Journal of Traumatic Stress, Vol. 13, No. 4, 2000

Prevalence, Characteristics, and Long-Term Sequelae of Natural Disaster Exposure in the General Population

John Briere[1,3] **and Diana Elliott**[2]

A sample of 935 participants from the general population completed a mail-out questionnaire containing the Trauma Symptom Inventory (J. Briere, 1995) and the Traumatic Events Survey (D. M. Elliott, 1992). The lifetime self-reported prevalence of natural disasters in this sample was 22%. Although time from the last disaster to involvement in the study was an average of 13 years, previous disaster was associated with significantly higher scores on 6 of 10 symptom scales. Disaster characteristics (especially the presence of physical injury, fear of death, and property loss) were better predictors of symptomatology than was disaster type. Disaster exposure continued to predict symptomatology after controlling for interpersonal violence history, although interpersonal violence accounted for more overall symptom variance.

KEY WORDS: disaster; psychological symptoms; Trauma Symptom Inventory; Traumatic Events Survey.

Disasters may be defined as large-scale, stressful environmental events that adversely affect a significant number of people. Estimating the prevalence of disasters in the general population is complicated by whether disaster is thought to include technological or human-caused events (e.g., toxic spills, nuclear accidents) and large-scale transportation accidents (e.g., plane crashes, shipwrecks), in addition to "natural" disasters such as hurricanes or earthquakes. Under any of these conditions, however, it appears that disasters are relatively common in the United

Daniel W. Smith was the associate editor for this manuscript.

[1]Department of Psychiatry and the Behavioral Sciences, Keck School of Medicine, University of Southern California, Los Angeles, California 90033.

[2]Department of Psychiatry, Harbor—U.C.L.A. Medical Center, Torrance, California 90509.

[3]To whom correspondence should be addressed at USC Psychiatry, 1937 Hospital Place, Los Angeles, California 90033; e-mail: jbriere@hsc.usc.edu.

0894-9867/00/1000-0661$18.00/1

States. Rossi, Wright, Weber-Burdin, and Perina (1983), for example, estimate that 24.5 households per 1,000 experience injuries or damages from fires, floods, severe storms, and earthquakes each year. General population surveys suggest that between 13 and 30% of individuals have been exposed to one or more natural disasters in their lifetime (Green & Solomon, 1995).

A number of studies document the potential psychological effects of exposure to a natural disaster. These include the impacts of earthquakes (Carr, Lewin, Webster, Hazell, & Carter, 1997; Gavalya, 1987), fires (Maida, Gordon, Steinberg, & Gordon, 1989; McFarlane, Clayer, & Bookless, 1997), floods (Green et al., 1990; Norris, Phifer, & Kaniasty, 1994), hurricanes (Burnett et al., 1997; Khoury et al., 1997), and tornados (Madakasira & O'Brien, 1987; North, Smith, & Lightcap, 1989). Among the psychological symptoms that have been associated with natural disasters are posttraumatic stress (Johnsen, Eid, Løvstad, & Michelsen, 1997; McMillan, Smith, & Fisher, 1997), anxiety (Phifer & Norris, 1989; Shore, Tatum, & Vollmer, 1986), depression (Canino, Bravo, Rubio-Stipec, & Woodbury, 1990; Green, Lindy, Grace, & Leonard, 1992), anger (McFarlane, 1987), dissociation (Cardeña & Speigel, 1993), aggression and antisocial behavior (Adams & Adams, 1984; Khoury et al., 1997), somatic complaints (McFarlane, Atchison, Rafalowicz, & Papay, 1994; Norris et al., 1994), and substance abuse (Adams & Adams, 1984; McFarlane et al., 1994).[4]

Although the literature reviewed earlier suggests the prevalence and potential psychological impacts of disasters, further research is required regarding the relationship between disaster and hypothesized psychological outcomes. A review of the disaster literature suggests several issues that have yet to be fully addressed by extant studies.

Although the long-term mental health correlates of potentially traumatic events have been established for a variety of stressors (especially interpersonal violence), most of the research on disaster impacts has been limited to acute symptoms of relatively recent events. Those relatively few studies that have examined long-term impacts have tended to report significant symptom decreases over time (e.g., Adams & Adams, 1984; Johnsen et al., 1997; Murphey, 1986; Shore et al., 1986), although not invariably so and not always for all symptom categories (e.g., Canino et al., 1990; Gleser, Green, & Winget, 1981; Holen, 1991; McFarlane, 1987). Few of these studies, however, have used standardized instruments that allow assessment of whether these various subjects returned to normative levels of distress at some point postdisaster. For example, it is possible that although

the most severe sequella of natural disasters recede over time for most people, significant residual symptomatology might be present years later.

Differential Impacts of Different Disaster Types

It is not clear whether natural disaster should be viewed as a unitary phenomenon with regard to psychological outcomes, or whether different disasters (e.g., fires vs. floods) might have different effects. As noted by Green and Solomon (1995), however, such comparisons should take into account any severity characteristics (e.g., likelihood of producing extreme fear, capacity to injure or kill) that might vary according to the disaster type. For instance, although fire might be found to predict symptoms more than tornados, this might be due to a potentially greater likelihood of exposure to death or injury in the former. Unfortunately, because most studies of disaster effects have focused on a single disaster incident, data are generally lacking in this area.

Sampling Issues

One of the potential limitations of the disaster literature is its frequent reliance on convenience samples. Typically, researchers determine that a disaster has occurred in a given geographic area, and then symptom measures are administered to individuals at that locale. Although this methodology has yielded real benefits in terms of descriptions of specific disaster impacts, generalizability of the findings to other disasters and other people may be limited. For instance, data on the effects of a flood in a Southern state may not generalize well to the effects of a different flood in the Midwest. The two floods may vary in terms of their severity, other negative events associated with each (e.g., property damage, outbreaks of disease, secondary fires), community and national response, and demographics of those affected, such as race or socioeconomic status.

An alternate methodology is to survey victims of a variety of disaster experiences across a variety of geographic areas and sociodemographic parameters, and include large numbers of subjects who have not been exposed to any disaster or a specific disaster type. This methodology provides more heterogenous and representative samples, thereby increasing the potential generalizability of any findings, as well as generating meaningful comparison groups of unaffected individuals.

Moderation by Other Traumas

Although rarely tested in the disaster literature, it is possible that the symptomatology of some disaster victims may arise, in part, from distress associated with other traumatic events they have experienced. As noted by Freedy, Resnick, and Kilpatrick (1992, p. 8), for example, "[i]t may be that individuals faced with a

large number of negative life events in the year prior to experiencing a large-scale disaster are vulnerable to subsequent adjustment difficulties." This more complicated scenario might be addressed by examining the unique impacts of disaster exposure on symptomatology while controlling for exposure to other, nondisaster traumas, and by examining the interaction between disaster and nondisaster trauma exposure. Unfortunately, to the best of the authors' knowledge, no studies have been conducted in this manner.

Specific Effects of Disaster Characteristics

More investigated than the issues presented earlier are the effects of specific disaster characteristics. The disaster literature indicates that more severe mental health outcomes are often associated with environmental events that involve physical injury, witnessing death or injury of others, and property loss (e.g., Bravo, Rubio-Stipec, Canino, Woodbury, & Ribera, 1990; Burnett et al., 1997; Phifer & Norris, 1989; Shore et al., 1986). However, because most of these relationships were found for a specific disaster event, their generalizability across disaster types has not been well-specified. For example, fear of death or injury might be less common or less intense among those exposed to a flood than among those who experienced a tornado, and thus its relation to psychological symptoms might easily vary according to disaster type.

The study presented ahead addresses these various issues in a large, representative sample of the United States general population. Given the sample size, multivariate analyses of various disaster–symptom relationships could be done, both within and across disaster types.

Methods

Participants

A national sampling service generated a random sample of 1,442 potential participants with deliverable addresses, stratified to accurately reflect geographical representation of registered owners of automobiles and individuals with listed telephones in the United States (see Briere, 1995, and Elliott, 1997, for more sampling details).

Of the 935 participants in this sample, 464 (49.6%) were men and 471 (50.4%) were women. The mean age was 46 years (SD = 16.6), with a range of 18–90. The modal marital status was married/cohabiting (n = 528, 55.6%), followed by never married (n = 170, 18.2%). Racial breakdown was Caucasian (n = 698, 74.7%), African American (n = 106, 11.3%), Hispanic (n = 68, 7.3%), Asian (n = 28, 3.0%), Native American (n = 19, 2.0%), and "other" (n = 16, 1.7%). The modal education level was some college or completed trade school (n = 304, 32.5%) and the modal family income was $10,000–$19,999 (n = 182, 19.6%), followed

by $20,000–29,999 ($n$ = 174, 18.6%). This sample is generally comparable to the 1990 census data on important variables, although it slightly overrepresents Caucasian, married, and more educated individuals (see Briere, 1995, for a detailed comparison to 1990 census data for the first 836 participants of this sample).

Measures

The Traumatic Events Survey (TES; Elliott, 1992) evaluates a wide range of childhood and adult traumas. Of the 30 interpersonal and environmental traumas examined by the TES, 20 address adult events and 10 are devoted to childhood events. Adult traumas listed in the TES include natural disasters, sexual and physical assault, torture, war, auto accidents, and witnessing a murder. Specific natural disasters examined by the TES are earthquakes, fires, floods, hurricanes, and tornados, each of which is evaluated in terms of a variety of characteristics, including age at the time of the disaster, how upsetting it was perceived to be, and whether the respondent feared for his/her life, lost possessions, experienced serious injury, or witnessed serious injury or death in someone close to them. The TES appears to be a valid measure of exposure to potentially traumatic events, and has been used in several published studies of trauma impacts (see Briere, 1997, for a more detailed review of this measure).

The Trauma Symptom Inventory (TSI; Briere, 1995) is a 100-item test of posttraumatic stress and other psychological sequelae of traumatic events. It has 3 validity scales and 10 clinical scales, although only the clinical scale results are reported for this study. The latter are Anxious Arousal, Depression, Anger–Irritability, Intrusive Experiences, Defensive Avoidance, Dissociation, Sexual Concerns, Dysfunctional Sexual Behavior, Impaired Self Reference, and Tension Reduction Behavior. These scales are internally consistent (mean αs of .86, .87, .84, and .84 in general population, clinical, university, and military samples, respectively), and exhibit reasonable convergent, predictive, and incremental validity in empirical studies (e.g., Briere, 1995; Briere, Elliott, Harris, & Cotman, 1995; Green et al., 2000; Roche, Runtz, & Hunter, 1999; Shapiro & Schwartz, 1997).

Procedure

All participants were mailed a questionnaire that included, among other measures, the TES (Elliott, 1992) and the TSI (Briere, 1995), as described earlier. Three follow-up mailings were sent to nonrespondents at approximately 1-month intervals. Of all potential participants, 935 (64.8%) returned surveys with complete data for the measures used in this study.[5] Although response rates varied according to three types of solicitation approaches (some received no money, some received

[5]These data represent the 836 participants of the TSI normative dataset, as well as an additional 99 individuals whose data were received after the TSI norms were completed.

$5 with the questionnaire, and some received $5 if they mailed back the completed questionnaire), no demographic variable, self-reported trauma experience, or TSI scale score differed according to method. Given this equivalence, the different solicitation samples were combined into a single group.

Analytic Strategy

Because of the relatively large number of variables examined in this study, and thus the potential for experiment-wise error rate inflation, a relatively conservative analytic approach was used. When multivariate tests were conducted (e.g., canonical correlation analysis, multiple regression analysis), the minimal acceptable p value for statistical significance was set at .05. When post hoc univariate tests were performed, however, a minimum value of $p < .01$ was required for statistical significance. Finally, two-tailed tests of significance were used whenever possible. Even more conservative approaches (e.g., Bonferroni corrections) were not considered necessary, as univariate tests were only conducted in the presence of a significant multivariate test, whenever possible, and hence were "protected" from significant error rate inflation (Cohen & Cohen, 1983).

Results

Prevalence, Disaster Characteristics, and Demographics

As indicated in Table 1, the lifetime prevalence of natural disasters in this sample ranged from 4% (for hurricanes) to 8% (for earthquakes), with 22% of participants reporting at least one disaster experience. Among those exposed to a disaster, 64% had feared for their life, 57% had lost possessions, 10% had been injured, and 9% reported that a significant other had been injured or killed. Mean age at last disaster was 30 years. The mean amount of time since last exposure to a disaster among those with a disaster experience was 13 years. On a 4-point scale, ranging from 0 (*not at all*) to 3 (*very*), participants who experienced a disaster reported being relatively upset at the time it occurred ($M = 2.4$), but less upset about it at the time of the survey ($M = 1.1$).

Logistic regression analysis revealed no relationship between reports of having experienced a disaster and participant's sex, age, race, marital status, and income, $\chi^2(11, N = 927) = 6.87$, *ns*.

Geographic locale/census region. As indicated in Table 2, the type of disaster reported by participants varied according to geographic/census region, especially for earthquakes, which were more prevalent in the West, and tornadoes and hurricanes, which were more common in the South.[6] Overall, reports of at least one

[6]This geographic region designation is based on the U.S. Census four-region demarcation, and places a number of states from the so-called "tornado alley" (Oklahoma, Texas, and Arkansas) into the "South" region.

Table 1. Prevalence and Characteristics of Natural Disasters in the General Population

	Prevalence		Fear of death		Loss of possessions		Injury to self		Injury/death of other		Age at last disaster		Years since occurrence		Upset then		Upset now	
Disaster	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Earthquake	75	8.0	55	73.3	37	49.3	11	14.7	9	12.0	33.5	14.1	7.7	13.0	2.4	0.8	1.1	1.0
Fire	48	5.1	19	39.6	36	75.0	2	4.2	1	2.1	29.6	14.8	18.1	15.2	2.4	0.8	1.2	1.3
Flood	41	4.4	17	41.4	32	78.0	1	2.4	0	0.0	29.9	16.5	19.4	14.2	2.2	0.9	0.9	1.0
Hurricane	35	3.7	26	74.3	17	48.6	2	5.7	5	14.3	32.9	15.8	17.1	14.5	2.1	0.9	0.4	0.9
Tornado	46	4.9	37	80.4	13	28.3	8	17.4	6	13.0	25.1	17.9	17.8	13.8	2.4	0.8	1.0	1.1
Any disaster	202	21.5	130	64.4	116	57.4	20	9.9	19	9.4	29.6	16.4	12.5[a]	13.8	2.4[b]	0.8	1.1[b]	1.1

[a]Lowest value.
[b]Highest value.

Table 2. Prevalence of Disasters as a Function of Geographic Region

	North-east		Mid-west		South		West		
Disaster	*n*	%	*n*	%	*n*	%	*n*	%	$\chi^2(3)$
Earthquake	4	5.3	6	8.0	16	21.3	49	65.3	105.1*
Fire	9	18.8	9	18.8	13	27.1	17	35.4	7.5
Flood	9	22.0	10	24.4	15	36.6	7	7.1	0.4
Hurricane	4	11.4	4	11.4	23	65.7	4	11.4	17.6*
Tornado	8	17.4	11	23.9	23	50.0	4	7.7	7.7*
Any disaster	31	15.3	34	16.8	70	34.7	67	33.6	33.6*

*$p < .01$.

disaster were least common in the Northeast (15%), followed by the Midwest (17%), whereas participants in the South and West were most likely to report at least one disaster (35% and 33%, respectively).

Relationship between disaster exposure and symptomatology. Canonical correlation analysis of the relationship between specific disaster type and current symptomatology indicated a significant multivariate association, $F(50, 4162.72) = 1.72$, $p < .001$. As shown in Table 3, post hoc *t*-tests indicated that, as compared to participants who had not experienced that specific disaster type,[7] participants exposed to fires had higher TSI scores on Depression, Intrusive Experiences, Defensive Avoidance, and Dissociation; those who experienced floods scored higher on Anxious Arousal, Depression, Intrusive Experiences, Defensive Avoidance, Dissociation, and Impaired Self Reference; and those exposed to tornados had higher scores on Anxious Arousal, Intrusive Experiences, and Dissociation. There was only one significant symptom–disaster characteristic relationship for earthquakes, on Intrusive Experiences ($M = 49.9$, $SD = 9.9$, vs. $M = 53.3$, $SD = 3$: $t(925) = -2.8$, $p < .005$), and no relationship between hurricanes and later TSI scores.

Disaster characteristics. In order to test whether different kinds of natural disasters were associated intrinsically with different types of symptomatology (i.e., independent of the characteristics of those disasters), the five disaster types (e.g., earthquake, fire) and six disaster characteristics (fear of death, loss of possessions, a significant other being killed or injured, the respondent being injured, age at last disaster, and years since last disaster) were used to predict TSI scales in a series of simultaneous multiple regression analyses. In only a few instances was disaster type found to continue to predict TSI scale variance above and beyond that predicted by specific disaster characteristics: earthquakes were negatively associated with three TSI scales, and floods were positively associated with the Dissociation scale

[7]Participants exposed to a specific disaster type were compared to those with no exposure to that type of disaster (but potentially exposed to other disaster types), as opposed to participants with no disaster exposure at all. This relatively conservative approach controls for the effects of disaster exposure, per se, thereby allowing consideration of specific disaster type effects, as desired.

Table 3. TSI Score Differences as a Function of Disaster Type (for Significant Disasters)

TSI scale	Fire			Flood			Tornado		
	No (n = 879)	Yes (n = 48)	t(925)	No (n = 886)	Yes (n = 41)	t(925)	No (n = 881)	Yes (n = 46)	t(925)
Anxious Arousal									
M	49.7	52.0	−1.5	49.6	54.6	−3.1*	49.6	54.9	−3.6*
SD	9.9	10.5		9.9	10.6		9.8	11.1	
Depression									
M	49.8	53.8	−2.8*	49.7	55.6	−3.8*	49.8	53.3	−2.4
SD	9.7	10.8		9.5	14.1		9.7	10.7	
Anger/Irritability									
M	49.7	51.6	−1.3	49.6	53.5	−2.4	49.6	53.2	−2.4
SD	9.8	10.2		9.7	12.7		9.8	10.2	
Intrusive Experiences									
M	49.9	53.9	−2.7*	49.9	55.2	−3.4*	49.9	54.8	−3.3*
SD	9.9	12.2		9.9	11.6		9.8	13.4	
Defensive Avoidance									
M	49.9	53.5	−2.5*	49.8	55.6	−3.3*	49.9	53.2	−2.2
SD	10.0	10.9		9.9	11.1		9.9	11.2	
Dissociation									
M	49.8	53.9	−2.8*	49.7	55.6	−3.7*	49.8	53.8	−2.7*
SD	9.9	11.8		9.9	12.4		10.0	10.1	
Sexual Concerns									
M	49.8	51.0	−0.8	49.7	52.5	−1.7	49.8	50.8	−0.7
SD	10.0	9.7		9.9	12.0		10.0	9.1	
Dysfunctional Sexual Behavior									
M	50.1	51.3	−0.8	50.1	51.5	−0.9	50.0	51.8	−1.1
SD	10.0	12.0		10.0	11.2		10.1	10.6	
Impaired Self Reference									
M	49.8	53.0	−2.1	49.8	54.3	−2.9*	49.9	52.6	−1.9
SD	9.7	11.1		9.6	13.8		9.7	11.2	
Tension Reduction Behavior									
M	50.2	50.2	0.00	50.1	54.0	−2.4	50.1	53.6	−2.3
SD	10.1	10.0		10.1	10.4		10.1	10.8	

*$p < .01$.

of the TSI. In contrast, disaster characteristics were often predictive of TSI scales above and beyond disaster type, especially those involving the respondent having been injured, having feared for his/her life, or having experienced property loss (see Table 4). Interestingly, time since last disaster was generally not a predictor of current symptomatology, except for Intrusive Experiences. In the latter instance, intrusive reexperiencing decreased as a function of time since last disaster.

Because three disaster characteristics (fear, injury, and loss) appear to especially increase the relationship between disaster exposure and later symptomatology, a one-way MANOVA was calculated with the number of these disaster characteristics to which victims had been exposed (ranging from 0 to 3) serving as the independent variable, and the 10 TSI scales being the dependent variables. This analysis was significant, $F(30, 584.78) = 2.13$, $p < .001$, with post hoc ANOVAs indicating relationships for all 10 TSI scales. In general, the most powerful association was for the highest number of disaster characteristics. Participants reporting exposure to all three characteristics had scores in the clinical range (T score of 65 or higher, per the TSI manual; Briere, 1995) for 6 of 10 TSI scales: Anxious Arousal, Depression, Intrusive Experiences, Defensive Avoidance, Dissociation, and Tension Reduction Behavior). See Table 5 for means, standard deviations, and F values.

This analysis was repeated in a slightly different form to probe the role of disaster severity in the general failure to find a time effect, as described earlier. To determine if the absence of a time effect was contingent on how severe the disaster was, a 2(number of characteristics, dichotomized into 0 [no characteristics or one characteristic] or 1 [two characteristics or three characteristics] $\times$ 4 (time since last disaster: 1 = within the last year [$n = 31$], 2 = 1 year ago [$n = 21$], 3 = 2–5 years ago [$n = 43$], 4 = more than 5 years ago [$n = 96$]) MANOVA was calculated, using the 10 TSI scales as dependent variables. No multivariate interaction was found between severity and time since disaster, $F(30, 511.4) = 1.10$, *ns*, indicating that passage of time did not predict symptomatology for either higher or lower severity disasters. As per the earlier findings, there was no main effect of time, $F(30, 511.4) = 1.43$, *ns*, whereas there was a severity effect, $F(30, 511.4) = 1.89$, $p = .05$.

Controlling for exposure to other traumas. In order to test whether other, nondisaster traumas might moderate the disaster-symptom relationship noted earlier, a unique (simultaneous) sums of squares MANOVA was conducted. In this analysis, independent variables were presence or absence of interpersonal violence (child abuse and child peer assaults, adult physical and sexual assault [including spouse abuse], per the TES) and presence or absence of disaster exposure, and the dependent variables were TSI scale scores. No two- or three-way interactions were found between sex, interpersonal violence, or disaster exposure, indicating that males and females with or without a history of interpersonal violence had equivalent symptomatology in response to disaster exposure. Although there was

Table 4. Multiple Regression (β) of Disaster Type and Characteristics on TSI Scales

TSI scale	Quake	Fire	Flood	Hurricane	Tornado	Fear of death	Loss	Injury to self	Injury to other	Age at last disaster	Years since last disaster	Education R^2	Education $F(8, 904)$
Anxious Arousal	−.11*	−.08	.04	−.03	−.01	.15	.20*	.26*	.14	−.09	−.09	.16	3.19*
Depression	−.16	.06	.11	−.00	−.02	.33*	.27*	.16*	.11	−.00	−.04	.17	3.29*
Anger–Irritability	−.26*	−.08	.03	−.06	−.05	.19*	.22*	.19*	−.00	−.18*	−.16	.11	2.08*
Intrusive Experiences	−.09	.04	.07	.03	.02	.15	.22*	.18*	.13	−.14	−.21*	.14	2.59*
Defensive Avoidance	−.14	.00	.05	−.03	−.04	.19*	.26*	.19*	.04	−.08	−.14	.11	2.01*
Dissociation	−.04	.13	.17*	.06	.04	.14	.11	.09	.21*	−.12	−.12	.13	2.42*
Sexual Concerns	−.21*	−.06	.04	−.13	−.11	.19*	.21*	.24*	.08	−.08	−.03	.11	2.03*
Dysfunctional Sexual Behavior	−.02	.04	.04	.02	.02	.27*	.15	.22*	.01	−.20*	−.03	.12	2.27*
Impaired Self Reference	—	—	—	—	—	—	—	—	—	—	—	.09	1.50
Tension Reduction Behavior	−.11	−.04	.11	.02	−.02	.20*	.13	.25*	.07	−.19*	−.11	.14	2.54*

*$p < .05$.

Table 5. Post hoc ANOVA Results for Significant Disaster Severity Characteristics Effects on Trauma Symptom Inventory (TSI) Scores

TSI scale	No characteristics ($n = 11$)		One characteristic ($n = 146$)		Two characteristics ($n = 47$)		Three characteristics ($n = 8$)		ANOVA
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	$F(3, 208)$
Anxious Arousal	48.1_a	8.1	51.4_a	9.6	53.4_a	10.9	67.3_b	9.5	7.40*
Depression	47.5_a	9.0	50.4_a	8.8	55.8_b	13.7	66.5_c	9.7	9.72*
Anger/Irritability	50.9_a	7.8	50.3_a	9.3	52.8_a	10.8	63.4_b	13.7	4.90*
Intrusive Experiences	$47.3_{a,b}$	9.2	51.9_a	11.1	55.9_b	12.3	67.2_c	14.3	6.52*
Defensive Avoidance	46.3_a	9.5	51.3_a	10.1	55.4_b	11.8	64.6_c	11.3	6.59*
Dissociation	52.9_a	10.5	51.2_a	10.5	54.3_a	12.6	65.7_b	15.6	4.84*
Sexual Concerns	51.8_a	10.4	49.2_a	8.2	52.1_a	11.6	63.1_b	15.6	6.14*
Dysfunctional Sexual Behavior	51.3_a	9.1	49.3_a	8.2	53.0_a	12.8	62.2_b	17.7	5.49*
Impaired Self Reference	49.0_a	7.4	50.2_a	9.6	54.7_b	14.6	61.5_b	8.2	4.54*
Tension Reduction Behavior	49.7_a	6.2	50.4_a	9.3	52.4_a	12.0	67.6_b	20.5	7.19*

Note. Means not sharing a common subscript are different at $p < .05$ (Newman–Keuls test).
*$p < .01$.

no main effect of sex, exposure to interpersonal violence and disaster were both related to TSI scale scores, $F(10, 910) = 9.85$, $p < .001$; and $F(10, 910) = 2.25$, $p < .05$, respectively. Inspection of the multivariate effects and the individual post hoc ANOVAs (see Table 6) indicates that a subset of disaster–symptom relationships (Anxious Arousal, Intrusive Experiences, and Defensive Avoidance) still pertained after controlling for exposure to interpersonal violence, whereas interpersonal violence was a considerably stronger predictor and was significantly related to all 10 TSI scales.

Discussion

The results of this study are discussed ahead in terms of disaster prevalence, psychological impact, and symptom persistence over time.

Prevalence, Characteristics, and Definitional Issues

In general agreement with Green and Solomon (1995), exposure to earthquakes, hurricanes, tornados, floods, or fires was reported by 22% of general population participants in the current study. The least common natural disaster was hurricanes (4%) and the most common was earthquakes (8%). The two most common geographic regions for these events were the South and the West, although no region was free of disaster. Well over half of those exposed to disaster reported fearing for their lives (64%) or having lost possessions (57%).

Table 6. Post hoc ANOVA Results for Significant Disaster and Interpersonal Violence Effects on Trauma Symptom Inventory (TSI) Scores

	Disaster exposure			Exposure to interpersonal violence		
TSI scale	No (n = 726)	Yes (n = 201)	$F(10, 910)$	No (n = 421)	Yes (n = 506)	$F(10, 910)$
Anxious Arousal						
M	49.1	52.5	8.1*	46.9	52.3	52.8*
SD	9.7	10.4		8.8	10.1	
Depression						
M	49.3	52.3	6.2	47.1	52.4	50.9*
SD	9.4	10.8		8.2	10.4	
Anger/Irritability						
M	49.4	51.4	2.1	46.6	52.5	57.1*
SD	9.7	10.2		8.3	10.3	
Intrusive Experiences						
M	49.2	53.5	15.9*	46.6	53.0	68.5*
SD	9.2	11.9		7.7	10.8	
Defensive Avoidance						
M	49.3	52.8	10.3*	46.4	53.1	69.6*
SD	9.6	10.9		8.1	10.5	
Dissociation						
M	49.3	52.5	5.7	46.6	52.8	71.6*
SD	9.5	11.5		7.5	11.0	
Sexual Concerns						
M	49.7	50.4	0.0	46.7	52.4	46.8*
SD	10.1	10.0		7.0	11.3	
Dysfunctional Sexual Behavior						
M	50.0	50.7	0.0	47.1	52.6	43.0*
SD	10.0	10.3		6.0	12.0	
Impaired Self Reference						
M	49.5	51.7	3.4	46.9	52.6	50.7*
SD	9.4	11.2		7.2	10.9	
Tension Reduction Behavior						
M	49.9	51.3	1.0	47.0	53.0	53.3*
SD	9.8	11.0		7.4	11.3	

*$p < .01$.

If only those natural stressors that induced a significant amount of fear of death, actual injury, or property loss among exposed individuals were to be considered "disasters," the prevalence rates cited in this and other studies would decrease significantly. It may be argued, in fact, that it is the presence of such characteristics that discriminates a negative environmental event from a disaster. Although most modern definitions of "disaster" refer to "high-magnitude stressful life events" (Baum, 1987; Freedy et al., 1992, p. 3) or "environmental stressors that happen to a community" (Green & Solomon, 1995, p. 164), such definitions may inappropriately include stressful but not injurious or life-threatening events, or events that do not involve major property loss. For example, a minor, but widely felt earthquake in Southern California might be perceived as stressful, but probably should not

be considered a disaster if it did not involve significant property loss, injury, or threat of death. Thus, the epidemiology of disaster depends greatly on definitional issues, primarily in terms of what minimal threshold of negative characteristics is required to define the existence of a disaster, per se.

Despite these considerations, it should be noted that the majority of reported events in this study were associated with significant negative characteristics. If, as indicated ahead, exposure to such events is associated with subsequent psychological symptoms, the relatively high prevalence of disasters in the general population may represent a significant mental health risk factor.

Psychological Impacts

Although the mean period of time from last disaster exposure to involvement in the present study was 13 years, previous disaster was associated with current elevations on 6 of 10 TSI scores: Anxious Arousal, Depression, Intrusive Experiences, Defensive Avoidance, Dissociation, Impaired Self Reference. Interestingly, the type of disaster (e.g., hurricanes vs. floods) did not appear to determine symptomatology as much as did exposure to specific disaster characteristics—especially physical injury, fear of death, or property loss. In fact, participants who were exposed to all three of these disaster characteristics produced TSI scores that were at clinical levels ($T \geq 65$) for most scales, whereas those exposed to disasters where none or only one of these characteristics were present had TSI T-scores lower than or equivalent to the normative sample.

Probably apropos of the importance of disaster characteristics in symptom outcome, multiple regression analyses indicated that when disaster type and characteristics were entered simultaneously, several disaster types (most notably earthquakes, but also tornadoes, hurricanes, and fires) were associated with *negative* beta weights despite their positive univariate relationship to symptoms. Such findings suggest that removing variance associated with severity characteristics such as fear, loss, and injury in the relationship between disaster and symptomatology produces statistical anomalies by virtue of the greater predictive power of the former relative to the latter. In the current context, it is likely that controlling for disaster severity characteristics in the disaster–symptom relationship is "partialing the relation out of itself" (Briere, 1988, p. 83; Gordon, 1968): a phenomenon known to result in supressor relationships or uninterpretable beta weights (Briere & Elliott, 1993; Pedhazur, 1982).

The fact that characteristics of a given potential disaster predict symptoms more than does specific disaster type may be a noteworthy finding. Although the presence or absence of these characteristics may be considered a gross indicator of disaster severity, per se, the findings of increased symptomatology for those experiencing traumas that include physical injury or fear of death has been shown for other, nondisaster-related stressors (Foy, Resnick, Sipprelle, & Carroll, 1987;

Heltzer, Robins, & McEnvoy, 1987; Kilpatrick & Resnick, 1993; Ursano, Fullerton, & McCaughey, 1994). In this regard, it may be that a natural stressor is traumagenic primarily to the extent that it contains those characteristics generally known to produce lasting distress, as opposed to merely involving shaking earth, very high winds, flooding, etc.

The present study also examined whether disaster–symptom relationships remained when controlling for other, nondisaster traumas—specifically, exposure to interpersonal violence. Findings suggest that symptoms of posttraumatic stress (Anxious Arousal, Intrusive Experiences, and Defensive Avoidance) remain even after other trauma exposure is taken into account. Further, this analysis indicated that although disaster exposure accounted for significant symptom variance, far more variance was accounted for by exposure to interpersonal violence.

Persistence Over Time

A relatively unexpected finding was the apparent persistence of disaster effects over time. Current symptom reports of participants exposed to more recent disasters were not significantly greater than those of participants whose exposure was considerably farther in the past. In fact, the only TSI scale found to lessen as a function of time since disaster was Intrusive Experiences.

The present study found that this symptom persistence effect did not vary as a function of the severity of the disaster. This potential interaction was examined because events that might be considered merely environmental stressors (i.e., involving one or no severity characteristics described earlier) were not associated with significant symptomatology, and thus provided little symptom variance for meaningful reductions over time. In contrast, those events more obviously disaster-like (i.e., containing two or three severity characteristics) were associated with significant symptomatology and therefore were a better test of symptom persistence. Yet, high severity disaster symptoms were no more likely to abate with time than those associated with lower-level events. These results are in relative contradistinction to studies that find time-related decrements in disaster effects (Adams & Adams, 1984; Johnsen et al., 1997; Murphey, 1986; Shore et al., 1986). They are more in agreement with studies that report persistence of at least some, if not all, symptoms following disaster (Canino et al., 1990; Gleser et al., 1981; Holen, 1993; McFarlane, 1987).

Perhaps the best comparison to the present study is Grace, Green, Lindy, and Leonard's 14-year follow-up (Grace, Green, Lindy, & Leonard, 1993) of the Buffalo Creek Dam disaster. Grace et al. found that the prevalence of PTSD was 44% at the time of the dam collapse, and 28% 14 years later. These data support the notion that disaster effects can persist over the long-term, albeit at a somewhat reduced level. Because the current study used a continuous measure of symptomatology (the TSI), as opposed to PTSD diagnosis, the results of these

two studies cannot be directly compared. It is likely, however, that the decrease in intrusive posttraumatic symptoms found in the present study would correspond to a somewhat decreased rate of PTSD for these participants over time.

Conclusions

A methodological advantage of the current study is its attention to generalizability issues. Because the present sample was relatively large, representative of the general population on most demographic variables, and included individuals exposed to a wide variety of different disasters or no disasters at all, the results reported here are relatively independent of the peculiarities of any specific disaster occurrence. As a result, these analyses address the notion of disaster, per se, and avoid possible problems associated with generalizing from convenience sample data derived from a specific event and locale.

A disadvantage of this study is its use of retrospective, cross-sectional data. Because the same participants were not sampled repeatedly over time, the specific time-course of disaster-related symptoms (including the waxing and waning of posttraumatic stress, as described by Blank, 1993) could not be evaluated, only inferred.

The current data suggest that the effects of some disasters may persist for a decade or more. This finding may have clinical implications. Although psychological intervention is often offered to disaster victims, such treatment is typically short-term and usually focuses on more immediate sequella of the disaster experience. The current findings suggest that some disaster effects may be more chronic, and may require treatment long after acute disaster mental health services have departed the scene. Similarly, psychotherapists often assume that the most enduring posttraumatic symptoms arise from interpersonal violence experiences such as child abuse or rape. As a result, clinicians are frequently advised to inquire about victimization experiences that might be etiologic in the distress of their patients (Briere, 1997; Carlson, 1997; Falsetti & Resnick, 1995). Although the present data support this approach by indicating the greatest effects for interpersonal violence, they also suggest that some chronic posttraumatic symptoms may be disaster-related. As a result, the clinician may choose to consider potential histories of all previous traumatic events, including natural disaster, when evaluating those requesting clinical services.

References

Adams, P., & Adams, G. (1984). Mount Saint Helen's ashfall. *American Psychologist, 39*, 252–260.

Baum, A. (1987). Toxins, technology, and natural disasters. In B. K. VandenBos (Ed.), *Cataclysms, crises, and catastrophes: Psychology in action.* Washington, DC: American Psychological Association.

Blank, A. S. (1993). The longitudinal course of Posttraumatic Stress Disorder. In J. R. T. Davidson & E. B. Foa (Eds.), *Posttraumatic stress disorder: DSM-IV and beyond* (pp. 3–22). Washington, DC: American Psychiatric Press.

Bravo, M., Rubio-Stipec, M., Canino, G. J., Woodbury, M. A., & Ribera, J. C. (1990). The psychological sequelae of disaster stress prospectively and retrospectively evaluated. *American Journal of Community Psychology, 18,* 661–680.

Briere, J. (1988). Controlling for family variables in abuse effects research: A critique of the "partialling" approach. *Journal of Interpersonal Violence, 3,* 80–89.

Briere, J. (1995). *Trauma Symptom Inventory professional manual.* Odessa, FL: Psychological Assessment Resources.

Briere, J. (1997). *Psychological assessment of adult posttraumatic states.* Washington, DC: American Psychological Association.

Briere, J., & Elliott, D. M. (1993). Sexual abuse, family environment, and psychological symptoms: On the validity of statistical control. *Journal of Consulting and Clinical Psychology, 61,* 284–288.

Briere, J., Elliott, D. M., Harris, K., & Cotman, A. (1995). Trauma Symptom Inventory: Psychometrics and association with childhood and adult trauma in clinical samples. *Journal of Interpersonal Violence, 10,* 387–401.

Burnett, K., Ironson, G., Benight, C., Wynings, C., Greenwood, D., Carver, C. S., Cruess, D., Baum, A., & Schneiderman, N. (1997). Measurement of perceived disruption during rebuilding following Hurricane Andrew. *Journal of Traumatic Stress, 10,* 673–681.

Canino, G., Bravo, M., Rubio-Stipec, M., & Woodbury, M. (1990). The impact of disaster on mental health: Prospective and retrospective analyses. *International Journal of Mental Health, 19,* 51–69.

Cardeña, E., & Speigel, D. (1993). Dissociative reactions to the San Francisco Bay Area Earthquake of 1989. *American Journal of Psychiatry, 150,* 474–478.

Carlson, E. B. (1997). *Trauma assessments: A clinician's guide.* New York: Guilford.

Carr, V. J., Lewin, T. J., Webster, R. A., Kenardy, J. A., Hazell, P. L., & Carter, G. L. (1997). Psychosocial sequelae of the 1989 Newcastle earthquake: II. Exposure and morbidity profiles during the first 2 years post-disaster. *Psychological Medicine, 27,* 167–177.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Elliott, D. M. (1992). *Traumatic Events Survey* (TES). Torrance, CA: Author.

Elliott, D. M. (1997). Traumatic events: prevalence and delayed recall in the general population. *Journal of Consulting and Clinical Psychology, 65,* 811–820.

Falsetti, S. A., & Resnick, H. S. (1995). Helping the victims of violent crime. In J. R. Freedy & S. E. Hobfoll (Eds.), *Traumatic stress: From theory to practice.* New York: Plenum Press.

Foy, D. W., Resnick, H. S., Sipprelle, R. C., & Carroll, E. M. (1987). Premilitary, military, and postmilitary factors in the development of combat-related Posttraumatic Stress Disorder. *The Behavior Therapist, 10,* 3–9.

Freedy, J. R., Resnick, H. S., & Kilpatrick, D. G. (1992). Conceptual framework for evaluating disaster impact: Implications for clinical intervention. In L. S. Austin (Ed.), *Responding to disaster: A guide for mental health professionals.* Washington, DC: American Psychiatric Press.

Gavalya, A. S. (1987). Reactions to the 1985 Mexican earthquake: Case vignettes. *Hospital and Community Psychiatry, 38,* 1327–1330.

Gleser, G. C., Green, B. L., & Winget, C. N. (1981). *Prolonged psychosocial effects of disaster: A study of Buffalo Creek.* New York: Academic Press.

Gordon, R. A. (1968). Issues in multiple regression. *American Journal of Sociology, 73,* 592–616.

Grace, M. C., Green, B. L., Lindy, J. D., & Leonard, A. C. (1993). The Buffalo Creek disaster: A 14-year follow-up. In J. P. Wilson & B. Raphael (Eds.), *International handbook of traumatic stress syndromes* (pp. 441–449). New York: Plenum.

Green, B. L., Goodman, L. A., Krupnick, J. L., Corcoran, C. B., Petty, R. M., Stockton, P., & Stern, N. M. (2000). Outcomes of single versus multiple trauma exposure in a screening sample. *Journal of Traumatic Stress, 13,* 271–286.

Green, B., Grace, M., Lindy, J., Gleser, G., Leonard, A., & Kramer, T. (1990). Buffalo Creek survivors in the second decade: Comparison with unexposed and nonlitigant groups. *Journal of Applied Social Psychology, 20,* 1033–1050.

Green, B. L., Lindy, J. D., Grace, M. C., & Leonard, A. C. (1992). Chronic posttraumtic stress disorder and diagnostic comorbidity in a disaster sample. *Journal of Nervous and Mental Disease, 180,* 760–766.

Green, B. L., & Solomon, S. D. (1995). The mental health impact of natural and technological disasters. In J. R. Freedy & S. E. Hobfoll (Eds.), *Traumatic stress: From theory to practice.* New York: Plenum Press.

Heltzer, J. K., Robins, L. N., & McEnvoy, L. (1987). Posttraumatic stress disorder in the general population. *New England Journal of Medicine, 317,* 1630–1634.

Holen, A. (1993). The north sea oil rig disaster. In J. P. Wilson & B. Raphael (Eds.), *International handbook of traumatic stress syndromes.* New York: Plenum.

Johnsen, B. H., Eid, J., Lovstad, T., & Michelsen, L. T. (1997). Posttraumatic stress symptoms in nonexposed, victims, and spontaneous rescuers after an avalanche. *Journal of Traumatic Stress, 10,* 133–140.

Khoury, E. L., Warheit, G. J., Hargrove, M. C., Zimmerman, R. S., Vega, W. A., & Gil, A. G. (1997). The impact of Hurricane Andrew on deviant behavior among a multi-racial/ethnic sample of adolescents in Dade County, Florida: a longitudinal analysis. *Journal of Traumatic Stress, 10,* 71–91.

Kilpatrick, D. G., & Resnick, H. S. (1993). Posttraumatic stress disorder associated with exposure to criminal victimization in clinical and community populations. In J. R. T. Davidson & E. B. Foa (Eds.), *Posttraumatic stress disorder: DSM-IV and beyond* (pp. 113–143). Washington, DC: American Psychiatric Press.

Madakasira, S., & O'Brien, K. F. (1987). Acute posttraumatic stress disorder in victims of a natural disaster. *Journal of Nervous and Mental Disease, 175,* 286–290.

Krug, E. G., Kresnow, M., Peddicord, J. P., Dahlberg, L. L., Powell, K. E., Crosby, A. E., & Annest, J. L. (1998). Suicide after natural disasters. *New England Journal of Medicine, 338,* 373–378.

Krug, E. G., Kresnow, M., Peddicord, J. P., Dahlberg, L. L., Powell, K. E., Crosby, A. E., & Annest, J. L. (1999). Retraction: Suicide after natural disasters. *New England Journal of Medicine,* 340.

Maida, C. A., Gordon, N. S., Steinberg, A., & Gordon, G. (1989). Psychosocial impact of disasters: Victims of the Baldwin Hills fire. *Journal of Traumatic Stress, 2,* 37–48.

McFarlane, A. (1987). Family functioning and overprotection following a natural disaster: The longitudinal effects of posttraumatic morbidity. *Australian and New Zealand Journal of Psychiatry, 21,* 210–218.

McFarlane, A. C., Atchison, M., Rafalowicz, E., & Papay, P. (1994). Physical symptoms in posttraumatic stress disorder. *Journal of Psychosomatic Research, 38,* 715–726.

McFarlane, A. C., Clayer, J. R., & Bookless, C. L. (1997). Psychiatric morbidity following a natural disaster: An Australian bushfire. *Social Psychiatry and Psychiatric Epidemiology, 32,* 261–268.

McMillen, J. C., Smith, E. M., & Fisher, R. H. (1997). Perceived benefit and mental health after three types of disaster. *Journal of Consulting and Clinical Psychology, 65,* 733–739.

Murphey, S. (1986). Stress levels and health status of victims of a natural disaster. *Research in Nursing and Health, 9,* 331–340.

Norris, F. H., Phifer, J. F., & Kaniasty, K. (1994). Individual and community reactions to the Kentucky floods: Findings from a longitudinal study of older adults. In R. J. Ursano, C. S. Fullerton, & B. G. McCaughey (Eds.), *Individual and community response to trauma and disaster: The structure of human chaos.* Cambridge: Cambridge University Press.

North, C. S., Smith, E. M., McCool, R. E., & Lightcap, P. E. (1989). Acute postdisaster coping and adjustment. *Journal of Traumatic Stress, 2,* 353–360.

Phifer, J., & Norris, F. (1989). Psychological symptoms in older adults following natural disaster: Nature, timing, duration, and course. *Journal of Gerontology: Social Sciences, 44,* S207–S217.

Roche, D. N., Runtz, M. G., & Hunter, M. A. (1999). Adult attachment: A mediator between child sexual abuse and later psychological adjustment. *Journal of Interpersonal Violence, 14,* 184–207.

Rossi, P. H., Wright, J. D., Weber-Burdin, E., & Perina, J. (1983). Victimization by natural hazards in the United States, 1970–1980; survey estimates. *International Journal of Mass Emergencies and Disasters, 1,* 467–482.

Shapiro, B. L., & Schwarz, J. C. (1997). Date rape: Its relationship to trauma symptoms and sexual self-esteem. *Journal of Interpersonal Violence, 12,* 407–419.

Shore, J. H., Tatum, E. L., & Vollmer, W. M. (1986). Psychiatric reactions to disaster: The Mount St. Helens experience. *American Journal of Psychiatry, 143,* 590–595.

Ursano, R. J., Fullerton, C. S., & McCaughey, B. G. (1994). Trauma and disaster. In R. J. Ursano, C. S. Fullerton, & B. G. McCaughey (Eds.), *Individual and community response to trauma and disaster: The structure of human chaos.* Cambridge: Cambridge University Press.