Impact of Maternal Posttraumatic Stress Disorder and Depression Following Exposure to the September 11 Attacks on Preschool Children's Behavior

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To evaluate whether conjoined maternal posttraumatic stress disorder (PTSD) and depression are associated with increased behavioral problems among terrorism-exposed preschool children (N = 116; 18–54 months), this study compared clinically significant child behavioral problem rates among the preschool children of mothers with PTSD and depression, depression alone, and neither disorder. Behavioral problems were independently rated by mothers and preschool teachers. Maternal depression and PTSD, relative to maternal depression alone, and to neither disorder, were associated with substantially increased child problems. Notably, maternal depression and PTSD were associated with increased emotional reactivity (relative risk [RR] = 5.9 by mother's and 3.4 by teacher's reports) and aggressive behavior problems (RR = 11.0 by mother's and RR = 5.9 by teacher's reports). This was corroborated by teacher ratings. Implications for intervening with terrorism-exposed preschool children are discussed.

Although preschool children are highly vulnerable to the effects of traumatic events, the effects of maternal psychopathology on preschool children exposed to terrorism are not as yet well understood (Chemtob, Nomura, & Abramovitz, 2008; DeVoe, Bannon, & Klein, 2006; Fremont, 2004; Laor, Wolmer, & Cohen, 2001; Pfefferbaum, 2005; Pine, Costello, & Masten, 2005; Thabet, Karim, & Vostanis, 2006).

Consistent with McEwen's (1998) allostatic load hypothesis, preschool children with conjoined exposure to World Trade Center (WTC) attack-related events and to other traumatic events have been found to be far more likely to develop clinically significant behavioral problems than children with WTC-attack exposure alone, or with other trauma exposure alone, compared to children without either type of trauma exposure (Chemtob et al., 2008). Clearly, exposure to the WTC attacks is likely to have also impacted the mothers of these children

and may have caused some of these mothers to develop psychological disorders.

It is likely that very young children are affected by terrorism both as a result of the effects of direct exposure and, more indirectly, as a result of the impact of terrorism on their mothers' psychological functioning. However, little is known about whether maternal psychopathology associated with exposure to terrorism may be associated with increased rates of child behavioral problems.

Limitations of Current Research

The extant studies of the effects of maternal psychopathology on trauma-exposed children have tended to focus on older school-age children (cf. McCloskey & Walker, 2000; Najarian, Goenjian, Pelcovitz, Mandel, & Najarian, 1996; Smith, Perrin, Yule, & Rabe-Hesketh, 2001; Vila et al., 2001). Also, studies have usually confounded the effects of maternal and child event exposure (cf. Green et al.,

1991; Kilic, Ozguven, & Sayil, 2003; Wolmer, Laor, Gershon, Mayes, & Cohen, 2000). Moreover, research on the effects of disaster-related exposure on children has generally not distinguished the effects of disaster exposure from the effects of exposure to other lifetime trauma (cf. Chemtob et al., 2008), nor, to the best of our knowledge, have any of these studies specifically examined the effects of co-occurring maternal disorders on disaster-related child psychopathology.

In addition, nearly all the above studies relied on mothers as the sole informants about their preschool children. This reliance on mothers introduces a potential confound because of the possibility that maternal psychopathology would create systematic biases in the ratings of children's behavioral problems (Breslau, Davis, & Prabucki, 1988; Fergusson, Lynskey, & Horwood, 1993; Renouf & Kovacs, 1994). These maternal ratings of children may reflect the influence of their depression or posttraumatic stress disorder (PTSD) symptoms to an unknown degree and may result in rating biases. Teacher ratings are not necessarily more veridical than those of mothers, because teachers interact with children in a different context with different demands (Richters & Pellegrini, 1989). Nevertheless, examining both maternal and teacher ratings of child behavior would provide an opportunity to evaluate independent ratings of the child's functioning.

Finally, studies of the effects of maternal psychopathology on children have largely focused on maternal depression (Galea et al., 2002). To the best of our knowledge, no studies have directly contrasted the effects of maternal depression alone with the effects of co-occurring maternal depression and PTSD on terrorism-exposed very young children. Comparing the effects of maternal depression alone with the effects of conjoined depression and PTSD is potentially conceptually important. PTSD is a disorder in which the dysregulation of the response to threat is highly salient (Chemtob, Roitblat, Hamada, Carlson, & Twentyman, 1988; Yehuda, 2002). Chemtob et al. (1988) described the salience of threat detection as an attentional priming effect. The priming hypothesis has subsequently been empirically supported (Michael & Ehlers, 2007; Michael, Ehlers, & Halligan, 2005; Vythilingam et al., 2007). In addition, notably, there is evidence that women may have a lower threshold to threat appraisal compared to men (Olff, Langeland, Draijer, & Gersons, 2007). Thus, it can be expected that as a result of direct exposure to a direct threat to self and to child, a mother with PTSD will subsequently be more vigilant with respect to the presence of a possible threat and to have a lower threshold for identifying events as dangerous to herself, and to her child's safety.

Thus, a mother's PTSD can be expected to result in an increased emotional regulation burden for both mother and very young child (Hirshfeld, Biederman, Brody, Faraone, & Rosebaum, 1997) as the mother seeks to restore a sense of safety following exposure to terrorism. In short, a mother with PTSD may face a greater challenge in creating a sense of safety in her child because of her sensitivity—subtle or more overt—to potential danger. As a result, she may cue her young child to the presence of danger even when it is not present.

Depressed mothers may exhibit a lack of control over their environment, an inability to draw boundaries and inconsistency in disciplining their children (Kochanska, Kuczynski, Radke-Yarrow, & Welsh, 1987; Zahn-Waxler, Iannotti, Cummings, & Denham, 1990). They may also show more withdrawn or uneven affect and may have trouble interacting appropriately with infants and toddlers (Cohn & Tronick, 1989; Downey & Coyne, 1990; Murray, 1992; Stein et al., 1991). Thus, maternal depression is likely to be expressed through reduced maternal engagement with the child and reduced availability to the child, which may result in a lack of support for the child's emotional and behavioral regulation. Indeed, it has been suggested that infants who receive inconsistent responses from their caregivers may not develop the ego strength and ability to recover from the effect of negative interactions (Osofsky & Eberhart-Wright, 1988). Similarly, a depressed mother may be less attuned to the child's needs for contact, support, and encouragement. This suggests that the lack of availability of a depressed mother may restrict a child's ability to restore emotional and behavioral regulation following exposure to the threat of terrorism.

Thus, it could be argued that combined depression and PTSD might be expected to have a greater impact on a mother's ability to support her child's emotional and behavioral regulation. A mother's relative lack of availability (related to depression) to support her child's recovery, and her disposition to feeling unsafe and to overidentify potential threats (related to her PTSD) would compound the difficulty for a child of restoring his or her sense of safety after exposure to terrorism. This would then be predicted to result in increased problems in emotional and behavioral regulation, leading to a higher rate, and larger number, of child behavioral

problems being associated with conjoined maternal PTSD and depression. Conversely, maternal depression *alone* may be sufficiently pervasive in its effects on child well-being in young children, because of its effects on attachment and child security, that the additional burden of maternal PTSD would have no added consequence for the child's ability to regulate emotion and behavior. In this instance, it would be expected that there would be no difference in rate, or number, of behavioral problems between the children of mothers with both PTSD and depression and the children of mothers with only depression relative to the children of mothers with neither disorder.

The Current Study

Accordingly, this study compared the impact of maternal depression alone to the effects of maternal depression and PTSD together on child behavior problems. We examined data from our study of the long-term impact of direct exposure to the WTC attacks on clinically significant behavioral problems in preschool children (Chemtob et al., 2008). In keeping with our interest in examining the relative effects of disaster exposure and lifetime exposure to other types of trauma, we had assessed maternal exposure to both the WTC attacks and to other trauma. We had also assessed maternal depression and PTSD. Finally, because a significant limitation of prior research on the impact of maternal psychopathology on very young children has been its reliance on single informants (usually mothers), we had obtained independent child behavior ratings from the preschool teachers of the children we studied. The teacher ratings provided the opportunity to obtain evidence from independent observers, who were not aware of the mother's mental state, about the children's behavior problems.

To address our primary question, we divided mothers into three groups: (a) mothers with neither disorder, (b) mothers with depression in the absence of PTSD, and (c) mothers with both depression and PTSD. We hypothesized that after removing the effects of child and mother exposure to the WTC attacks, and to other trauma, as well as demographic confounders, co-occurring maternal depression and PTSD would be associated with higher rates of clinically significant child behavioral problems compared to children of mothers with depression only, and compared to children of mothers with neither PTSD nor depression. We also hypothesized that the children of mothers with both depression and PTSD would have the highest number of clinically significant behavior problems. We focused on clinically significant behavior problems because they indicate child problems severe enough to be of possible public health significance.

Method

Participants

This study was reviewed and approved by the Mount Sinai School of Medicine's Institutional Review Board. It was conducted between March 2003 and December 2005 (a mean of 35 months after the WTC attacks) to assess the longer term impact of WTC-attack exposure on preschool children age 5 years or younger at the time of the WTC attacks. Families with children born between September 11, 1996, and September 11, 2002, were included if: (a) they lived in Lower Manhattan or (b) attended preschool or day care in Lower Manhattan on September 11, 2001 (the day of the WTC attacks). Families were recruited using extensive outreach in the Lower Manhattan area, primarily to preschools. (See Figure 1 for the geographical location of preschools relative to the site of the WTC attacks.)

After consent was obtained, mothers completed questionnaires about their child and themselves that included demographic information, exposure to the WTC attacks, exposure to other traumatic events, and emotional and behavioral functioning (see the Measures section). Children and mothers were assessed, and if symptomatic, they were offered free diagnostic and counseling services. The child's preschool teacher, who was blind to maternal report of the child behavioral problems and maternal psychopathology, also completed a questionnaire about the child's behavior. Teacher and parent questionnaires were administered independently from each other.

A total of 116 children and their mothers were included in the study (Chemtob et al., 2008). Three children of mothers who had PTSD only were excluded from these analyses, leaving 113 children. Participants who dropped out of the study did not differ on age, gender, race, or socioeconomic status (SES) from completers.

Measures

Demographics. Age, ethnicity of the child, and maternal education in years were reported by the mother. Children's age and time elapsed since the

Figure 1. The geographical location of preschools relative to the World Trade Center (WTC).

WTC attacks were calculated based on the date of assessment, the child's date of birth, and September 11, 2001, respectively. SES was measured by maternal education, a reliable and valid index of SES (Bollen, Glanville, & Stecklov, 2007; Liberatos, Link, & Kelsey, 1988).

Maternal exposure to the WTC attacks and to other trauma. Maternal WTC-attack exposure was measured using the mother's dichotomous responses to six questions about direct exposure to high-intensity WTC-attack-related events. Respondents were asked whether they 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 to the six questions were summed to denote level of exposure. We used the trauma event checklist of the Posttraumatic Stress Diagnostic Scale (PDS) to measure lifetime history of other trauma exposure (Foa, 1995).

Child exposure to the WTC attacks and to other trauma. Mothers reported on the extent to which their children had been directly exposed to the WTC attacks. We created an index of child exposure to the same six high-intensity attack-related events. Child lifetime history of exposure to trauma other than the WTC attacks was measured using a modified version of the Traumatic Events Screening Inventory (TESI; Ghosh Ippen et al.,

2002). The instrument measures exposure to traumatic 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.

Child behavior problems. Mothers used the preschool version of the Child Behavioral Checklist (CBCL/1.5–5; Achenbach & Rescorla, 2000), a widely used behavioral checklist with very good reliability and validity (Calkins & Dedmon, 2000; Gross et al., 2006; Mesman, Bongers, & Koot, 2001), to rate child behavior problems. In the normative study, test–retest reliability of syndrome scales of CBCL/1.5–5 ranged from .68 to .92 and it demonstrated good validity by its association with referral status of the child (Achenbach & Rescorla, 2000). Age and gender standardized T scores were calculated for the seven behavioral problem clusters (emotionally reactive, anxious/depressed, somatic complaints, withdrawn behavior, sleep problems, attention problems, and aggressive behavior). There were 5 children above the age of 5 at the time of assessment, 4 were 6 years old, and 1 was age 7. We followed the recommendation of the scale developer (Thomas Achenbach, personal communication, 2004) to use the preschool version of the scale for all the children in our sample. The preschool scale largely differs from the older child

scale (CBCL 6–18; Achenbach & Rescorla, 2001) in that it omits a number of items particularly appropriate to adolescent children.

Preschool teachers, who were "blind" to maternal psychopathology and to the child behavioral ratings provided by mothers, completed the preschool version of the Teacher Report Form (TRF; Achenbach & Rescorla, 2000). The TRF behavior-rating checklist (Achenbach & Rescorla, 2000) parallels the CBCL and was designed for completion by teachers. The TRF has high test–retest reliability (mean $r = .81$) and good correlations with the CBCL (mean $r = .40$). The CBCL sleep problems cluster is not included in the teacher rating form of the CBCL.

Nevertheless, because sleep problems are associated with trauma exposure in children, and because they are of clinical importance, we present the parental ratings of sleep problems in Table 2 (see p. 1134). However, as this article is focused on using parent and teacher ratings, and because teachers do not rate sleep problems, the sleep problems cluster is not included in further analyses.

This article focuses on clinically significant preschool child behavioral problems. Scores ≥ 65 (93rd percentile) for the behavioral problem scales are considered clinically significant levels of problems for both the CBCL and the TRF. This cutoff was used to define clinically significant levels of behavior problems for both mother ratings and teacher ratings.

Maternal depression and PTSD. The Center for Epidemiologic Studies Depression Scale (CES–D: Radloff, 1977) was used to assess maternal depressive symptomatology. Probable maternal depression was dichotomized using the CES–D clinical cutoff score of 16, which is widely used (Breslau, 1985) for that purpose. The PDS (Foa, 1995) was used to measure maternal posttraumatic stress symptoms. The structure and content of the PDS parallel the *DSM–IV* PTSD diagnostic criteria (Foa, 1995). The PDS has a test–retest reliability kappa of .74 for PTSD diagnosis and convergent validity with a kappa of .65 with the Structured Clinical Interview (SCID) for *DSM–III–R*, with 82% agreement between the two measures (Foa, 1995). The sensitivity and specificity of the PDS with respect to SCID diagnosis is .89 and .75, respectively (Foa, 1995). Mothers were considered to have PTSD if they met all six diagnostic criteria—exposure to a traumatic event, persistent reexperiencing 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.

Statistical Analysis

The major analyses are based on grouping the mothers according to whether they had: (a) neither depression nor PTSD, (b) depression alone, or (c) both depression and PTSD. Based on this subdivision, we first compared relevant demographic and trauma-exposure characteristics to detect potential confounding variables. Analyses were performed first based on mother's report. Confirmatory analyses were then conducted based on the behavioral ratings of teachers. Mother and teacher reports of child behavior were entered as dependent variables in separate models.

To examine the rates of clinically significant child behavior problems by maternal psychopathology, univariate analyses were conducted using chi-square tests for overall group difference followed by chi-square linear-by-linear association, also known as the Mantel Haenszel chi-square test (Dosemeci & Benichou, 1998; Hakulinen, 1981) for overall trend to evaluate a dose–response relation between maternal psychopathology groups (neither, depression only, and both depression and PTSD) and each child behavioral problem cluster.

Next, to examine the risk for each behavioral problem in children of mothers with PTSD and depression and in children of mothers with depression alone, hierarchical logistic regression was performed after creating two dummy variables for maternal psychopathology: (a) for mothers with depression only and (b) for mothers with both depression and PTSD. The group of mothers with neither PTSD nor depression served as the reference group. The effects of potential confounders described earlier were first included before the two dummy variables for maternal psychopathology group were entered in the model. The risk of having each behavioral problem (emotionally reactive, anxious/depressed, somatic complaints, withdrawn behaviors, aggressive behaviors, and attention problems), as measured by odds ratio, for children of mothers with only depression and children of mothers with comorbid depression and PTSD, as compared to the reference group, based on mother's and teacher's report, was first obtained. As odds ratio is only an approximation of the relative risk and could be inflated due to high occurrence of the problems, we converted our odds ratio into relative risk. We have used the converting formula presented by Zhang & Yu (1998):

$$RR = \frac{OR}{(1 - P_0) + (P_0 \times OR)},$$

where P_0 indicates the incidence of the outcome of interest in the nonexposed group (i.e., children of mothers with neither depression nor PTSD). Ninety-five percent confidence intervals (CI) were also converted, accordingly.

As children were drawn from 10 different preschools/day-care centers, and some were from the same family ($n = 13$), the assumption of independent observations underlying standard errors and CIs may be violated. To account for data clustering, standard errors for rates of behavioral problems were computed using the Taylor series linearization method, while standard errors and CIs for parameters estimated from the logistic analyses were computed by using the method of weighted maximum likelihood, adapted for survey and clustered data through implicit Taylor series (Binder, 1992; Lin & Wey, 1989). Missing data were handled through listwise deletion. There were no missing data on the key study variables and minimal missing data in the control variables: child exposure to trauma other than 9/11 related ($n = 2$, 1.7%) and maternal education ($n = 8$, 6.9%).

Finally, as shown in Figure 3 (see p. 1136), we counted the number of clinically significant behavioral problems rated by mothers and by teachers for each child. One-way analyses of covariance (ANCOVAs; with child age, maternal education, and time passed since the WTC attacks used as covariates) were conducted separately for mother and teacher ratings. We normalized the outcome variables (number of behavioral problems based on mothers and teachers reports) by logarithm transformation to satisfy the assumptions of normal distribution and heteroscedasticity, that is, a condition where the variances of dependent variable are not equal for every value of predictor or grouping variable (Kotler & Brown, 1990; Schmidt, 2000). Because we used logarithm-transformed values in our analysis to remove heteroskedasticity, the numbers reported were transformed back in the original integer scale. We provide the F statistics from the ANCOVA based on both the transformed and nontransformed variable. We present the diagram (Figure 3) that shows the mean number of clinically significant behavioral problems among different maternal psychopathology groups based on non-transformed outcome values, as they were very similar and some readers may find the nontransformed means more clinically meaningful.

Results

Table 1 presents participant characteristics by maternal psychopathology category. There were no differences in age, gender distribution, maternal education, or exposure to the WTC attacks. However, mothers with depression and PTSD, and their children, were significantly more likely to have experienced other traumatic events. Approximately, 12% of the children in the sample met criteria for clinically significant emotionally reactive behaviors and for somatic complaints, 10% for anxious/depressed, 9% for withdrawn behavior and for attention problem, and 8% for aggressive behavior clusters.

Table 1
Characteristics of Participants by Maternal Psychopathology Group

	Maternal psychopathology group		
	Neither ($n = 75$), M (SE)	Depression ($n = 24$), M (SE)	Comorbid ($n = 14$), M (SE)
Child age	3.95 (1.10)	3.79 (0.93)	3.50 (0.65)
Child gender (girls), % (n)	48.00 (36)	54.17 (13)	64.29 (9)
Maternal education[a]	13.65 (3.01)	14.13 (3.81)	12.64 (2.81)
Maternal exposure to the WTC-related trauma[b]	0.27 (0.55)	0.50 (0.83)	0.50 (0.85)
Maternal exposure to other trauma[b]	1.27 (1.62)	0.87 (0.97)	3.42 (1.55)[c]
Child exposure to the WTC-related trauma[b]	0.44 (0.85)	0.83 (1.23)	0.43 (0.65)
Child exposure to other trauma[b]	0.92 (1.24)	1.21 (1.41)	2.93 (1.94)[d]
Time passed since WTC attacks (months)	35.31 (11.93)	32.72 (10.60)	36.69 (9.24)

Note. n value may slightly vary due to missing values. WTC = World Trade Center.
[a]Number of years of education. [b]Number of different exposure. [c]Significant group difference based on analysis of variance (ANOVA), $F(2, 110) = 6.1$, $p < .001$. [d]Significant group difference based on ANOVA, $F(2, 110) = 8.7$, $p < .001$.

Table 2

Rates per 100 (SE) of Mothers' Reports of Behavioral Problems in Children According to Whether the Mother Has Neither, Depression Only, or Both Depression and Posttraumatic Stress Disorder (PTSD)

Child behavior problems[a]	Maternal psychopathology								
	Group 1 Neither (n = 75) % (SE)	Group 2 Depression only (n = 24) % (SE)	Group 3 Depression & PTSD (n = 14) % (SE)	Overall difference			Linear-by-linear associations[b]		
				χ^2	df	p value	χ^2	df	p value
Emotionally reactive	5.33 (0.03)	8.70 (0.06)	57.14 (0.14)	29.34	2	.0001	22.47	1	.00001
Anxious/depressed	4.00 (0.02)	13.00 (0.07)	35.71 (0.13)	13.74	2	.001	13.38	1	.0002
Somatic complaints	6.66 (0.03)	22.70 (0.08)	28.57 (0.12)	7.68	2	.02	7.13	1	.008
Withdrawn behavior	6.66 (0.03)	8.70 (0.06)	21.43 (0.11)	3.16	2	.21	3.12	1	.08
Sleep problems	4.00 (0.02)	29.00 (0.10)	29.00 (0.13)	14.46	2	.001	11.93	1	.001
Aggressive behavior	2.66 (0.02)	4.54 (0.04)	42.85 (0.14)	26.04	2	.001	19.05	1	.00001
Attention problems	5.33 (0.03)	13.64 (0.07)	21.43 (0.11)	4.45	2	.11	4.32	1	.04

Note. The *n* values may vary due to missing values.
[a]A score of 65 or more on each Child Behavioral Checklist cluster was used to indicate behavioral problem symptoms. Depression is defined as scores above 16 on the Center for Epidemiologic Studies Depression Scale; PTSD is defined as positive on all six symptom clusters indicated by the PDS. [b]Chi-square linear-by-linear association is used to evaluate whether rate of behavior problems increases in a dose–response fashion.

Table 3

Rates per 100 (SE) of Teacher's Report of Her Child's Behavioral Problems in Children According to Whether the Mother Has Neither, Depression Only, or Both Depression and Posttraumatic Stress Disorder (PTSD)

Child behavior problems[a]	Maternal psychopathology								
	Group 1 Neither (n = 64) % (SE)	Group 2 Depression only (n = 24) % (SE)	Group 3 Depression & PTSD (n = 14) % (SE)	Overall difference[b]			Linear-by-linear associations[c]		
				χ^2	df	p value	χ^2	df	p value
Emotionally reactive	14.29 (0.04)	18.18 (0.06)	42.86 (0.14)	6.05	2	.005	4.96	1	.026
Anxious/depressed	14.29 (0.04)	18.18 (0.07)	35.71 (0.13)	3.54	2	.014	13.39	1	.08
Somatic complaints	6.35 (0.03)	9.10 (0.08)	14.29 (0.10)	1.01	2	.07	7.13	1	.32
Withdrawn behavior	9.52 (0.04)	13.64 (0.06)	28.57 (0.13)	3.65	2	.017	3.12	1	.07
Aggressive behavior	7.94 (0.03)	22.73 (0.04)	57.14 (0.14)	19.04	2	.00001	19.05	1	.00001
Attention problems	7.94 (0.03)	22.73 (0.07)	28.57 (0.13)	5.70	2	.04	4.32	1	.02

[a]A score of 65 or more on each Child Behavioral Checklist cluster was used to indicate behavioral problem symptoms. Depression is defined as scores above 16 on the Center for Epidemiologic Studies Depression Scale; PTSD is defined as positive on all six symptom clusters indicated by the PDS. [b]Fisher's exact test was applied for chi-square statistics when at least one of the cells had ≤ 5 observations. [c]Chi-square linear-by-linear association is used to evaluate whether rate of behavior problems increases in a dose–response fashion.

Table 2 presents the rate of each behavioral problem cluster in children, based on mother's report. When the rates of behavioral problems in children associated with each of three groups of mothers were compared, there were significant differences for all child behavioral problem clusters, except for withdrawn behavior and attention problems. There was a significant dose–response relation (i.e., where dose is defined as the number of maternal diagnoses) for all child behavioral domains, except withdrawn behavior. When the analyses were repeated using teacher reports, we found that the rates of child behavior problems associated with the maternal psychopathology groups were similar to those found based on the mother ratings of the children. However, teachers reported observing fewer child somatic complaints and more aggressive behavior. For teachers, as seen in Table 3, a significant dose–response relation in emotionally reactive, aggressive behavior, and attention problems was found. Fisher's exact test was applied in all analyses.

To confirm the increased risk based on maternal psychopathology category, a multiple logistic regression was performed. To minimize bias due to multicollinearity between mothers' and children's exposure to other trauma and maternal psychopathology group, first we entered potential confounders, including a priori determined demographic confounders and mothers' and children's exposure to the WTC and other trauma and then entered maternal psychopathology dummy variables in the model. Figure 2 presents the relative risks (RR) based on the mothers' ratings and the teachers' ratings of child behavior side by side. Whiskers at the end of the bars represent standard errors. Compared to the reference group of children of mothers with neither depression nor PTSD, depression and PTSD occurring together significantly increased the risk for aggressive behavior (RR = 11.0), emotionally reactive (RR = 5.9), anxious/depressed (RR = 4.8), and somatic complaints (RR = 4.1). In contrast, there was no significantly increased risk for behavioral problems in children of mothers with only depression with the exception of somatic complaints (RR = 3.4).

Similar patterns were observed across rater type (mother, teacher) in emotionally reactive behavior and aggressive behavior. However, teachers were more likely to observe problems in withdrawn behavior (RR = 9.0, p = .006) among the children of mothers with depression and PTSD. Based on mothers reports, significant increased risk of somatic complaints were reported in children whose mothers had both PTSD and depression (RR = 4.1, p = .03) and children whose mothers had only depression (RR = 3.4, p = .04), whereas no significant increased risk was reported based on teachers report.

Finally, as shown in Figure 3, we present the mean number of clinically significant behavioral problems (i.e., nontransformed), as rated by mothers and by teachers for each child. One-way ANCOVA (with child age, maternal education, and time passed since the WTC attacks used as covariates) shows that there was a significant difference in number of child behavioral problems by mater-
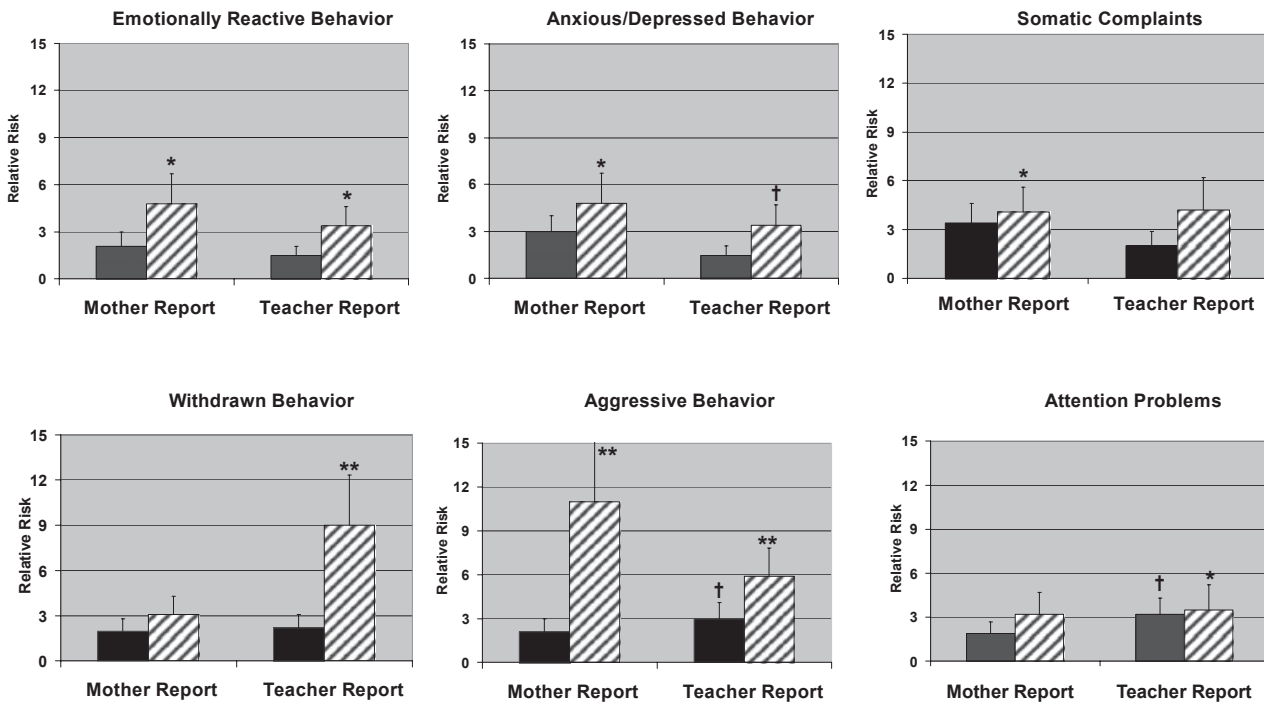

Figure 2. Risk for behavioral problems in children of mothers with only depression and with both depression and posttraumatic stress disorder (PTSD), based on mother's and teacher's reports.
Note. Striped bars represent both PTSD and depression. Bars with block print represent depression only. Risk in two groups (depression only and PTSD and depression) was calculated relative to that in children whose mother had neither depression nor PTSD. The effects of exposure to the World Trade Center and other trauma as well as potential confounder effect were statistically adjusted for in multiple logistic regression model.
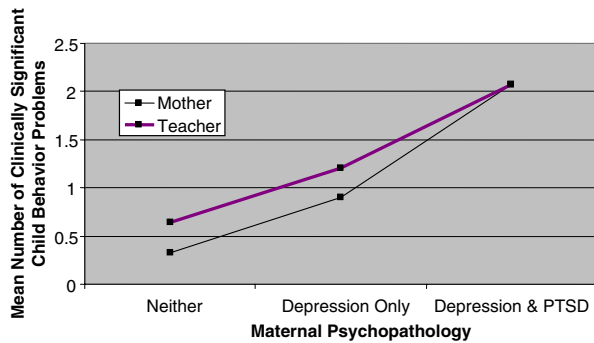$^{+}p < .10.$ $^{*}p < .05.$ $^{**}p < .01.$

Figure 3. Mean number of clinically significant child behavior problem clusters (as rated by mothers and teachers) by maternal psychopathology group.

nal psychopathology category, and by mother's report based on nontransformed outcome variable, $F(2, 110) = 15.1$, $p = .001$, and transformed outcome variable, $F(2, 110) = 4.1$, $p = .002$. There was a similar significant difference in number of child behavioral problems by maternal psychopathology category by teacher's report based on the nontransformed outcome variable, $F(2, 96) = 5.4$, $p = .006$, and the transformed outcome variable, $F(2, 96) = 3.7$, $p = .004$. Post hoc testing, based on the transformed outcome variable, demonstrated that children of mothers with depression alone had a larger number of behavioral problem clusters that met clinical significance than children of mothers with neither PTSD nor depression, rated by the mother ($p = .04$). Children of mothers with both depression and PTSD had a significantly larger number of behavioral problem clusters that met clinical significance criteria than children of mothers with depression alone, rated by mother ($p = .04$) or by teacher ($p = .03$). A test of the difference between the regression slopes associated with each informant type showed no significant difference ($p = .78$).

Discussion

This study has three main findings. First, the children of mothers with co-occurring probable depression and PTSD had the highest rate of clinically significant behavior problems compared to children of mothers with depression and to the children of mothers with neither disorder. Second, the linear-by-linear association analysis showed a significant dose–response relation in emotionally reactive, aggressive behavior, and attention problems in their children, based on both mother's and independent teacher's reports. Mothers' reports additionally showed a dose–response relation in anxious/depressed and somatic complaints in their children. Third, similarly controlling for child and mother trauma exposure, children of mothers who had depression and PTSD were found to meet the cutoff for clinical significance for a larger number of behavior problem clusters, as rated by both mothers and teachers. Maternal and teacher reports were strikingly concordant in this regard highlighting that the differences in rates of child behavioral problems by maternal psychopathology grouping were not due to rating biases associated with maternal psychopathology.

Emotionally reactive behavior problems and aggressive behavior problems appear to be the most saliently associated with co-occurring maternal PTSD and depression. Notably, they are also the behavioral problems on which mothers and teachers have the highest observed concordance. The emotionally reactive behavior cluster indexes emotional regulation (Achenbach & Rescorla, 2000), whereas the aggressive behavior cluster indexes the behavioral regulation of outer-directed negative behaviors (cf. Barkley et al., 2000; Calkins & Dedmon, 2000; Shaw, Owens, Giovannelli, & Winslow, 2001). These two behavior clusters are of high public health significance. The results suggest that co-occurring maternal depression and PTSD interfere substantially more with the mother's ability to assist her young child in accomplishing the tasks associated with emotional and behavioral regulation than maternal depression alone.

Our findings may be interpreted either as consistent with the proposition that having two diagnoses is generally more impairing for mothers than having one, or to the additive but different effects of maternal PTSD and depression. The question of differential effects of maternal ''dose'' or ''type'' of psychopathology should be pursued in future studies. Little is known about whether a mother having co-occurring PTSD and depression results in greater generalized maternal impairment and reflects a nonspecific additive burden (a greater dose) or alternately whether maternal PTSD and depression each interfere with specific maternal functions and result in greater impact on the child because multiple maternal functions are affected (type). To illustrate, a depressed mother may be selectively unable to praise positive behavior in her child. A mother with PTSD may selectively respond to potential threat in her child's play and increase the child's anxiety. A mother with depression and PTSD may be so affected by her own distress that

she is generally unavailable to her child, reflecting a generalized effects of dose (number of psychopathologic problems), or she may be both unable to praise positive behavior, reducing her support for child's positive coping and selectively overrespond to perceived threats increasing her child's anxiety. This latter possibility would suggest specificity (type) effects related to maternal PTSD and depression. The question is further complicated because children may react with specific behavior problems in association with specific maternal problems. However, it is also possible that they would have more problems in general as maternal number of problems increases without specific expression, reflecting whether the mother has depression, PTSD, or both.

These are important questions for further research with traumatized very young children and their mothers to explore. Such studies would be materially advanced by incorporating observational studies of dyadic interaction. Indeed, if there are different patterns of dyadic interaction associated with conjoined PTSD and depression, compared to the other two groups, and these dyadic interaction differences are associated with distinct child behavioral problems, this would suggest that specific behavioral problems in offspring may have different etiologies and modes of transmission. Similarly, it would be useful to examine biological markers associated with the intergenerational transmission of traumatic stress vulnerability (Yehuda & Bierer, 2008). Although they are highly informative, the data on which this study is based do not allow us to address the question of how maternal depression and PTSD specifically exert their effects on preschool children, and this remains an important research frontier.

Study Limitations

Although cross-sectional in design, our study included consideration of the effects of maternal and child lifetime history of other trauma exposure. This aspect of trauma exposure has not previously been taken into account systematically to the best of our knowledge. Our findings are strongly buttressed by the concordance of independent ratings of child problems by parent and teacher. Future studies should further extend these descriptive findings by including observational and behavioral measures to characterize differences among children and mothers in more specific detail. Also, future studies should specifically examine possible differences in dyadic interaction between child and

mother that might be associated with maternal psychopathology. Such observational and behavioral studies may help elucidate mechanisms that distinguish the effects of conjoined depression and PTSD from those of maternal depression alone. We assessed maternal PTSD and depression using well-validated self-report measures. Nevertheless, future studies should also include SCIDs that assess the full range of maternal psychopathology, in consideration of possible contributions of other maternal psychopathology, than PTSD and depression to preschool children's behavior problems.

The primary purpose of this study was to assess the relative impact of maternal depression alone versus conjoined maternal depression and PTSD on child behavior problems. Future studies can extend these findings by comparing the effects of maternal PTSD alone with the relative effects of maternal depression alone. This study could not illuminate whether maternal depression existed prior to exposure to the WTC attacks. In addition, this study focused on maternal depression and PTSD as categorical variables and examined their association to clinically significant behavior problems in preschoolers (also a categorical variable). Thus, this study's focus addressed itself to the effects of clinically significant maternal psychological problems on clinically significant child behavioral problems. Future studies will address the associations of maternal PTSD and depression and preschool child behavioral problems using continuous measures of symptomatology and child behavior problems.

Studies of child and maternal vulnerability prior to exposure to terrorism and disaster would help clarify the interaction of vulnerability and exposure. Similarly, the design of this study could not address whether maternal PTSD alone might have been found more frequently closer in time to the actual exposure to the WTC attacks among these mothers of young children. Answering these types of questions would require the use of prospective longitudinal designs. In short, an important focus for future research should be to characterize the course of natural recovery of mother and child over time, ideally considering preexposure vulnerability, and examining dyadic interaction patterns. Finally, although these findings point to the importance of maternal psychopathology in the behavioral outcomes associated with terrorism exposure in preschool children, we cannot be certain that our results will generalize to other types of terrorism attacks (chronic and recurrent; other types of smaller impact single events) and to the effects of other disasters.

Clinical Implications

These data strongly suggest that very young children are vulnerable to the effects of terrorism and, given the time of assessment postexposure, that these behavioral effects are persistent. Yet, it appears that young children were provided services far less than other populations following the WTC attacks (Covell et al., 2006). We previously recommended that one strategy to increase efficacy in identifying children at need of services would be through screening by pediatricians (Chemtob et al., 2008).

The present findings suggest that a complementary strategy to identify very young children at risk is through identifying psychopathology among the mothers of very young children in the aftermath of large-scale disasters. Moreover, particular attention should be given to identifying mothers with co-occurring depression and PTSD when developing a strategy to identify very young children who are at risk subsequent to terrorism exposure. Given the apparent persistence of the effects of terrorism, interventions need to consider multiple stressors faced by both mothers and children over time (Appleyard & Osofsky, 2003; see also Chemtob et al., 2008, as recovery from exposure to terrorism occurs over time in the context of often challenging postdisaster recovery environments.

Screening and intervening with the mothers of young children may serve to help both mother and young child more efficaciously. In this regard, our findings add to the growing literature pointing to the importance of considering the mother–child dyad in conceptualizing the effects of trauma as well as its treatment especially when very young children are involved (Chemtob et al., 2008; Lieberman & Van Horn, 2005; Schechter et al., 2002). Promising data have indicated that dyadic intervention can enhance the well-being of both mother and young child following domestic violence exposure (Lieberman, Ghosh Ippen, & Van Horn, 2006). There is a need for dyadic interventions that target supporting young children and their mothers following exposure to terrorism and disaster. As well, Weissman has shown that treating maternal depression alone can have a salutary effect on child symptoms (Weissman et al., 2006). There is certainly value in pursuing both dyadic and mother-centered treatment research that focuses on ameliorating outcomes for mothers with conjoined PTSD and depression and their young children following exposure to terrorism and to other types of disaster.

References

Achenbach, T. M., & Rescorla, L. (2000). *Manual for the ASEBA preschool forms & profiles*. Burlington: University of Vermont Press.

Achenbach, T. M., & Rescorla, L. (2001). *Manual for the ASEBA school-age forms & profiles*. Burlington: University of Vermont Press.

Appleyard, K., & Osofsky, J. D. (2003). Parenting after trauma: Supporting parents and caregivers in the treatment of children impacted by violence. *Infant Mental Health Journal, 24*, 111–125.

Barkley, R. A., Shelton, T. L., Crosswait, C., Moorehouse, M., Fletcher, K., Barrett, S., et al. (2000). Multi-method psycho-educational intervention for preschool children with disruptive behavior: Preliminary results at post-treatment. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 41*, 319–332.

Binder, D. A. (1992). Fitting Cox's proportional hazards models from survey data. *Biometrika, 79*, 139–147.

Bollen, K. A., Glanville, J. L., & Stecklov, G. (2007). Socio-economic status, permanent income, and fertility: A latent-variable approach. *Population Studies, 61*, 15–34.

Breslau, N. (1985). Depressive symptoms, major depression, and generalized anxiety—A comparison of self-reports on CES–D and results from diagnostic interviews. *Psychiatry Research, 15*, 219–229.

Breslau, N., Davis, G. C., & Prabucki, K. (1988). Depressed mothers as informants in family history research—Are they accurate? *Psychiatry Research, 24*, 345–359.

Calkins, S. D., & Dedmon, S. E. (2000). Physiologic and behavioral regulation in two-year-old children with aggressive/destructive behavior problems. *Journal of Abnormal Child Psychology, 28*, 103–118.

Chemtob, C. M., Nomura, Y., & Abramovitz, R. (2008). Impact of conjoined exposure to the World Trade Center attacks and to other traumatic events on the behavioral problems of preschool children. *Archives of Pediatrics and Adolescent Medicine, 162*, 126–132.

Chemtob, C. M., Roitblat, H. L., Hamada, R. S., Carlson, J. G., & Twentyman, C. T. (1988). A cognitive action theory of post-traumatic stress disorder. *Journal of Anxiety Disorders, 2*, 253–275.

Cohn, J. F., & Tronick, E. (1989). Specificity of infants response to mothers affective behavior. *Journal of the American Academy of Child and Adolescent Psychiatry, 28*, 242–248.

Covell, N. H., Allen, G., Essock, S. M., Pease, E. A., Felton, C. J., Lanzara, C. B., et al. (2006). Service utilization and event reaction patterns among children who received Project Liberty counseling services. *Psychiatric Services, 57*, 1277–1282.

DeVoe, E. R., Bannon, W. M., & Klein, T. P. (2006). Post-9/11 helpseeking by New York City parents on behalf of highly exposed young children. *American Journal of Orthopsychiatry, 76*, 167–175.

Dosemeci, M., & Benichou, J. (1998). An alternative test for trend in exposure-response analysis. *Journal of*

Exposure Analysis and Environmental Epidemiology, *8*, 9–15.

Downey, G., & Coyne, J. C. (1990). Children of depressed parents—An integrative review. *Psychological Bulletin*, *108*, 50–76.

Fergusson, D. M., Lynskey, M. T., & Horwood, L. J. (1993). The effect of maternal depression on maternal ratings of child behavior. *Journal of Abnormal Child Psychology*, *21*, 245–269.

Foa, E. B. (1995). *Manual for the Posttraumatic Stress Diagnostic Scale (PDS)*. Minneapolis, MN: NCS Pearson.

Fremont, W. P. (2004). Childhood reactions to terrorism-induced trauma: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry*, *43*, 381–392.

Galea, S., Ahern, J., Resnick, H., Kilpatrick, D., Bucuvalas, M., Gold, J., et al. (2002). Psychological sequelae of the September 11 terrorist attacks in New York City. *New England Journal of Medicine*, *346*, 982–987.

Ghosh Ippen, C., Ford, J., Racusin, R., Acker, M., Bosquet, M., Rogers, K., et al. (2002). *Traumatic Events Screening Inventory—Parent Report Revised*. San Francisco: The Child Trauma Research Project of the Early Trauma Network and the National Center for PTSD Dartmouth Child Trauma Research Group.

Green, B. L., Korol, M., Grace, M. C., Vary, M. G., Leonard, A. C., Gleser, G. C., et al. (1991). Children and disaster: Age, gender, and parental effects on PTSD symptoms. *Journal of the American Academy of Child and Adolescent Psychiatry*, *30*, 945–951.

Gross, D., Fogg, L., Young, M., Ridge, A., Cowell, J. M., Richardson, R., et al. (2006). The equivalence of the Child Behavior Checklist 1½-5 across parent race/ethnicity, income level, and language. *Psychological Assessment*, *18*, 313–323.

Hakulinen, T. A. (1981). Mantel-Haenszel statistic for testing the association between a polychotomous exposure and a rare outcome. *American Journal of Epidemiology*, *113*, 192–197.

Hirshfeld, D. R., Biederman, J., Brody, L., Faraone, S. V., & Rosebaum, J. F. (1997). Expressed emotion toward children with behavioral inhibition: Associations with maternal anxiety disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, *30*, 367–399.

Kilic, E. Z., Ozguven, H. D., & Sayil, I. (2003). The psychological effects of parental mental health on children experiencing disaster: The experience of Bolu earthquake in Turkey. *Family Process*, *42*, 485–495.

Kochanska, G., Kuczynski, L., Radke-Yarrow, M., & Welsh, J. D. (1987). Resolutions of control episodes between well and affectively ill mothers and their young-children. *Journal of Abnormal Child Psychology*, *15*, 441–456.

Kotler, B. P., & Brown, J. S. (1990). Harvest rates of two species of gerbilline rodents. *Journal of Mammalogy*, *71*, 591–596.

Laor, N., Wolmer, L., & Cohen, D. J. (2001). Mothers' functioning and children's symptoms 5 years after a SCUD missile attack. *American Journal of Psychiatry*, *158*, 1020–1026.

Liberatos, P., Link, B. G., & Kelsey, J. L. (1988). The measurement of social class in epidemiology. *Epidemiologic Review*, *10*, 87–121.

Lieberman, A. F., Ghosh Ippen, C., & Van Horn, P. (2006). Child-parent psychotherapy: 6-month follow-up of a randomized controlled trial. *Journal of American Academy of Child & Adolescent Psychiatry*, *45*, 913–918.

Lieberman, A. F., & Van Horn, P. (2005). *Don't hit my mommy*. Washington, DC: Zero to Three Press.

Lin, D. Y., & Wey, L. J. (1989). The robust inference for the proportional hazards model. *Journal of American Statistical Association*, *84*, 1074–1078.

McCloskey, L. A., & Walker, M. (2000). Posttraumatic stress in children exposed to family violence and single-event trauma. *Journal of the American Academy of Child and Adolescent Psychiatry*, *39*, 108–115.

McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine*, *338*, 171–179.

Mesman, J., Bongers, I. L., & Koot, H. M. (2001). Preschool developmental pathways to preadolescent internalizing and externalizing problems. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *42*, 679–689.

Michael, T., & Ehlers, A. (2007). Enhanced perceptual priming for neutral stimuli occurring in a traumatic context: Two experimental investigations. *Behaviour Research and Therapy*, *45*, 341–358.

Michael, T., Ehlers, A., & Halligan, S. L. (2005). Enhanced priming for trauma-related material in posttraumatic stress disorder. *Emotion*, *5*, 103–112.

Murray, L. (1992). The impact of postnatal depression on infant development. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *33*, 543–561.

Najarian, L. M., Goenjian, A. K., Pelcovitz, D., Mandel, F., & Najarian, B. (1996). Relocation after a disaster: Posttraumatic stress disorder in Armenia after the earthquake. *Journal of American Academy of Child and Adolescent Psychiatry*, *35*, 347–383.

Olff, M., Langeland, W., Draijer, N., & Gersons, B. P. R. (2007). Gender differences in posttraumatic stress disorder. *Psychological Bulletin*, *133*, 183–204.

Osofsky, J. D., & Eberhart-Wright, A. (1988). Affective exchanges between high risk mothers and infants. *International Journal of Psychoanalysis*, *69*, 221–231.

Pfefferbaum, B. J. (2005). Psychological impact of terrorism on children and families in the United States. *Journal of Aggression, Maltreatment and Trauma*, *9*, 305–317.

Pine, D. S., Costello, J., & Masten, A. (2005). Trauma, proximity, and developmental psychopathology: The effects of war and terrorism on children. *Neuropsychopharmacology*, *30*, 1781–1792.

Radloff, L. S. (1977). The CES–D Scale: A self-report depression scale for research in the general population. *Journal of Applied Psychological Measurement*, *1*, 385–401.

Renouf, A. G., & Kovacs, M. (1994). Concordance between mothers' reports and children's self-reports of depressive symptoms—A longitudinal study. *Journal of the American Academy of Child and Adolescent Psychiatry*, *33*, 208–216.

Richters, J., & Pellegrini, D. (1989). Depressed mothers' judgments about their children: An examination of the depression-distortion hypothesis. *Child Development*, *60*, 1068–1075.

Schechter, D. S., Zeanah, C. H., Myers, M. M., Brunelli, S., Coates, S. W., Grienenberger, J., et al. (2002, July). *Negative and distorted maternal attributions among violence-exposed mothers of very young children before and after single-session videofeedback: Are maternal psychopathology and reflective functioning predictive?* Paper presented at the meetings of the World Association of Infant Mental Health, Amsterdam, Netherlands.

Schmidt, K. A. (2000). Interactions between food chemistry and predation risk in fox squirrels—Statistical data included. *Ecology*, *29*, 1–13.

Shaw, D. S., Owens, E. B., Giovannelli, J., & Winslow, E. B. (2001). Infant and toddler pathways leading to early externalizing disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, *40*, 36–43.

Smith, P., Perrin, S., Yule, W., & Rabe-Hesketh, S. (2001). War exposure and maternal reactions in the psychological adjustment of children from Bosnia-Hercegovina. *Journal of Child Psychology and Psychiatry*, *42*, 395–404.

Stein, A., Gath, D. H., Bucher, J., Bond, A., Day, A., & Cooper, P. J. (1991). The relationship between postnatal depression and mother-child interaction. *British Journal of Psychiatry*, *158*, 46–52.

Thabet, A. A. M., Karim, K., & Vostanis, P. (2006). Trauma exposure in pre-school children in a war zone. *British Journal of Psychiatry*, *188*, 154–158.

Vila, G., Witkowski, P., Tondini, M. C., Perez-Diaz, F., Mouren-Simeoni, M. C., & Jouvent, R. (2001). A study of posttraumatic disorders in children who experienced an industrial disaster in the Briey region. *European Child and Adolescent Psychiatry*, *10*, 10–18.

Vythilingam, M., Blair, K. S., McCaffrey, D., Scaramozza, M., Jones, M., Nakic, M., et al. (2007). Biased emotional attention in post-traumatic stress disorder: A help as well as a hindrance? *Psychological Medicine*, *37*, 1445–1455.

Weissman, M. M., Pilowsky, D. J., Wickramaratne, P. J., Talati, A., Wisniewski, S. R., Fava, M., et al. (2006). Remissions in maternal depression and child psychopathology—A STAR*D-child report. *Journal of the American Medical Association*, *295*, 1389–1398.

Wolmer, L., Laor, N., Gershon, A., Mayes, L. C., & Cohen, D. J. (2000). The mother-child dyad facing trauma—A developmental outlook. *Journal of Nervous and Mental Disease*, *188*, 409–415.

Yehuda, R. (2002). Clinical relevance of biologic findings in PTSD. *Psychiatric Quarterly*, *73*, 123–133.

Yehuda, R., & Bierer, L. M. (2008). Transgenerational transmission of cortisol and PTSD risk. *Progress in Brain Research*, *167*, 121–135.

Zahn-Waxler, C., Iannotti, S., Cummings, E., & Denham, S. (1990). Antecedents of problem behaviors in children of depressed mothers. *Development and Psychopathology*, *2*, 271–291.

Zhang, J., & Yu, K. F. (1998). What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *Journal of the American Medical Association*, *280*, 1690–1691.