

Examining a Comprehensive Model of Disaster-Related Posttraumatic Stress Disorder in Systematically Studied Survivors of 10 Disasters

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The frequency of major disasters in the United States alone is staggeringly high: once a week on average, a new disaster strikes somewhere in the United States.¹ Considering the frequency and devastation caused by such events in the United States and worldwide, understanding the psychiatric sequelae of major disasters is a public health issue of paramount importance.

A comprehensive model, developed by this research team, of the mental health outcomes of disaster provides a framework for understanding factors associated with mental health sequelae of disasters.² This model includes domains of personal characteristics of survivors, characteristics of the disaster agent and individual exposures to it, characteristics of the disaster community, and secondary sequelae and other negative life events. Few studies, however, are designed to assess the relative contribution of these different factors, and comparison of the prevalence of psychiatric disorders among survivors of different disasters has been hampered by lack of diagnostic rigor and inconsistent methods across studies.

A landmark review by Norris et al.^{3,4} compiled mental health outcome data across the domains of the comprehensive model in a careful synthesis of 20 years of disaster research. This review included 250 published articles on the combined experience of 61 396 disaster survivors from 102 disasters. The body of original research reviewed was conducted in separate studies of numerous disasters by many research teams using “a variety of designs, time frames, assessment strategies, and sampling methods.”^{3(p240)} Although Norris’s group noted widely held assumptions that human-caused disasters result in more severe mental health sequelae compared with natural disasters, they urged further consideration of these relationships.⁴ They also identified a continuing need for research that is

Objectives. Using a comprehensive disaster model, we examined predictors of posttraumatic stress disorder (PTSD) in combined data from 10 different disasters.

Methods. The combined sample included data from 811 directly exposed survivors of 10 disasters between 1987 and 1995. We used consistent methods across all 10 disaster samples, including full diagnostic assessment.

Results. In multivariate analyses, predictors of PTSD were female gender, younger age, Hispanic ethnicity, less education, ever-married status, predisaster psychopathology, disaster injury, and witnessing injury or death; exposure through death or injury to friends or family members and witnessing the disaster aftermath did not confer additional PTSD risk. Intentionally caused disasters associated with PTSD in bivariate analysis did not independently predict PTSD in multivariate analysis. Avoidance and numbing symptoms represented a PTSD marker.

Conclusions. Despite confirming some previous research findings, we found no associations between PTSD and disaster typology. Prospective research is needed to determine whether early avoidance and numbing symptoms identify individuals likely to develop PTSD later. Our findings may help identify at-risk populations for treatment research. (*Am J Public Health.* 2012;102:e40–e48. doi: 10.2105/AJPH.2012.300689)

prospective and longitudinal and examines diverse populations whose exposure is sufficient to yield adverse mental health consequences.

The inherently emergent and chaotic nature of the postdisaster setting presents barriers to methodological rigor in disaster research. These conditions hamper timely access to highly exposed survivors, impede systematic sampling, restrict sample sizes, and limit time and resources that are critical to conducting full diagnostic assessments, and they undoubtedly contribute to contradictory findings in disaster research. Comparison of disaster research findings is limited by the variability in types and severity of disasters (e.g., large-scale vs more limited, local disasters; terrorism vs natural disasters), diversity of research samples (e.g., highly exposed survivors vs people who were distant from the incident; general population members vs treatment samples), and breadth of research methods (e.g., full diagnostic assessment vs questionnaires and

symptom scales) inherent in this body of research.

To overcome these limitations in understanding the psychosocial effects of disasters, comprehensive studies are needed that examine a breadth of disasters and exposed populations and use consistent methods. In the largest cross-disaster study conducted to date using consistent methods (uniform assessments and time frames) with full diagnostic evaluation, we merged data from 811 directly exposed survivors of 10 disasters of various types, conducted by 1 disaster team, to provide systematic data on the prevalence of posttraumatic stress disorder (PTSD) and its predictors.

METHODS

Using systematic and consistent data collection and analysis, we studied survivors of 10 disasters (October 1987–April 1995) in the early postdisaster period. These disasters

represented the full range of established disaster typology⁵: natural disasters (floods in the St. Louis, MO area; a tornado in Madison, FL; an earthquake in Northridge, CA), technological accidents (a firestorm in Oakland–Berkeley, CA; a plane crash into a hotel in Indianapolis, IN), and intentionally caused disasters (4 mass-shooting episodes—at businesses in Russellville, AR; a restaurant in Killeen, TX; the courthouse in Clayton, MO; and the University of Iowa, Iowa City, IA—and a terrorist bombing of a federal building in Oklahoma City, OK). Overall, 811 directly exposed survivors of these disasters completed systematic interviews regarding their disaster experience and a structured diagnostic interview, at a median of 3 months (range of median values = 1–6 months) after the disaster. A previous publication provides specifics on the characteristics of each disaster, numbers of survivors interviewed in each site, and the timing of interviews relative to the disaster⁶; several previous publications provide more specific details on individual disaster findings.^{6–23} The combined research participation rate was 77% (437 of 571) among 6 disaster sites sampled systematically; the other 4 sites had volunteer samples with unknown participation.

Because the research protocols and assessment methods used were consistent across all 10 disaster studies, databases from the individual studies were readily merged into a single cross-site database for analysis. The Diagnostic Interview Schedule,²⁴ which has well-established validity and reliability^{25–29} and a long history of use in disaster research, provided lifetime prevalence through full assessment of current criteria for diagnoses, including PTSD, major depression, alcohol and drug abuse or dependence, panic disorder, and generalized anxiety disorder. We keyed onset and recency questions to the date of the disaster, allowing determination of predisaster and postdisaster prevalence as well as postdisaster incidence of psychiatric disorders. The Disaster Supplement to the Diagnostic Interview Schedule³⁰ collected data on details of disaster exposure and other information relevant to the disaster experience—specifically, direct physical endangerment during the disaster, physical injury, seeing others being injured or killed, witnessing the aftermath (i.e., exposed to injured or dead people at the scene after the disaster), knowing

others injured or killed, and having other stressful life events (e.g., lost job or major income, was robbed, close family member died) since the disaster.

For statistical analysis we used SAS version 9.2 (SAS Institute, Cary, NC).³¹ Descriptive data are presented with raw numbers, proportions, means, standard deviations, ranges, and median values. We compared categorical variables using 2-sided χ^2 tests, substituting Fisher's exact tests for expected cell sizes less than 5. We compared continuous variables with dichotomous variables using *t* tests, substituting Satterthwaite analysis in cases of unequal variance. We set statistical significance level at $\alpha = 0.05$.

We constructed 2 multiple logistic regression models to predict PTSD (dependent variable) from independent covariates entered simultaneously in the model to control for effects of variables on one another in prediction of PTSD. In constructing a single large model, all variables presented in the bivariate analyses were considered for inclusion; when more than 1 variable of a category (e.g., injured; hospitalized for injuries) was highly correlated, we selected 1 representative variable to best characterize the category. We computed the variance explained by these models with adjustment for generalization of R^2 by the method of Nagelkerke,³² using the “max-rescaled R^2 ” option for PROC LOGISTIC in SAS.

RESULTS

Table 1 presents demographic characteristics of the sample and details of their disaster exposures. The sample was slightly more than one half female and predominately White, with an average age in the mid-40s. Two thirds were currently married and about one third had a college degree.

The disaster typology category experienced by the largest number of participants in this sample was intentionally caused disaster (mass shooting, terrorist bombing). The next largest category represented was natural disaster (earthquake, flood, tornado). Technological accidents (plane–hotel crash, firestorm) were experienced by 10%. The overall mean number of reported fatalities in these disasters was 60.2 (SD = 62.1; median = 24; range = 1–169) and

the mean number of reported injuries was 404.1 (SD = 544.2; median = 20; range = 0–1500), based on information collected at the time from public reports and news media. Most of the survivors were directly exposed to danger during the disaster, a type of trauma exposure that qualifies for consideration of a diagnosis of PTSD in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR)*.³³ Another 6% were exposed only to the gruesome aftermath of the disaster (e.g., people who entered the shooting area only after the shooting had ended, witnessing carnage at the scene), representing another type of qualifying trauma exposure.

More than one third of the sample sustained injuries in the disaster, most requiring medical treatment. More than one third witnessed injuries or death in the disaster. One half knew someone injured or killed in the disaster; a smaller proportion had family members or friends injured or killed in the disaster.

Table 1 also shows predisaster prevalence, postdisaster prevalence, and postdisaster incidence of psychiatric disorders. More than one third of the sample had a predisaster disorder, the most prevalent being alcohol use disorder (in nearly one fourth). One third (33%) of the survivors met criteria for a postdisaster diagnosis. PTSD was the most prevalent postdisaster disorder (20%), followed in frequency by major depression (16%) and alcohol use disorder (9%). Nearly 1 of 5 developed a new (incident) disorder after the disaster. Three fourths of the disaster-related PTSD represented incident PTSD after the disaster, but more than one half of postdisaster major depression represented preexisting major depression. Incident postdisaster diagnoses were rare for alcohol and nonexistent for drug use disorders.

The *DSM-IV-TR*³³ divides PTSD symptoms into 3 groups: reexperiencing (group B), avoidance and numbing (group C), and hyperarousal (group D) symptoms. Most of the combined sample met PTSD symptom group criteria for group B (71%, 577 of 811) and D (68%, 551 of 811), but only a minority met group C criteria (24%, 194 of 811). Full PTSD criteria were met by only a minority of those who met group B (28%, 163 of 577) or D (30%, 163 of 551) criteria, but by most (84%, 163 of 194) of those who met group C criteria.

TABLE 1—Sample Characteristics of Directly Exposed Survivors of Selected Disasters: United States, 1987–1995

Characteristic	% (No./Total No) or Mean \pm SD (Median; Range)
Demographics	
Male gender	43 (348/811)
Age, y	45.9 \pm 14.7 (44; 18–89)
18–29	13 (105/811)
30–44	37 (303/811)
45–64	37 (297/811)
\geq 65	13 (106/811)
Ethnicity	
White	91 (737/810)
Black	6 (49/810)
Hispanic	2 (15/810)
Asian	0 (3/810)
Other	1 (6/810)
Education	
Years of education	13.8 \pm 2.3 (14; 4–17)
College graduate	35 (280/798)
Marital status	
Currently married	67 (541/810)
Widowed	5 (42/810)
Divorced	3 (21/810)
Separated	13 (102/810)
Never married	13 (104/810)
Type of Disaster	
Natural disaster (earthquake, flood, tornado)	41 (329/811)
Technological accident (plane–hotel crash, firestorm)	10 (78/811)
Intentionally caused disaster (mass shooting, bombing)	50 (404/811)
Direct Disaster Exposures	
Directly physically endangered in disaster	94 (764/811)
Exposed only to disaster aftermath	6 (47/811)
Injured in disaster	39 (318/809)
Received medical care for injuries	30 (240/809)
Hospitalized for injuries	8 (62/809)
No. of injuries sustained	3.7–3.3 (3; 0–19)
Directly witnessed injury or death in disaster	40 (325/804)
Knew People Injured or Killed in Disaster	
Knew someone injured or killed in disaster	51 (393/778)
Friend or family member killed in disaster	18 (145/811)
Friend or family member injured but not killed in disaster	18 (140/778)
Psychiatric Disorders	
All PTSD	
Predisaster prevalence	10 (80/791)
Postdisaster prevalence	23 (178/791)
Postdisaster incidence ^a	16 (132/811)

Continued

Figure 1 shows the postdisaster prevalence of disaster-related PTSD and any diagnosis by disaster site. The highest disaster-related PTSD and postdisaster diagnosis prevalence for any psychiatric disorder was in association with the Indianapolis plane–hotel crash (35% and 59%, respectively) and the Oklahoma City bombing (34% and 45%, respectively). The lowest postdisaster prevalences of disaster-related PTSD and any psychiatric disorder were in the Iowa City shooting episode (0% and 11%, respectively), the Madison, Florida tornado (3% and 8%, respectively), and the Oakland–Berkeley firestorm (3% and 16%, respectively).

Table 2 lists variables tested in separate bivariate analyses for associations with disaster-related PTSD. All categories in the table had variables significantly associated with PTSD. More women than men developed PTSD. Older people were less likely to develop PTSD. Hispanic ethnicity was associated with more than twice the prevalence of PTSD compared with other ethnic/racial groups. Level of education was negatively associated with PTSD; incidence of PTSD was about half among college graduates compared with those without college education. Those who had never married had significantly less prevalence of PTSD than those ever married. A predisaster psychiatric disorder more than doubled the likelihood of disaster-related PTSD. Prevalence of PTSD was approximately twice as high among those who were directly exposed to the disaster as among those exposed only to the disaster aftermath. PTSD was significantly associated with being injured, seeing people being injured or killed, and having a friend or family member who was killed in the disaster. Experiencing other stressful events after the disaster was also associated with development of PTSD.

The incidence of disaster-related PTSD was higher among those exposed to intentionally caused disasters than among those exposed to technological accidents (26% vs 10%; $\chi^2_1 = 8.79$; $P = .003$) or natural disasters (26% vs 16%; $\chi^2_1 = 11.41$; $P < .001$); natural disasters and technological accidents did not differ in their association with PTSD ($P > .05$). Disaster-related PTSD was positively associated with the number of fatalities (but not the number of injuries) resulting from the disaster (Table 2). Additionally, disaster-related PTSD was

TABLE 1—Continued

Disaster-related PTSD	
Predisaster prevalence	...
Postdisaster prevalence	20 (163/811)
Postdisaster incidence ^a	16 (130/811)
Major depression	
Predisaster prevalence	15 (117/807)
Postdisaster prevalence	14 (113/808)
Postdisaster incidence	6 (45/807)
Panic disorder	
Predisaster prevalence	2 (17/801)
Postdisaster prevalence	3 (23/801)
Postdisaster incidence	1 (11/801)
Generalized anxiety disorder	
Predisaster prevalence	3 (25/798)
Postdisaster prevalence	3 (24/796)
Postdisaster incidence	1 (9/797)
Alcohol use disorder	
Predisaster prevalence	23 (180/795)
Postdisaster prevalence	9 (72/797)
Postdisaster incidence	1 (9/795)
Drug use disorder	
Predisaster prevalence	7 (58/799)
Postdisaster prevalence	1 (7/799)
Postdisaster incidence	0 (0/799)
Any of above disorders	
Predisaster prevalence	39 (317/811)
Postdisaster prevalence	33 (264/811)
Postdisaster incidence	20 (160/811)

Note. PTSD = posttraumatic stress disorder.

^aAmong those with no predisaster lifetime history of PTSD from any trauma.

positively associated with the number of months elapsed between the disaster and the interview (mean = 4.2; SD = 2.6 among those with PTSD vs mean = 3.5; SD = 2.2 months among those without PTSD; $t_{223} = 3.38$; $P < .001$).

We constructed a multiple logistic regression model (not shown in tables) with PTSD as the dependent variable to examine the contribution of exposure to a specific disaster relative to the type of disaster and preexisting characteristics of the samples exposed to these different disasters. Independent variables entered into this model were the type of disaster, demographic covariates (gender, age, education, ethnic group, marital status), presence of any predisaster psychiatric disorder, and the specific disaster. In this model, PTSD was not

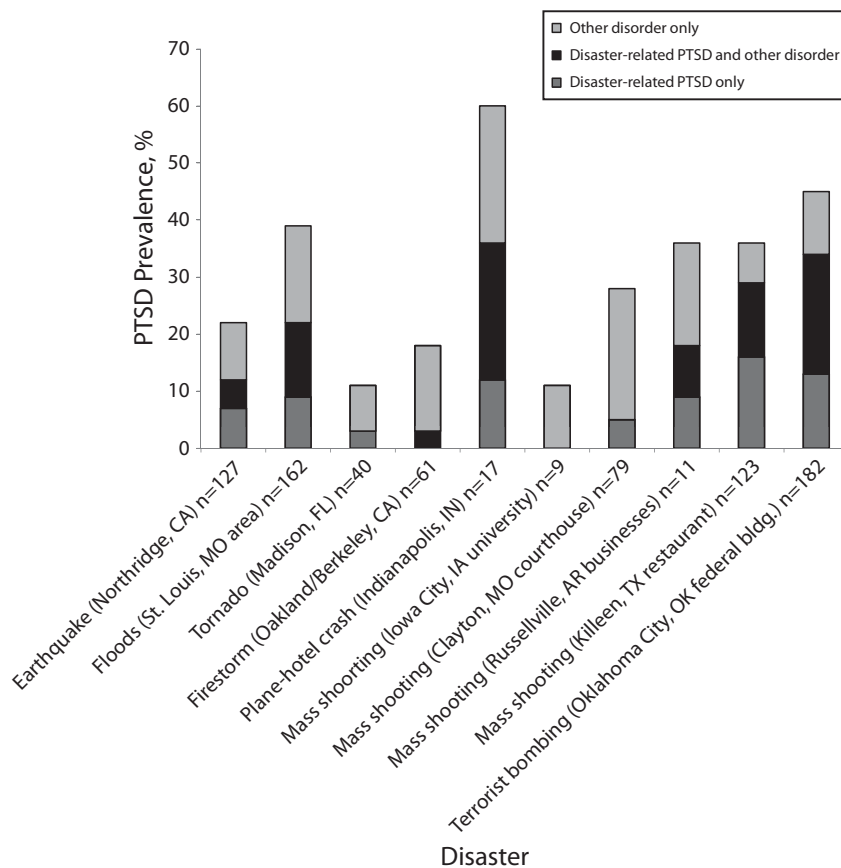
associated with either the specific disaster or the type of disaster ($P > .05$ for both variables). Thus, the observed association of PTSD with different disasters and disaster types in bivariate comparisons was apparently a function of the differing demographic and predisaster characteristics of the separate disaster samples. On the basis of this analysis, variables representing the specific disaster and disaster type were not included in further multivariate analyses predicting disaster-related PTSD.

Table 3 presents findings of a single large multivariate model predicting disaster-related PTSD (dependent variable) from several independent variables entered simultaneously into the model, including demographic and exposure variables, knowing someone injured or killed in the disaster, and having other

stressful life event(s) since the disaster, controlling for number of months elapsed since the disaster. This model provides representation of all the variable categories listed in Tables 1 and 2 (except for disaster site and disaster type, which were no longer associated with PTSD once preexisting characteristics of the associated disaster samples were controlled for). In this model, disaster-related PTSD was positively associated with several demographic variables (female gender, younger age, Hispanic ethnicity, less than college education, and ever-married status), history of predisaster psychiatric disorder, disaster injury, and witnessing injury or death. Exposure to the disaster aftermath approached statistical significance ($P = .096$). Other variables not adding significantly to the multivariate prediction of PTSD in this model were number of fatalities associated with the disaster, injuries or fatalities among family or friends, experiencing a stressful life event since the disaster, and time elapsed since the disaster, although these variables were predictive in separate bivariate analyses. This multivariate model accounted for 27% of the variance, with good predictive ability demonstrated by a concordance index value $c = 0.80$.

DISCUSSION

A major strength of this research was the uniformity of methods employed across a variety of disaster studies, which allowed data from directly exposed populations of various disasters to be combined into a single database for systematic analysis. Another important strength was the full diagnostic assessment with a structured diagnostic interview administered across the disaster samples. Although full diagnostic assessment constitutes a considerable research burden, it provides psychiatric diagnoses conforming to accepted diagnostic criteria. This combined disaster sample provides one of the largest databases of directly exposed survivors ever collected using full diagnostic assessment and the largest cross-disaster study ever conducted using consistent methods with full diagnostic evaluation. All survivors had qualifying trauma exposures, allowing examination of PTSD in a highly exposed, uniformly assessed sample interviewed within the first few post-disaster months. Their exposures represented



Note. bldg. = building; PTSD = posttraumatic stress disorder

FIGURE 1—Prevalence of disaster-related posttraumatic stress disorder and any postdisaster disorder, by disaster site: United States, 1987–1995.

the range of disaster typology: natural disasters, technological accidents, and intentionally human-caused disasters, including terrorism.

Using this large, uniformly collected database of directly exposed survivors of various disasters, we found that one third of the survivors experienced a postdisaster disorder. Although these results provide considerable evidence of the adverse mental health effects of disasters, they also attest to human psychological resilience because most survivors did not suffer psychiatric illness despite substantial disaster exposures. PTSD was the most prevalent postdisaster disorder (observed in one fifth), and major depression was second in prevalence. Virtually no incident (new) postdisaster cases of substance use disorders were identified, as previously described for disaster-related alcohol use disorders.⁶

Group B (intrusion) and D (hyperarousal) PTSD symptoms were quite common (with

more than two thirds of the survivors meeting criteria), but few (less than one third) of those meeting group B and D criteria met full PTSD criteria. The less prevalent group C (avoidance or numbing) symptoms (met by less than one fourth), however, were highly associated with PTSD: 84% of those meeting group C criteria met full PTSD criteria. Thus, group C emerged as a marker for PTSD. Further research is needed to determine whether this retrospectively demonstrated relationship holds prospectively. If group C can predict PTSD in the first days after a disaster, then people with high risk for developing PTSD could potentially be identified well before the full month that is required before a diagnosis can be considered.

In multivariate analysis of this study's combined disaster database, the risk of PTSD was positively associated with individual demographic characteristics (female gender, youthfulness, Hispanic ethnicity, less

education, and ever-married status), predisaster psychopathology, disaster injury, and witnessing injury or death. The findings of these analyses of a unified disaster database thus confirm many observations of separate research studies as summarized in the Norris et al. reviews.^{3,4}

Consistent with the findings of this study, Norris et al. also concluded that PTSD was the most frequently observed diagnosis, and that although the group B and D symptoms are very common, the less common group C posttraumatic symptoms “drive the diagnosis of PTSD.”^{3(p216)} Their review further noted that research findings to date collectively indicate that the risk of mental health problems following disasters is generally associated with disaster severity and greater exposure to the disaster, female gender, youthfulness, ethnic minorities, lower socioeconomic status, marital status (married for women and unmarried for men), other stressful life events, predisaster psychiatric illness, and lack of perceived and actual social support. Despite the observation by Norris et al. that the literature on disaster research is in general agreement on these associations, their review also identified many contradictory findings in reported associations of psychosocial outcomes with age, gender, ethnicity, marital status, and social support. Even individuals exposed to the same disasters were found to differ markedly in outcomes, and disasters of the same type varied considerably in associated mental health effects.⁴

The current study's consistent methodology permitted direct comparison of PTSD related to different disasters and disaster types not possible in comparisons of studies with varied methods. In bivariate analyses, PTSD appeared to be more prevalent after intentionally caused disasters compared with technological accidents and natural disasters. Multivariate analyses controlling for the preexisting characteristics of the exposed populations and the specifics of their exposures, however, found that PTSD was not independently associated with disaster type. Other variables that initially appeared to predict PTSD in bivariate analyses but did not hold statistical significance for prediction of PTSD in the multivariate model were the disaster magnitude or severity as reflected by

TABLE 2—Association of Posttraumatic Stress Disorder (PTSD) With Selected Characteristics of Disaster Survivors in Bivariate Analyses: United States, 1987–1995

	Disaster-Related PTSD, % (No./Total No.)	PTSD, Mean (SD)	No PTSD, Mean (SD)	Significance
Demographics				
Age, y		42.5 (11.9)	46.7 (15.2)	$t = 3.78, P < .001$
18–29	25 (26/105)			NS
30–44	23 (71/303)			NS
45–64	20 (60/297)			NS
≥ 65	6 (6/106)			$\chi^2 = 15.83, P < .001$
Gender				$\chi^2 = 10.09, P = .002$
Male	15 (52/348)			
Female	24 (111/463)			
Race/ethnicity				
White	20 (145/737)			NS
Black	20 (10/49)			NS
Hispanic	53 (8/15)			$\chi^2 = 10.51, P = .001$
Asian	0 (0/3)			NS
Other	0 (0/6)			NS
College graduate				
Yes	12 (34/280)			$\chi^2 = 17.28, P < .001$
No	25 (127/518)			
Years of education		13.4 (2.1)	13.9 (2.4)	$t = 2.97, P = .003$
Marital status				
Married	20 (108/541)			NS
Widowed	24 (10/42)			NS
Divorced	33 (7/21)			NS
Separated	24 (24/103)			NS
Never married	13 (13/104)			$\chi^2 = 4.19, P = .041$
Disaster characteristics				
Disaster type				
Natural disaster	16 (51/329)			$\chi^2 = 7.28, P = .007$
Technological accident	10 (8/78)			$\chi^2 = 5.21, P = .023$
Intentionally caused disaster	26 (104/404)			$\chi^2 = 15.97, P < .001$
No. of disaster-related fatalities		82.1 (69.9)	54.6 (58.8)	$t = 4.61, P < .001$
No. of disaster-related injuries		404.7 (472.2)	403.9 (561.2)	NS
Direct disaster exposures				
Directly physically endangered in disaster	21 (159/764)			$\chi^2 = 4.17, P = .041$
Exposed only to disaster aftermath	9 (4/47)			
Injured				
Yes	31 (97/318)			$\chi^2 = 35.92, P < .001$
No	13 (65/491)			
No. of injuries		5.1 (4.2)	3.1 (2.4)	$t = 4.08, P < .001$
Medical care for injuries				
Yes	35 (84/240)			$\chi^2 = 47.78, P < .001$
No	14 (78/569)			
Hospitalized for injuries				
Yes	36 (22/62)			$\chi^2 = 9.98, P = .002$
No	19 (140/746)			

Continued

TABLE 2—Continued

Directly witnessed injuries or fatalities in disaster				
Yes	29 (95/325)			$\chi^2 = 28.87, P < .001$
No	14 (66/479)			
Knew people injured or killed in disaster				
Knew someone hurt or killed in disaster				
Yes	26 (100/393)			$\chi^2 = 11.58, P = .001$
No	16 (60/385)			
Friend or family member hurt or killed in disaster				
Yes	29 (82/285)			$\chi^2 = 18.54, P < .001$
No	16 (78/493)			
Friend or family member killed in disaster				
Yes	30 (44/145)			$\chi^2 = 11.54, P = .001$
No	18 (119/666)			
Stressful life events since the disaster				
Any postdisaster life stressful event				
Yes	22 (127/582)			$\chi^2 = 4.08, P = .044$
No	16 (35/226)			
No. of postdisaster stressful life events		1.9 (1.6)	1.4 (1.3)	$t = 3.5, P = .001$
Predisaster psychiatric disorders				
Any disorder				
Yes	31 (99/317)			$\chi^2 = 40.16, P < .001$
No	13 (64/494)			
No. of disorders		1.0 (1.1)	0.5 (0.7)	$t = 6.36, P < .001$
Alcohol use disorder				
Yes	28 (50/180)			$\chi^2 = 8.16, P = .004$
No	18 (111/615)			
Drug use disorder				
Yes	35 (20/58)			$\chi^2 = 7.98, P = .005$
No	19 (141/741)			
Generalized anxiety disorder				
Yes	44 (11/25)			$\chi^2 = 9.38, P = .002$
No	19 (148/773)			
Panic disorder				
Yes	59 (10/17)			$\chi^2 = 16.40, P < .001$
No	19 (150/784)			
PTSD				
Yes	41 (33/80)			$\chi^2 = 23.18, P < .001$
No	18 (130/711)			
Major depression				
Yes	43 (50/117)			$\chi^2 = 43.80, P < .001$
No	16 (112/690)			

Note. NS = not significant.

the number of disaster fatalities, exposure through injuries or fatalities of family members or friends, and experience of other postdisaster stressful life events. These variables were thus not independently predictive of PTSD; rather, their effects acted through, or were

overwhelmed by, the effects of other variables in the model.

Limitations

This study had several relevant methodological limitations. Although the disaster studies

in this series followed a uniform research protocol, the circumstances of the individual disasters necessarily rendered a certain amount of variability in the sampling and timing of assessments. Systematic sampling was possible for only 70% of the database analyzed for this

TABLE 3—Multivariate Logistic Regression Model Predicting Disaster-Related Posttraumatic Stress Disorder: United States, 1987–1995

Parameter	Point Estimate, OR (95% Wald CI)	P
Intercept		.232
Female gender	1.85 (1.20, 2.85)	.005
Age	0.98 (0.97, 1.00)	.032
Hispanic ethnicity	7.08 (1.82, 27.60)	.005
College graduate	0.45 (0.28, 0.73)	.001
Never married	0.48 (0.24, 0.99)	.047
Predisaster psychiatric disorder	3.12 (2.06, 4.71)	< .001
Injured in disaster	1.88 (1.18, 3.00)	.008
Saw someone hurt or killed	2.11 (1.29, 3.47)	.003
Exposed to aftermath	1.68 (0.91, 3.08)	.096
No. of fatalities in the disaster	1.00 (0.99, 1.00)	.376
Family or friends hurt or killed	1.40 (0.90, 2.18)	.135
Stressful life event(s) after disaster	1.07 (0.67, 1.72)	.784
Months since disaster	1.09 (0.97, 1.22)	.137

Note. CI = confidence interval; OR = odds ratio. Model max-rescaled R^2 (variance explained by model) = 0.27; concordance index c = 0.80.

study, introducing potential sampling bias. Although effects of sampling variation could not be tested in these analyses, we found that the amount of time elapsed from the disaster to the assessment did not contribute to the final multivariate prediction of PTSD. The data for this study were collected many years ago. Although human responses to disasters are not expected to change substantially, the data may be limited by the evolution of current diagnostic criteria from the *DSM-III-R* to the *DSM-IV-TR* during the course of this series of disaster studies, yielding variation in diagnoses based on different versions of the diagnostic criteria. Changes in diagnostic criteria for PTSD predominantly revolved around qualifications for trauma exposure, especially through the direct exposure of close associates,³⁴ and this study's trauma exposures were confined mostly to people who were directly exposed to disasters through direct endangerment or who directly witnessed injury or death in these disasters; consequently, the effects on this study's database are likely minimal. Finally, even in a relatively large and variable database such as the one we used, the statistical power may be insufficient to detect real differences in psychiatric sequelae of different types of

disaster. Additionally, further research would be needed to assess any effects of changes in preparedness and interventions since the period of this study.

Conclusions

Some of the findings of this study confirm existing beliefs arising from smaller studies and review of available literature. This study did not detect differences in prevalence of PTSD by type of disaster. That does not necessarily mean that disaster types are definitively equivalent in their associated outcomes, but it does challenge the conventional wisdom stated in the *DSM-IV-TR*³³ that psychiatric outcomes of human-caused disasters—and, specifically, intentionally caused disasters such as terrorism—may be more contributory to posttraumatic psychopathology than those associated with natural disasters. Considering this study's uniformity across disasters and relatively large sample with full diagnostic assessment, we know of no other study that is better designed to examine the relative contribution of different types of disasters to PTSD. For more definitive answers to questions about the contribution of disaster type to psychiatric consequences, additional studies of similar diagnostic rigor and consistency will be

needed, ones that include even more disasters, greater variability in scope and magnitude across disasters, and larger samples.

This study's confirmatory findings of the diagnostic significance of group C avoidance or numbing symptoms for PTSD provide a basis for future prospective studies to determine whether group C symptoms can predict the future occurrence of PTSD. This study also points to the potential to identify specific at-risk populations to serve as the focus of future treatment research. ■

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Contributors

C. S. North designed the study, obtained the funding, was responsible for data collection, completed the statistical analysis, and authored the article. J. Oliver contributed to analysis and interpretation of data and writing of the article. A. Pandya contributed to interpretation of data and writing of the article.

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Human Participant Protection

Human studies approval was originally provided by Washington University School of Medicine, and later by University of Texas Southwestern Medical Center for further data analysis. All participants provided informed consent before being interviewed.

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