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Peritraumatic panic attacks and health outcomes two years after psychological trauma: Implications for intervention and research

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Abstract

Several studies have suggested that experiencing a peritraumatic panic attack (PPA) during a traumatic event predicts future mental health status. Some investigators have suggested that this finding has psychotherapeutic significance. We assessed the hypothesis that PPA was *not* related to longer-term health status after event exposure, once background confounders were controlled. In our study we assessed exposure to the World Trade Center disaster (WTCD) and other negative life events, demographic factors, social support, self-esteem, and panic attack onset in predicting health outcome among 1681 New York City residents 2 years after the attack. Initial bivariate results indicated that a PPA was related to a number of adverse outcomes 2 years after the WTCD, including posttraumatic stress disorder, depression, poor physical health, anxiety, binge drinking, and mental health treatment seeking. However, when multivariate (MV) models were estimated adjusting for potential confounders, most of these associations were either non-significant or substantially reduced. Contrary to previous predictions, these MV models revealed that recent negative life events and current self-esteem at follow-up were the best predictors of health outcomes, not PPA. Although post-trauma interventions may target individuals who experienced PPA after traumatic exposures, reducing the long-term health consequences following such exposures based on PPA alone may be problematic. Modifications of psychopathology constructs based on the reported correlation between PPA and post-trauma outcomes may be premature.

Keywords: Peritraumatic; Panic attack; Posttraumatic stress disorder; Depression; Anxiety; Disaster; Alcohol use; Mental health treatment

1. Introduction

Research has suggested that having a history of panic attacks is a good indicator of having other psychiatric disorders, including posttraumatic stress disorder (PTSD), depression, attention deficit, substance abuse, as well as other mental health disorders (Reed and Wittchen, 1998; Goodwin and Hamilton, 2002; Goodwin et al., 2004; Baillie and Rapee, 2005; Goodwin

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et al., 2005). Current research suggests that as many as 24% of adults have had a panic attack in their lifetimes (Kessler et al., 2006). Reported risk factors for this condition include race/ethnicity, gender, socioeconomic status, history of childhood abuse, as well as genetic factors (Goodwin and Hamilton, 2002; Kessler et al., 2006; Safren et al., 2002). Recently it has been suggested that "peritraumatic" panic attacks (PPAs), that is, those occurring in close temporal proximity to traumatic exposures (Boscarino et al., 2002; Ahern et al., 2004), have prognostic and clinical value related to future mental health status (Bryant and Panasetis, 2001; Lawyer et al., 2006; Person et al., 2006; Pfefferbaum et al., 2006). If so, then this finding may have significant therapeutic and pubic health implications. For example, it has been reported that brief work-site mental health interventions after the World Trade Center disaster (WTCD) were highly effective for workers up to 2 years after the attack (Boscarino et al., 2006a). If this can be confirmed in other studies, then it might be important to focus interventions among those who experienced PPAs following mass-casualty events, where treatment resources could be limited (Foa et al., 2005; Boscarino et al., 2006d).

A significant limitation of past PPA research, however, was that investigators have either assessed post-event outcomes on a short-term basis (e.g., a year or less) (Boscarino et al., 2002) or only evaluated one or two health outcomes of interest (Pfefferbaum et al., 2006). In addition, many previous studies have not controlled for key pre-exposure and post-exposure variables that could have affected mental health status (Fikretoglu et al., 2007). Consequently, the PPA findings reported to date may be limited. If this were correct, PPA may be a poor measure for future health outcomes and of limited clinical value post-exposure. This is important because there has been speculation about the psychotherapeutic implications of this reported association (Lawyer et al., 2006; Pfefferbaum et al., 2006).

To better assess the prognostic value of PPA, we examined a battery of mental health outcomes possibly correlated with PPAs, including PTSD, depression, anxiety, functional health status, alcohol use, and mental health service utilization among New York City (NYC) adults 2 years after the WTCD. Past research has suggested that exposure to community-wide disasters was often associated with the onset of panic attacks, as well as depression, PTSD and other adverse mental health outcomes (Adams et al., 2002; Galea et al., 2002; Boscarino et al., 2004a,b). However, as suggested, the value of PPA in predicting such outcomes over the long term, independent of other common risk factors, is unknown.

The WTCD represented one of the most destructive community disasters in US history (Galea et al., 2002; Boscarino et al., 2004a). Since past research suggested that the WTCD had the elements that could result in long-term health problems, including major loss of life, extensive property damage, ongoing financial problems, and a disaster caused by human intent (Rubonis and Bickman, 1991; Norris et al., 2002), one would expect persistent adverse health outcomes following this event. Earlier studies following the Oklahoma City bombing suggested that persons directly exposed to the blast were more likely to report PTSD symptoms 6 months post-disaster (North et al., 1999). Similarly, studies following the WTCD reported that 7.5% of adults living near the WTC on September 11th met criteria for PTSD and 9.7% met criteria of major depression (Galea et al., 2002). Other studies reported similar results (Boscarino et al., 2004a; Boscarino et al., 2004b).

In the current study, as discussed below, we used a general hierarchical model that examined the significance of PPA in predicting longer-term health outcomes after the WTCD that was used in previous studies (Adams and Boscarino, 2005b; Boscarino et al., 2006c). Another study suggested that while the WTCD had a major impact on mental health status among NYC workers 1 year after this event, 2 years after the attack these effects had dissipated (Boscarino et al., 2006c). Consequently, and inconsistent with previous reports (Bryant and Panasetis, 2001; Lawyer et al., 2006; Person et al., 2006; Pfefferbaum et al., 2006), we hypothesized that experiencing a PPA during or shortly after the WTCD would *not* be predictive of longer-term health outcomes, once pre-disaster mental health status and other risk factors were controlled. In this way, we sought to evaluate the longer-term health outcomes associated with PPA, unconfounded by potential pre- and post-morbid disaster factors. If our hypothesis was correct, we note that this would not necessarily diminish the prognostic value of PPA, per se, but rather refocus the clinical implications of this correlation. For example, it would suggest that speculation related to intrapsychic and clinical implications of such an association, such as focusing interventions on perceived fears or psychosomatic symptoms (Bryant and Panasetis, 2001; Nixon and Bryant, 2003), might be premature at this time.

2. Data and methods

2.1. Study participants

The data for our present study come from a prospective cohort study of adults who were living in NYC

on the day of the WTCD. Using random-digit dialing, we conducted a baseline telephone survey a year after the attack. As part of the overall study, we over-sampled residents who reported receiving any mental health treatment in the year after the attack by use of screener questions at the beginning of the survey. Our baseline population was also stratified by the five NYC boroughs and gender and sampled proportionately. Questionnaires were translated into Spanish and then back-translated by bilingual Americans to ensure linguistic and cultural appropriateness. Approximately 7% of the interviews were conducted in Spanish at baseline. The baseline survey occurred between October and December 2002, and a follow-up survey occurred 1 year later, between October 2003, and February 2004. The data collection procedures were the same for both surveys. Trained interviewers, using computer-assisted telephone interviewing, conducted the interviews. All interviewers were supervised and monitored by the survey contractor in collaboration with the investigative staff. The mean duration of the interview was 45 min for the baseline and 35 min for the follow-up survey. The Institutional Review Board of The New York Academy of Medicine reviewed and approved the study's protocols. For the baseline, 2368 individuals completed the survey. We were able to re-interview 1681 of these respondents in the follow-up survey. On the basis of industry-standard survey definitions, the baseline cooperation rate was 63% (American Association for Public Opinion Research, 2000), and the re-interview rate for the follow-up study was 71% (Adams et al., 2006a), consistent with previous epidemiological investigations (Galea et al., 2002; Boscarino et al., 2004b).

Sampling weights were developed for each wave to correct for potential selection bias related to the number of telephone numbers and persons per household and for the over-sampling of treatment-seeking respondents (Groves et al., 2004). Demographic weights also were used in the follow-up data to adjust for slight differences in response rates by different demographic groups, a common practice in panel surveys (Kessler et al., 1995). With these survey adjustments, our study is considered representative of adults who were living in NYC on the day of the WTCD (Groves et al., 2004; Adams et al., 2006a).

2.2. Assessment of peritraumatic panic attack (PPA)

Our study assessed whether the respondents met criteria for panic attack, including experiencing a peritraumatic panic attack during the WTCD event. This measure was derived from the panic disorder section of the Diagnostic Interview Schedule (DIS) (Robins et al., 1999). Panic disorder in the DIS is based on the *Diagnostic and Statistical Manual of Mental Disorders*, *Fourth Edition* (DSM-IV) criteria (American Psychiatric Association, 1994). However, for our PPA measure, questions were phrased to assess panic symptoms that occurred during or shortly after the events of September 11th (Galea et al., 2002). For example, for this assessment we asked respondents to report DIS-DSM-IV panic symptoms that may have occurred during or within the first few hours after the WTCD event, rather than in their lifetimes or in the past year, which is the standard for assessing panic disorder. However, consistent with the criteria for panic attack, the presence of four or more symptoms classified the person as having a PPA, if these symptoms reached their peak within 10 min of onset (Robins et al., 1999). This variable was coded as a binary measure. This PPA measure has been extensively used and validated in previous WTCD studies (Galea et al., 2002; Boscarino et al., 2003, 2004a; Adams and Boscarino, 2005b). Using this measure, it was previously reported that approximately 11% of NYC adults experienced a PPA during the WTCD (Boscarino et al., 2004a). As discussed below, in addition to PPA, we also assessed the lifetime occurrence of panic attack, also based on DIS-DSM-IV criteria (Robins et al., 1999).

2.3. Health outcomes assessed

In our study we assessed the following post-disaster health outcomes: PTSD, sub-clinical PTSD, depression, anxiety disorder, functional health status, alcohol use/abuse, and mental health services utilization. Since other studies have examined short-term outcomes related to PPA (Galea et al., 2002; Boscarino et al, 2002, 2003, 2004a; Pfefferbaum et al., 2006; Lawyer et al., 2006) and our focus was on assessing longer-term impacts, the outcomes we examine in the current study occurred 2 years after the WTCD.

2.3.1. PTSD and sub-clinical PTSD

Our PTSD scale was also based on DSM-IV (American Psychiatric Association, 1994) and specifically adapted for telephone administration (Resnick et al., 1993; Kilpatrick et al., 1998; Galea et al., 2002; Boscarino et al., 2004a,b). To meet PTSD criteria, first, a respondent had to be exposed to a traumatic event and experience intense feelings of fear, helplessness, or horror (Criteria A1 and A2). Second, the person had to re-experience the event in one of five ways (Criterion B),

avoid stimuli associated with the event in three of seven ways (Criterion C), and had to have increased arousal in two of five ways (Criterion D). Third, these symptoms had to last 1 month or longer (Criterion E). Fourth, the symptoms had to have a significant impact on the individual's functional status (Criterion F). Our assessment involved several sets of experiences, including the WTCD, the most stressful traumatic event experienced other than the WTCD, and any other traumatic event experienced. To have PTSD, the person had to meet criteria A through F for one or more of these traumatic events in the past 12 months. Data supporting the validity of this instrument have been presented elsewhere and suggested that this scale can successfully diagnose PTSD in the general population (Boscarino et al., 2004a,b; Adams and Boscarino, 2005b, 2006; Boscarino et al., 2006a,b,c). For the current analyses we so defined PTSD as present if the respondent had subclinical or partial PTSD at follow-up. As was noted elsewhere (Adams et al., 2006b), even though individuals may not meet the full PTSD criteria at follow-up, many still have partial PTSD and are still impaired. Partial PTSD was classified based on a method previously described (Breslau et al., 2004). For this classification, respondents met criteria for partial PTSD if they experienced at least one symptom from each symptom group (B, C, and D) and the symptoms lasted at least 1 month. We used this partial PTSD measure to identify individuals who suffer from PTSD symptoms, but do not necessarily meet full criteria; as noted, although these individuals fail to meet criteria for full PTSD, they have significantly more impairment than those who do not meet these criteria (Breslau et al., 2004).

2.3.2. Depression

For a diagnosis of major depression, we used a version of the SCID's major depressive disorder scale from the non-patient version (Spitzer et al., 1987), which also has been used in telephone-based, population surveys (Acierno et al., 2000; Galea et al., 2002; Kilpatrick et al., 2003; Boscarino et al., 2004a,b). Following DSM-IV criteria (American Psychiatric Association, 1994), respondents met the criteria for depression if they had five or more depression symptoms for at least 2 weeks. In the current study, Cronbach's alpha for the 10 symptoms used in this scale was 0.87. Data related to the validity of this scale were also previously reported and suggested that this scale successfully diagnoses depression in the general population (Acierno et al., 2000; Galea et al., 2002; Kilpatrick et al., 2003; Boscarino et al., 2004a,b).

2.3.3. Functional health status

Functional health status was assessed using the Short Form-12, version 2 (SF-12-v2) (Cronbach's alpha = 0.87). Following standard scoring algorithms, the items were converted into *z*-scores and summed into two separate scales representing physical and psychological status (Ware et al, 2002). The physical health scale measures physical functioning, vitality, and body pain in the past 30 days. The psychological health scale measures emotional problems, mood, and depression symptoms in the past 30 days. In our study, we used the recommended score of less than 35 to define individuals as clinical cases for each of these measures (Ware et al., 2002). Since the psychological health scale significantly overlapped with depression and these results were similar, we do not report the results for this scale in the current study. These functional status measures have been reported to have excellent validity and reliability (Ware et al., 1996, 2002) and have been extensively used in health research (Ware et al. 1996; Burdine et al., 2000; Fleishman and Lawrence, 2003).

2.3.4. Anxiety disorder

Our study also included measures related to anxiety disorder status. This measure was from the Brief Symptom Inventory-18 (BSI-18). This measure was based on symptoms reported in the past 30 days and derived from the Hopkins Symptom Checklist (Derogatis, 2001). The BSI-18 has been standardized based on a community sample and has a standard clinical cut-off score for case definition (Derogatis, 2001). For this scale, we used a *T*-score of 65+, representing a symptom score above the 90th percentile, to define a case. The Cronbach's alphas for the BSI-18 scales range from 0.74 to 0.89 and test-retest correlations range from 0.68 to 0.90 (Derogatis, 2001). Convergent validity for the BSI-18 with the Symptom Checklist 90-Revised was reported to be high, with correlations ranging from 0.91 to 0.96 (Derogatis, 2001).

2.3.5. Alcohol use

Our study also included measures related to alcohol use including alcohol consumption and binge drinking (Adams et al., 2006b; Boscarino et al., 2006b). Following a standard for assessing binge drinking (Allen and Columbus, 1995; Naimi et al., 2003), in the survey respondents were asked how many times in the past year they had had six or more alcoholic drinks on one occasion. Those who reported that they drank that much or more on at least one occasion (15%) were classified as "binge drinkers." In the survey, we also inquired about the respondent's specific alcohol consumption. This was

based on the number of drinks reported per month, which was the combination of two survey questions. Respondents were first asked on how many days in the past month they drank alcoholic beverages and then asked how many drinks they had on the days that they drank. We multiplied the responses to these two questions to calculate the drinks per month. Those that consumed 30 drinks or more per month (6%) were classified as heavy drinkers. These measures were used and validated in previous WTCD studies (Adams et al., 2006b; Boscarino et al., 2006b).

2.3.6. Mental health service utilization

In our study, we adopted the National Comorbidity Survey (NCS) for our assessments of mental health service use (Kessler et al., 1997, 1999). Specifically, we asked participants about receiving counseling from a helping professional (e.g., psychiatrist, counselor, physician, or self-help group) for "problems with emotions or nerves or use of alcohol or drugs" after the attacks. We asked how many visits they had to each of these professionals during the past 12 months in both the baseline and in the follow-up surveys, respectively. This measure has been used and validated in previous national surveys (Kessler et al., 1997, 1999). A more detailed description of this mental health use measure has been presented elsewhere (Boscarino et al., 2004a). Validity studies of self-reported mental health visits suggest that this may under-represent actual visits, but is accurate when the timeframe is relatively short (Kessler et al., 1997). Based on previous WTCD studies (Boscarino et al., 2004a), we developed two mental health visit measures: any post-disaster visits and any post-disaster visits related to the WTC disaster. For the latter measure, respondents who had post-disaster mental health visits were asked if these were related to the WTCD. If the respondent reported that these visits were related to the attacks, the individual was classified as having had a WTCD-related visit. These service visit questions were pre-tested before final implementation and had been used in previous WTCD pilot surveys (Boscarino et al., 2002, 2003).

2.4. Study control variables

Our analyses included measures of demographic status, stressor exposures, psychosocial resources, and pre-disaster mental status, which were used as study control variables in our analyses. As noted, we included these variables to better assess the impact of peri-traumatic panic in predicting longer-term outcomes independent of background demographics, stressor exposures, psychosocial resources, and mental health history.

2.4.1. Demographic characteristics

Our analyses included eight demographic measures collected during the baseline survey, including age, education, gender, marital status, employment status, children at home, race/ethnicity, and income. Age was coded in years (baseline mean=43.3; SD=20.4). Education was collected and coded as an ordinal scale ranging from 1 to 5, representing less than high school through to graduate school (baseline mean=3.1; SD=1.5). Female gender, employment status, children at home, and marital status were coded as binary variables, with the latter dichotomized as married/cohabitating *vs*. not married/cohabitating. Consistent with past research (Galea et al., 2002; Boscarino et al., 2004a), race/ethnicity was classified based on self-report and coded as a categorical variable as follows: White, Black or African American, Latino/Hispanic, and Other. Income was collected and coded as a 7-point ordinal scale ranging from under $20,000 to greater than $100,000 (mean=3.9, SD=2.7). For those respondents who did not answer the demographic questions on the baseline survey, we asked for the information again at follow-up and substituted these answers for the baseline missing data. Approximately, 3% of respondents had missing data for income after substituting year-2 data. For these cases, we substituted the median baseline income category for these respondents.

2.4.2. Stressor exposure measures

Our statistical models included three stressor variables that could affect health outcomes. The first measure was a WTCD event exposure measure, which was only assessed during the baseline survey. This consisted of 14 possible events that the respondent could have experienced during the attacks (e.g., was at the WTCD site during attack, had to be evacuated, lost job because of the attacks). The mean for this measure was 2.0 (SD=1.6). The second stressor measure was a negative life event scale (Freedy et al., 1993, Boscarino et al., 2004a), which was the sum of eight experiences that the respondent could have had in the past 12 months from the day of the interview (e.g., divorce, death of spouse, or problems at work). The follow-up survey contained the same negative life events scale as used at baseline, but covered the past 12 months from the day of the interview. The mean for this measure was 0.8 (SD=1.2). The third stressor measure was a lifetime traumatic events scale that included 10 traumatic events (e.g., forced sexual contact, being attacked with a weapon, having a serious accident) (Freedy et al., 1993, Boscarino

et al., 2004a). Consistent with the mental health and stressor scales used in our analyses, the trauma scale measured lifetime trauma from the time of the follow-up survey. The combined mean lifetime trauma exposure at follow-up was 1.9 (SD=2.5). All three of these stressor measures were used and validated in previous WTCD studies and discussed in detail elsewhere (Galea et al., 2002; Boscarino et al., 2004a, b; Adams and Boscarino, 2005a,b; Adams et al., 2006a; Boscarino et al., 2006b,c).

2.4.3. Social support

Social support was the sum of four questions about emotional, informational, and instrumental support currently available to the respondent measured on a 4-point scale (e.g., someone available to help you if you were confined to bed; "not at all" to "all the time") (Sherbourne and Stewart, 1991). Due to the skewed distribution of this scale, we collapsed scale values into quintiles and used this as an ordinal scale (coded 0–4) in the MV analyses (mean=2.2, SD=1.8). This scale has been used and validated in previous studies and discussed in detail elsewhere (Galea et al., 2002; Boscarino et al., 2004a,b, 2006b,c; Adams and Boscarino, 2005a, b; Adams et al., 2006a).

2.4.4. Self-esteem

Self-esteem was measured by a brief version of the Rosenberg self-esteem scale (Rosenberg, 1979). This measure was the sum of five items measured on a 4-point scale (e.g., on the whole, I am satisfied with myself; never to always). Due to the skewed distribution of this scale, we collapsed scale values into quartiles and used this as an ordinal scale (coded 0–3) in the MV analyses (mean=1.9, SD=1.4). This measure was also used and validated in previous studies and also discussed in detail elsewhere (Boscarino et al., 2004a, 2006b,c; Adams and Boscarino, 2005a,b; Adams et al., 2006a).

2.4.5. Pre-disaster mental status

To control for pre-disaster mental status, we used two study variables, including history of pre-disaster major depression and history of pre-disaster panic attack. Both of these variables were based on DSM-IV criteria as discussed above and, consistent with the DIS (Robins et al., 1999), these were determined based on age of onset for each of these disorders, respectively.

2.5. Data analysis

In our data analysis we sought to assess the impact of PPA in predicting longer-term health status across a number of outcomes. To do this, we first describe the characteristics of our population and then conduct bivariate analyses of PPA by health outcomes at 2 years post-event. Next, multivariate (MV) logistic regressions were conducted predicting health outcomes, hierarchically, similar to other analyses following the WTCD (Adams and Boscarino, 2005b; Boscarino et al., 2006c), whereby we controlled for demographic factors, stressor exposures, protective factors, and finally pre-disaster status. In the current MV analyses, covariates representing age, education, income, stressor exposures, social support, and self-esteem were used as continuous variables; race/ethnicity, gender, and marital status were used as categorical variables, as discussed. As suggested, our analytical objective was to assess longer-term health outcomes, after controlling for other factors that could be associated with PPAs. Our plan was to replicate previous analyses (Galea et al., 2002; Boscarino et al, 2002, 2004a: Lawyer et al., 2006; Pfefferbaum et al., 2006), but this time over a 2-year period. The one exception was the addition of pre-exposure mental health status in these analyses, which had not been previously assessed in most studies. As noted, our hypothesis was that PPA would not be a consistent predictor of future mental health status when longer-term outcomes were assessed and key confounders were controlled. For the statistical analyses reported, we used Stata, Version 9.2 (Stata Corporation, 2007). Significant *P*-values were defined as those <0.05. The results shown were based on two-tailed tests.

3. Results

As discussed elsewhere, the demographics of our study matched the demographic profile of the NYC adult population (Adams et al., 2006a). As can be seen in Table 1, at baseline over 75% of respondents were 30 years old or older, 54% were females, 42% were college graduates, 50% were married, 42% had children in the household, 17% had household incomes of $100,000 or more, nearly 80% were employed, and 50% were African American or Hispanic. In addition, at baseline 30% reported "high" or "very high" exposure to WTCD events, 37% had experienced one or more negative life events in the past year, and 30% had experienced three or more traumatic events in their lifetimes. Noteworthy is that all but two of the variables (marital and employment status) were associated with having had a WTCD-related PPA. As can also be seen in Table 1, PPAs tended to be more prevalent among those who were 30–44 years old, women, less educated, lower

Table 1
Associations between baseline status and peritraumatic panic attack.

Baseline status[a]	Weighted % (unweighted *N*)	Peri-traumatic panic attack
Age		
18–29	22.7 (284)	27.4 (45)**
30–44	32.9 (596)	43.2 (103)
45–64	32.5 (586)	24.4 (68)
65+	11.9 (215)	5.1 (14)
Gender		
Male	46.2 (693)	34.3 (76)**
Female	53.8 (988)	65.8 (154)
Education		
Less than high school graduate	8.2 (155)	16.4 (37)***
High school graduate/GED	27.4 (389)	31.6 (63)
Some college	22.7 (362)	21.5 (49)
College graduate	25.0 (461)	21.8 (58)
Graduate/professional degree	16.7 (314)	8.8 (23)
Marital status		
Married	50.3 (709)	46.5 (92)
Not married	49.7 (972)	53.5 (138)
Children under 18 living in household		
No	57.8 (1041)	38.1 (106)***
Yes	42.2 (640)	61.9 (124)
Income		
<$30,000	35.1 (599)	48.0 (106)**
$30,000–$99,999	48.2 (782)	42.2 (99)
$100,000+	16.7 (247)	9.7 (21)
Employed		
No	27.3 (479)	33.2 (73)
Yes	77.7 (1202)	66.8 (157)
Race/ethnicity		
Non-Hispanic white	43.0 (782)	22.1 (60)***
Non-Hispanic black/African American	26.0 (422)	30.7 (67)
Hispanic	24.1 (367)	35.9 (82)
Other race/no race given	7.0 (110)	11.3 (21)
WTCD Exposure		
Low (0–1 event)	26.7 (362)	15.9 (20)***
Moderate (2–3 events)	43.9 (719)	27.1 (62)
High (4–5 events)	21.8 (416)	34.1 (82)
Very high (6+events)	7.6 (184)	22.9 (66)
Negative life events past year		
None	63.3 (991)	45.9 (101)***
1 Event	24.7 (429)	27.0 (54)
2 or more events	12.0 (261)	27.1 (75)
Lifetime traumatic events		
None	30.6 (418)	23.8 (46)**
1–2	39.4 (677)	39.6 (84)
3–4	18.0 (334)	14.7 (45)
5 or more	12.3 (252)	21.8 (55)
Self-esteem past year		
Low	36.4 (633)	58.1 (126)***
Moderate	23.7 (408)	14.9 (40)
High	39.9 (640)	27.0 (64)
Social support past year		
Low	35.7 (596)	49.6 (109)**
Moderate	37.9 (656)	30.9 (80)
High	26.4 (429)	19.5 (41)

Notes to Table 1
* $P<0.05$ ** $P<0.01$ *** $P<0.001$, two-tailed test.
[a]All percentages are weighted and all *N*'s are unweighted; All variables in Table 1 are from baseline assessment; WTCD=World Trade Center Disaster.

income, and those who were Hispanic. They were also more prevalent among those who had high exposure to WTCD events, experienced negative events during the past 12 months, and among those who had experienced more lifetime traumatic events. Also noteworthy was that those classified as having low self-esteem or low social support at baseline had a higher prevalence of PPAs as well (Table 1).

In terms of pre-disaster mental status and the health outcomes of interest, Table 2 indicates that 18% of New Yorkers had a history of pre-disaster depression and 14% had a history of pre-disaster panic attacks. In addition, at follow-up, about 4% had PTSD, 8% partial PTSD, and 12% depression. Furthermore, 8% met criteria for poor physical health, and 9% met criteria for BSI-anxiety disorder (Table 2). Additionally, 15% of New Yorkers were classified as binge drinkers and 6% as heavy drinkers. Finally, 21% used mental health services during the follow-up period and 12% used mental services directly related to the WTCD. A significantly higher prevalence of PPA (i.e., *P*-values< 0.001) was evident among New Yorkers with pre-disaster depression, as well as with PTSD, depression, poor physical health, anxiety, and mental health visits during the follow-up period (Table 2). Heavy drinking post-disaster was the only outcome not associated with peritraumatic panic attack and was, therefore, excluded from the multivariate analyses.

As noted, due to the potential impact of confounding, the longer-term direct impact of PPA cannot be inferred from bivariate analyses. Consequently, we used multivariate analyses examining our outcomes of interest, controlling, hierarchically, for demographic, stressor, and protective factors. Additionally, we also controlled for pre-disaster mental status, including history of pre-disaster depression and pre-disaster panic attack, respectively (Table 3). As can be seen, neither PTSD nor sub-clinical PTSD was related to PPA after only demographic variables were controlled. For depression and anxiety, however, both of these outcomes were significant in the final models at follow-up after all the variables were controlled, with adjusted odds ratios (ORs) of 1.90 ($P<0.05$) and 2.48 ($P<0.01$), respectively. Nevertheless, in addition to the PTSD measures, non-significance was observed for our measures of physical health status, binge drinking,

Table 2
Associations between peritraumatic panic attack, pre-disaster status and health outcomes at 2 years post disaster.

Pre-disaster status†	Weighted % (unweigted *N*)	Peri-traumatic panic attack
Lifetime depression pre-disaster		
No	81.7 (1261)	69.9 (152)***
Yes	18.3 (420)	30.1 (78)
Lifetime panic disorder pre-disaster		
No	85.7 (1388)	80.7 (175)
Yes	14.3 (293)	19.3 (55)
Outcomes 2 years post disaster†	**Weighted % (unweigted *N*)**	**Peri-traumatic panic attack**
PTSD past 12 months		
No	96.2 (1587)	88.9 (195)***
Yes	3.8 (94)	11.1 (35)
Sub-clinical PTSD past 12 months		
No	91.9 (1496)	79.4 (169)***
Yes	8.1 (185)	20.6 (61)
Depressed past 12 months		
No	88.4 (1404)	68.0 (150)***
Yes	11.6 (277)	32.0 (80)
Poor physical health past month		
No	92.5 (1518)	84.1 (190)***
Yes	7.5 (163)	15.9 (40)
Anxiety past month		
No	90.9 (1464)	70.9 (155)***
Yes	9.1 (217)	29.1 (75)
Binge drinking past 12 months		
No	85.1 (1448)	77.8 (183)*
Yes	14.9 (233)	22.2 (47)
Heavy drinking past month		
No	94.0 (1568)	95.1 (217)
Yes	6.0 (113)	4.9 (13)
Any mental health treatment past 12 months		
No	79.3 (1175)	65.7 (124)***
Yes	20.7 (506)	34.3 (106)
Mental health treatment related to WTCD past 12 months		
No	88.5 (1375)	72.3 (140)***
Yes	11.6 (306)	27.3 (90)

* $P<0.05$ ** $P<0.01$ *** $P<0.001$, two-tailed test.
†All percentages are weighted and all *N*'s are unweighted; WTCD=World Trade Center Disaster.

and post-disaster mental health service utilization, including any mental health service use and WTCD-related service use, after variables were controlled (Table 3). In fact, with one exception, WTCD-related service use, none of these outcomes – other than for depression or anxiety – were significant after only the demographic and stressor exposures variables were controlled, suggesting that these factors may be important in explaining the association between PPA and longer-term health outcomes.

Following these analyses, we also examined the individual variables in our MV predictive models and

Table 3
Hierarchical logistic regressions predicting year-2 post-disaster health outcomes by peritraumatic panic attack and study control variables (*N*=1667).

Health outcomes 2 years post disaster	Odds ratio (95%CI)
Model 1: PTSD past 12 months	
Peritraumatic panic attack only	4.07 (2.32–7.15)***
+ Demographic factors[a]	4.00 (2.31–6.95)***
+ Stressor risk factors[b]	1.54 (0.74–3.23)
+ Social/psychological resources[c]	1.55 (0.75–3.12)
+ Pre-exposure mental health[d]	1.48 (0.72–3.07)
Model 2: sub-clinical PTSD past 12 months	
Peritraumatic panic attack only	3.64 (2.31–5.74)***
+ Demographic factors[a]	3.33 (2.04–5.44)***
+ Stressor risk factors[b]	1.73 (0.88–3.36)
+ Social/psychological resources[c]	1.62 (0.86–3.08)
+ Pre-exposure mental health[d]	1.62 (0.86–3.06)
Model 3: depression past 12 months	
Peritraumatic panic attack only	4.63 (3.05–7.02)***
+ Demographic factors[a]	4.35 (2.84–6.65)***
+ Stressor risk factors[b]	2.34 (1.26–4.31)**
+ Social/psychological resources[c]	2.07 (1.17–3.67)*
+ Pre-exposure mental health[d]	1.90 (1.07–3.37)*
Model 4: anxiety past month	
Peritraumatic panic attack only	5.61 (3.60–8.76)***
+ Demographic factors[a]	4.84 (2.95–7.94)***
+ Stressor risk factors[b]	2.94 (1.52–5.67)**
+ Social/psychological resources[c]	2.74 (1.51–4.97)**
+ Pre-exposure mental health[d]	2.48 (1.40–4.41)**
Model 5: poor physical health past month	
Peritraumatic panic attack only	2.48 (1.48–4.18)**
+ Demographic factors[a]	2.11 (1.19–3.72)**
+ Stressor risk factors[b]	1.19 (0.60–2.35)
+ Social/psychological resources[c]	0.99 (0.51–1.91)
+ Pre-exposure mental health[d]	0.92 (0.49–1.74)
Model 6: binge drinking past 12 months	
Peritraumatic panic attack only	1.73 (1.11–2.70)*
+ Demographic factors[a]	1.89 (1.13–3.16)*
+ Stressor risk factors[b]	1.62 (0.93–2.81)
+ Social/psychological resources[c]	1.55 (0.89–2.70)
+ Pre-exposure mental health[d]	1.58 (0.90–2.75)
Model 7: any mental health treatment past 12 months	
Peritraumatic panic attack only	2.21 (1.53–3.19)***
+ Demographic factors[a]	2.05 (1.40–3.00)***
+ Stressor risk factors[b]	1.25 (0.84–1.87)
+ Social/psychological resources[c]	1.18 (0.78–1.78)
+ Pre-exposure mental health[d]	1.07 (0.70–1.64)
Model 8: mental health treatment related to WTCD past 12 months	
Peritraumatic panic attack only	3.48 (2.36–5.12)***
+ Demographic factors[a]	3.10 (2.06–4.67)***
+ Stressor risk factors[b]	1.62 (1.03–2.57)*
+ Social/psychological resources[c]	1.54 (0.98–2.44)
+ Pre-exposure mental health[d]	1.37 (0.86–2.20)

* $P<0.05$ ** $P<0.01$ *** $P<0.001$, two-tailed test.
[a] Includes: age, education, gender, children at home, income, race, employment status and marital status.
[b] Includes: World Trade Center disaster exposure level, negative life events past year and lifetime traumas at follow-up.
[c] Includes: level of social support and self-esteem at follow-up.
[d] Includes: history of pre-disaster depression and pre-disaster panic attacks. WTCD=World Trade Center Disaster.

discovered that the most consistently significant variable in predicting longer-term health outcomes was not PPA, but the number of negative life events experienced during the follow-up year. For example, in the final models examined, except for binge drinking, the number of negative life events experienced in the follow-up year was significant in predicting adverse health outcomes. Specifically, the adjusted Wald test for the negative life events measure in the final PTSD model (Table 3, model 1) was equal to $F(1, 1676)=27.87$, $P<0.001$. This finding held true for level of self-esteem as well, whereby lower self-esteem in year 2 tended to predict follow-up health status far better than experiencing a PPA in these models. It should be noted that when we removed negative life events from these models, PPA also now reached statistical significance (P-values <0.05) for PTSD, subclinical PTSD, and WTCD-related treatment seeking. Given this finding, we also tested for interaction effects for PPA by negative life events in the models where these main effects were significant, but none of these were statistically significant.

4. Discussion

In our current study we were interested in assessing the predictive value of PPA in forecasting longer-term post-disaster health outcomes. Preliminary studies have suggested that this peritraumatic event variable had important prognostic and clinical value (Bryant and Panasetis, 2001; Galea et al., 2002). Consequently, screening for this factor immediately post-disaster might aid in identifying those at greatest risk for adverse outcomes and focus limited resources on individuals at the greatest risk. As suggested, however, a limitation of past studies has been that either the investigators assessed this on a short-term basis (i.e., less than 12 months) or they only evaluated one or two mental health outcomes of interest. In addition, many studies did not fully examine other factors that might increase or reduce risk for such outcomes. As was seen, with the exception of depression and anxiety, PPA was not uniquely associated with adverse health outcome 2 years after the WTCD. Given that PPA was significant for all eight outcomes examined in our bivariate analyses, one could assume that PPA might be more of a surrogate marker for adverse outcomes, but not necessarily on a direct causal pathway for these outcomes, per se, which has significance for how this clinical information might be used.

As noted, following the WTCD, investigators reported that 11% of NYC adults experienced a peritraumatic panic attack during this event (Boscarino et al., 2004a). Furthermore, other research has suggested that having a history of panic attacks is also an indicator of comorbid psychiatric disorders, including PTSD, depression, substance abuse, and other mental health conditions (Goodwin and Hamilton, 2002; Goodwin et al., 2004; Baillie and Rapee, 2005). Current research suggests that as many as 24% of adults have had a panic attack in their lifetimes (Kessler et al., 2006). Risk factors for panic attacks have been reported to include a history of childhood abuse, as well as possibly genetic factors (Goodwin and Hamilton, 2002; Safren et al., 2002). As suggested, it has been noted by some that PPAs – panic attacks in close temporal proximity to a traumatic event exposure – have significant value in forecasting long-term psychological problems following these events (Pfefferbaum et al., 2006; Lawyer et al., 2006).

As was seen in the current study, when we examined a range of health outcomes potentially related to PPA following a traumatic event 2 years after exposure, few of these remained significant after demographic, stressor exposure, psychosocial resource, and pre-exposure mental health status variables were controlled. The two exceptions were for post-disaster depression and anxiety. Peritraumatic panic was not predictive of PTSD, binge drinking, physical health status, or post-disaster mental health service use 2 years post-trauma, once these risk/protective factors were controlled. Given previous research (Bryant and Panasetis, 2001; Nixon and Bryant, 2003; Lawyer et al., 2006; Person et al., 2006; Pfefferbaum et al., 2006), this seems to suggest that focusing on PPAs post-trauma might be somewhat misguided, especially in terms of clinical interventions related to experiencing of fear and panic symptoms and modification of cognitive arousal processes related to these symptoms (Nixon et al., 2004). As we noted above, and contrary to PPA conceptualizations, experiencing negative life events and lower self-esteem in the follow-up year are better in predicting longer-term health outcomes than PPA, per se, suggesting that a clinical focus on resiliency and coping skills might potentially be more beneficial (Boscarino et al., 2006b; Bonanno et al., 2006).

The current study has strengths and limitations that should be noted. A major strength was that our study involved a large-scale random survey among a multiethnic urban population. Others included that we assessed a broad spectrum of health outcomes over a 2-year period using standardized instruments and that we controlled for key confounders. Potential limitations include omission of individuals without a telephone, those who were institutionalized, and those who did not speak either English or Spanish. Given that our study's final completion rate was lower than desired, non-

response bias also could have affected our results. The absence of these households did not appear to have introduced a clear demographic bias, however, given that the sample matched the 2000 Census for NYC (Adams and Boscarino, 2005a; Adams et al., 2006a,b). As suggested, we did find slight biases related to non-response that we adjusted for using demographic weights in the follow-up data, which is a standard survey research method (Kessler et al., 1995) and that has been described elsewhere (Adams et al., 2006a). Another limitation was that while our mental health and exposure measures were based on standard, validated scales, these were based on self-report and, therefore, may contain response and recall bias. We also recognize that, while our alcohol measures were used and validated in previous WTCD studies (Adams et al., 2006b; Boscarino et al., 2006b), they were limited. In addition, the fact that our study only involved NYC residents should also be taken into consideration, since our results may differ from those in other geographic regions. Related to the latter was the fact that the current study was conducted among a population exposed to terrorism events, including bioterrorism incidents and ongoing threats related to deployment of non-conventional weapons over the previous 2 years (Boscarino et al., 2006d). These factors may have also affected our study results.

Despite these limitations, our data suggest that PPA is not a robust long-term predictor of post-disaster health outcomes, especially as this relates to PTSD and related disorders. It was previously reported that an assessment of health outcomes among workers after the WTCD suggested that while the health impact was notable 1 year after the attack, the adverse impact among workers had largely dissipated 2 years after-wards (Boscarino et al., 2006c). Within this context, it is possible that psychological resilience played a significant role among New Yorkers (Bonanno, et al., 2006), as well as perhaps posttraumatic growth (Calhoun and Tedeschi, 2006), given the attack and its aftermath in NYC (Boscarino et al., 2006d). Thus, the predictive value of PPA may be limited to a relatively short timeframe, to the most vulnerable in a population, and/or may only be a surrogate marker for underlying psychopathology. It is also worth noting, again, that the best predictor of health status at follow-up was not PPA, but psychosocial variables, such as experiencing negative life events or having low self-esteem in the follow-up year, similar to what has been reported for delayed PTSD after the WTCD (Adams and Boscarino, 2006).

While these latter variables are clearly interrelated with mental health status, they also hint at the limits of using PPA as a primary indicator of future psychopathology. At the very least, they suggest caution with respect to making inferences related to therapeutic interventions based on earlier reported PPA findings. In fact they suggest limitations related to making inferences about intrapsychic processes, without more definitive research. Future studies should examine these processes over a longer time period using causal modeling, in order to fully appreciate the impact of PPA in the manifestation of PTSD-related psychopathology. This psychopathogenic process appears to be more complicated than had been proposed and, as our study suggests, will likely involve more in-depth analyses of situational, time-dependent variables of clinical significance in the future.

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