtob. Critical revision of the manuscript for important intellectual content: Nomura and Chemtob. Statistical analysis: Nomura. Obtained funding: Chemtob. Administrative, technical, and material support: Chemtob. Study supervision: Chemtob.

Financial Disclosure: None reported.

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

Role of the Sponsors: No sponsors had a role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; or preparation, review, or approval of the manuscript.

Additional Contributions: Robert Abramovitz, MD, served as study coprincipal investigator, and we acknowledge his important contributions to the conduct of the study. Rebecca Shamoon-Shanook, PhD, and Bruce Grel-Long, PhD, collaborated with us during the formative stages of this study and provided valuable guidance. Alicia Lieberman, PhD, Joy Ososky, PhD, and Charles Zeanah, MD, contributed expertise as advisors during the formative stages of this study. Deborah Carroll, PhD, Kelly Dungan Burns, MA, and Adrian Guzman, MPH, served on the study staff and as assessors. We acknowledge the generosity of the families who participated in this study who were in the midst of rebuilding lives profoundly affected by the World Trade Center attacks.

REFERENCES
