

Psychological aftermath of the Lviv air show disaster: a prospective controlled study

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Objective: To investigate the psychological aftermath of an air show disaster using prospectively obtained epidemiologic data.

Method: Participants in a recently completed epidemiologic mental health survey in Lviv (disaster site) and controls from western Ukraine were interviewed shortly before and 6 months after a gruesome air show disaster.

Results: The Lviv group reported more psychopathology and post-traumatic stress symptom severity, but less anomie than controls. Somatization symptoms were similar in the two groups. Predisaster mental health and postdisaster threat were the strongest risk factors while demographic characteristics, emotional support, and repeated television viewing of the event were only weakly associated with postdisaster mental health.

Conclusion: This is the first prospective study to find a significantly higher rate of disorder as well as post-traumatic stress disorder symptomatology after a disaster. The risk factor findings suggest avenues for targeting postdisaster interventions.

**E. J. Bromet¹, J. M. Havenaar²,
S. F. Gluzman³, N. L. Tintle¹**

¹Department of Psychiatry, State University of New York at Stony Brook, NY, USA, ²Department of Psychiatry, Vrije Universiteit Amsterdam, Amsterdam, the Netherlands and ³Ukrainian Psychiatric Association, Kyiv, Ukraine

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Evelyn J. Bromet, Department of Psychiatry, Putnam Hall-South Campus, Stony Brook, NY 11794-8790, USA.
E-mail: evelyn.bromet@stonybrook.edu

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Introduction

Research on the psychological consequences of disasters has grown exponentially in the last two decades (1). Overall, these studies place the 1-year disaster-attributable prevalence of psychological morbidity at about 20% (2), but the range of probable cases may exceed 50% (e.g. 3). In addition to psychiatric disorders, mood, anxiety, and health-related anxiety symptoms, and distrust in authorities (alienation) are not only elevated (e.g. 4–5) but also often become intractable, especially after human-made catastrophes (6–8). Recent disasters, such as the September 11 World Trade Center catastrophe, have also had a psychological impact on indirectly exposed populations (through television primarily) although the strategies for configuring these samples raise serious concerns about generalizability (e.g. 9, 10). In spite of the uniqueness of each disaster in terms of severity, sociocultural context, and postdisaster response and of differences in methodologies to evaluate the psychiatric consequences, some high-risk groups have been consistently identified, including mothers of young children, individuals

with a history of psychopathology, and most importantly, the most severely exposed (1, 2, 11).

Although disasters are conceptualized as 'natural experiments,' only a handful of studies have used a pre–post design and hence contain unbiased pre-disaster morbidity data. The absence of such predisaster baseline data places constraints on the inferences that can be drawn about postdisaster prevalence rates and indeed may exaggerate the role of risk factors, such as mental health history. To date, only three epidemiologic disaster studies of random community samples and adequate controls (demographically similar unexposed populations) have used a pre–post design: the Epidemiologic Catchment Area follow-up after a set of human and natural disasters (12); the Puerto Rico follow-up of victims of a mud-slide (13, 14); and the Netherlands follow-up of high school students who survived a café fire (15). These studies found increases in psychosomatic and post-traumatic stress disorder (PTSD) symptoms, but not diagnosable psychopathology.

The present study adds significantly to this small body of pre–post studies by investigating a community sample before and after an air show

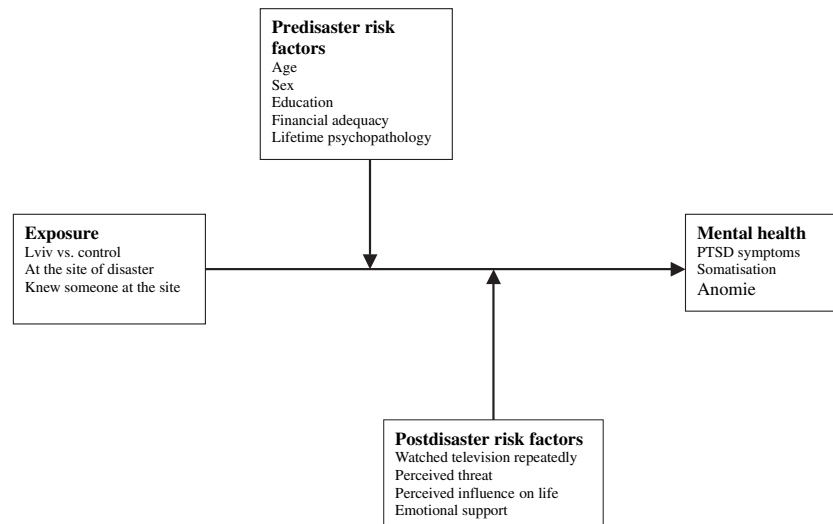


Fig. 1. Graphical representation of the stress-vulnerability model.

disaster in Ukraine in 2002 that killed or seriously injured over 100 people. Figure 1 shows the conceptual framework for the study. Because predisaster baseline data were available, we were able to examine mental health risk factors that were free of disaster-associated recall bias.

Aims of the study

The aim of the study was to examine the mental health effects of a gruesome air show disaster in Lviv, Ukraine, in July 2002, in a population who previously participated in an epidemiologic mental health survey. We examined differences in post-traumatic stress symptoms, somatization symptoms, and anomie between the Lviv group and controls from western Ukraine and the relationships of pre- and postdisaster risk factors to these mental health outcomes.

Material and methods

Event

On July 27, 2002, a 16-ton SU-27 warplane smashed into a crowd of air show spectators at Skniliff airbase outside Lviv (population 830 000) in western Ukraine, after failing to recover from a steep, low-altitude turn in which the pilot lost control of his plane’s trajectory. The pilot survived by ejecting himself from the cockpit, but the plane crashed, killing 85 spectators (19 children) on the ground and injuring 151 adults and children, 23 of whom seriously. During the hours and days that followed, the corridors of hospitals in the area were filled with relatives looking for lost family members. Television crews at the scene aired gruesome pictures of the

airport’s tarmac littered with body parts and human remains. Stories about the plane crash – the worst of its kind in 14 years – appeared on the front pages of newspapers worldwide. In September 2002, EJB and JMH were in Lviv to discuss the recently completed field work in Ukraine for the World Mental Health (WMH) prevalence study of psychiatric and substance disorders (16), and were impressed by the psychological turmoil the disaster appeared to have unleashed on the community. The psychiatrists participating in the WMH study were actively involved in providing mental health support to the stricken community, having translated American materials on PTSD and provision of care after September 11 that they disseminated to professionals and community members. The present study resulted directly from these discussions.

Sample

In 2002, we conducted a national survey of mental illness and substance disorders in Ukraine (17) as part of the WMH initiative (18). The Ukraine WMH study is a nationally representative survey of residents aged 18 and older from the 24 oblasts (counties) and the autonomous republic of Crimea (for details, see 17). Briefly, face-to-face interviews were carried out with 4725 respondents by the professional interview field staff of the Kiev International Institute of Sociology (KIIS) in collaboration with the Ukrainian Psychiatric Association (UPA). Interviewers explained the study and obtained written informed consent prior to beginning each interview. The recruitment, consent, and field procedures were approved by the Human Subjects Committees of University at Stony Brook, KIIS, and UPA. The response rate was 78.3%.

The WMH fieldwork in western Ukraine, where the accident occurred, was completed 1 month prior to the disaster. There were 92 respondents (response rate 89.2%) in the Lviv area where the accident occurred, and 90 controls (response rate 88.7%) in two western regions of Ukraine, Rivne and Ivano-Frankivsk, that served as the comparison site. Follow-up face-to-face interviews were conducted in November–December 2002, 6 months after the disaster, with 75 Lviv respondents (81.5%) and 77 controls (86.5%), with consent procedures approved by Stony Brook and KIIS. There were no demographic differences in either site between participants and non-participants in the follow-up except that in Lviv, the participation rate was higher in men (89.8%) than women (72.2%) (chi-square = 4.77; $df = 1$; $P < 0.05$).

Assessment and measures

The main tool of the initial survey was the WMH version of the Composite International Diagnostic Interview for DSM-IV (WMH-CIDI), a fully structured lay-administered diagnostic interview that generates DSM-IV and ICD-10 diagnoses (19). The CIDI was translated into Russian and Ukrainian using standard forward and back translation procedures. Five variables from the initial survey were included as predisaster risk factors: age, sex, education, financial adequacy, and lifetime disorder (DSM-IV mood, anxiety, and alcohol disorders, and/or ICD-10 neurasthenia). Financial adequacy was categorized as 'adequate' if there was enough money for durables and 'inadequate' if there was not enough money for clothing or food.

An Air Show Disaster Module was designed for the follow-up study. The exposure section inquired about direct exposure (being at the event or knowing someone involved), degree of perceived threat (based on the number of DSM-IV PTSD A1 criteria endorsed, e.g. felt personally threatened, traumatized, terrified or very frightened at the time, helpless, shocked or horrified, and numb), whether respondents watched the television coverage of the event repeatedly (vs. less often), whether respondents believed that the disaster had an important influence on their lives (vs. little or no influence relative to other events), and emotional support (number of types of people respondents turned to for support 'some' or 'a lot' as a result of the disaster). Postdisaster mental health included PTSD symptoms assessed with the 22-item Impact of Events Scale-R (20) which rated severity of intrusion, avoidance, and hyperarousal symptoms resulting from the air show disaster (1 = not at all;

5 = very much; Cronbach's alpha = 0.93); somatization symptoms assessed with 12-item somatization subscale of the Symptom Checklist-90-R (21) which rates symptoms over the past 2 weeks on a 5-point severity scale (0 = not at all; 4 = extremely; alpha = 0.85); and anomie, a particularly significant concern in Eastern Europe (22), assessed with a 4-item scale indicating whether respondents felt less safe, less able to control the forces that influence their lives, more pessimistic about their future well-being, and had less faith in the government's ability to protect them than before the air show disaster (1 = not at all true; 5 = extremely true; alpha = 0.78). Scoring for each scale involved summing across items.

The follow-up interview also included a modified version of the WMH-CIDI DSM-IV PTSD module that focused on the air show accident and the WMH-CIDI modules for neurasthenia, mood disorders, anxiety disorders, and heavy use of alcohol, defined as either binge drinking (80 g of pure ethanol a least once/month) or high frequency of use (60 g 3–4 days/week or 40 g nearly every day).

Data analysis

Differences between the groups were analyzed using *t*-tests and odds ratios (95% confidence intervals). Pearson correlations were used to examine bivariate associations. A series of linear regression analyses was performed to estimate i) the unique effects of exposure on symptomatology and anomie; ii) the group difference that remained after controlling for the predisaster risk factors; iii) the group difference that remained after controlling for the postdisaster risk factors; and iv) the group difference that remained after controlling for variables that were statistically significant ($P < 0.05$) in the pre- and postdisaster regression analyses.

Results

Compared with controls, the Lviv sample was significantly older (mean \pm SD: 49.7 \pm 18.6 vs. 43.6 \pm 14.1), included more men, and was more likely to report financial problems (Table 1). The groups were not significantly different on educational attainment and predisaster lifetime psychiatric disorder although the rate was somewhat higher in the Lviv group (33.3%) than in the controls (22.1%).

Twenty-three respondents (including one control) knew someone who was killed or injured at the accident. Two Lviv residents were at the airbase. As expected, a larger proportion of the

Table 1. Distribution of key variables by site

	Lviv (<i>n</i> = 75) %	Controls (<i>n</i> = 77) %	OR (95% CI)
Predisaster risk factors			
Sex (male)	58.7	40.3	2.11 (1.10–4.02)*
Age (> 45 years)	61.3	41.6	0.45 (0.23–0.86)*
Education, ≤high school	38.7	35.1	1.17 (0.60–2.26)
Finances, inadequate	90.5	56.6	7.35 (2.98–8.09)***
Mental or substance disorder	33.3	22.1	0.77 (0.86–3.63)
Disaster risk factor			
Attended event or knew someone killed/injured	29.3	1.3	31.5 (4.1–241.3)***
Postdisaster risk factors			
Watched television repeatedly	86.7	54.5	5.42 (2.43–12.09)***
Perceived influence on life	18.7	9.1	2.30 (0.87–6.06)
	Mean (SD)	Mean (SD)	<i>t</i> -test
Perceived threat	1.83 (1.71)	1.16 (1.37)	2.67**
Emotional support	2.80 (1.72)	2.62 (1.72)	0.63
Outcome variables			
PTSD symptoms	30.31 (9.39)	27.00 (8.24)	2.31*
Somatization symptoms	19.68 (6.94)	18.87 (5.84)	0.43
Anomie	7.29 (3.43)	11.18 (3.51)	6.89***

P* < 0.05, *P* < 0.01, ****P* < 0.001.

Lviv sample watched the television coverage of the event over and over again and reported feeling threatened or horrified by the event (Table 1). The groups were not significantly different with respect to emotional support received after the event or the extent to which they felt that the event had a significant influence on their lives (although twice as many Lviv residents endorsed this item).

Differences in postdisaster mental health

With respect to symptom severity, compared with controls, the Lviv sample had significantly higher PTSD symptom scores, but similar levels of somatization (Table 1). We note, however, that the single item from this scale which corresponds most closely to the Ukrainian and Russian idiom of distress, i.e. ‘do you feel heart pain,’ was significantly different (mean ± SD for Lviv = 1.87 ± 0.96 vs. 1.57 ± 0.70 for controls; *t* = 2.28, *P* < 0.05). Unexpectedly, the controls reported significantly greater anomie than the Lviv sample.

On a diagnostic level, 11 respondents from Lviv (14.7%) compared with no controls had episodes of depression, anxiety, neurasthenia, and/or PTSD during the 6 months following the disaster (chi-square = 12.2; *P* < 0.001). Six of 11 with disorder (54.5%) knew someone who was killed or injured compared with 16 of 64 without postdisaster disorder (25.0%; Fisher’s exact test = n.s.). Four of 11 cases experienced their first lifetime episode during this time, corresponding to an incidence rate of 8.0% (4/50 with no lifetime disorder at wave 1). Two respondents knew someone killed or injured, and two did not. One respondent, from

Lviv, met criteria for heavy alcohol use during the follow-up.

Bivariate relationships between the risk factors and symptomatology

A number of relationships were examined (three outcome variables × nine risk factors × two groups). We thus focus on correlations where *P* < 0.01. Among the predisaster risk factors, only lifetime mental/substance disorder was strongly related to the outcome measures. However, the postdisaster risk factors of perceived influence of the event and perceived threat were strongly associated to both PTSD symptoms and anomie in both groups. Repeatedly watching the disaster on television and social support were only weakly related to the outcome measures. Moreover, secondary analyses showed that when we combined the two sites, repeatedly watching television was significantly related to PTSD symptoms (*P* < 0.05). In the Lviv sample, being at the event or knowing someone who was injured or killed was not significantly related to the outcomes although it was correlated with perceived threat (*r* = 0.36; *P* < 0.01) and emotional support (*r* = 0.30; *P* < 0.01).

Multivariate analyses

The final analysis considered the ability of the pre- and postdisaster risk factors to account for group differences in the outcome measures. Consistent with Table 2, the unadjusted regression coefficients for group (row 1 of Table 3) were significant for PTSD and anomie. A comparison of these

	PTSD symptoms		Somatization		Anomie	
	Lviv	Controls	Lviv	Controls	Lviv	Controls
Predisaster risk factors						
Age	0.26*	-0.22*	0.22	0.04	0.07	-0.10
Sex	0.10	0.16	0.03	0.13	-0.06	-0.05
Education	0.07	0.04	-0.20	-0.17	-0.11	-0.02
Inadequate finances	0.19	-0.07	0.11	0.12	0.19	0.05
Mental or substance disorder	0.27*	0.16	0.18	0.24*	0.23*	0.33**
Disaster risk factor						
Attended event or knew someone killed/injured	-0.00	n/a	-0.05	n/a	0.19	n/a
Postdisaster risk factors						
Watched television repeatedly	0.13	0.17	-0.07	0.03	0.25*	0.00
Perceived influence on life	0.30**	0.39**	-0.02	0.22	0.36***	0.28**
Perceived threat	0.29*	0.54***	0.11	0.45***	0.43***	0.48***
Support	0.08	0.03	-0.16	-0.15	0.14	0.21

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 2. Relationship of background and disaster characteristics to mental health: Pearson correlation coefficients

Group differences	PTSD symptoms		Somatization symptoms		Anomie	
	Beta	r^2	Beta	r^2	Beta	r^2
Unadjusted†	3.31*	0.03	0.81	0.004	-6.89***	0.24
Adjusted for predisaster risk factors†	2.75	0.11	0.46	0.13	-4.51***	0.32
Adjusted for postdisaster risk factors†	1.14	0.23	0.34	-0.09	-4.66***	0.43
Adjusted for all significant risk factors‡	1.21	0.26	-0.06	0.13	-4.85***	0.48

†Unstandardized regression coefficients.

‡Adjusted for mental health history, perceived threat, perceived influence on life, and support.

* $P < 0.05$, *** $P < 0.001$.

Table 3. Accounting for differences between the Lviv and control groups before and after adjusting for pre- and postdisaster risk factors

unadjusted coefficients with the adjusted coefficients that controlled for the predisaster risk factors (row 2 of Table 3) showed that the group difference in PTSD symptom severity was no longer statistically significant, while that for anomie, although reduced in size, was still highly significant. The unadjusted and adjusted regression coefficients for somatization were non-significant. We note that the only predisaster variable that was significantly related to the outcomes in the regression analyses was lifetime disorder ($P < 0.01$ for all three outcome variables; data not shown).

When the multivariate analyses were repeated controlling for the postdisaster risk factors (row 3 of Table 3), the group difference in anomie remained highly significant although it was again reduced substantially compared with the unadjusted coefficient. The adjusted coefficients for PTSD and somatization were not significant. Except for repeatedly watching the television coverage, the other postdisaster risk factors were all significant in most of the models.

The final multivariate models thus adjusted for mental health history, perceived threat, perceived influence of the event, and repeatedly watching television. As shown in Table 3 (row 4), the regression coefficients for group were not significant in the

analysis of PTSD and somatization symptoms, but remained highly significant in the analysis of anomie. Specifically, in the final model for PTSD, the significant predictors were lifetime disorder ($P < 0.02$), perceived threat ($P < 0.001$), and influence on life ($P < 0.02$), but not exposure group. The significant predictors of somatization were lifetime disorder ($P < 0.01$), perceived threat ($P < 0.01$), and emotional support ($P < 0.05$), but not exposure group. In contrast, the significant predictors of anomie included lifetime psychopathology ($P < 0.001$), perceived threat ($P < 0.001$), emotional support ($P < 0.001$), as well as exposure group ($P < 0.001$; controls had greater anomie). We also examined the interaction coefficients for the various pairs of risk factors, and none was significant.

Table 3 also shows that for each outcome, the final adjusted model explained substantially more of the variance than the unadjusted model. For PTSD symptoms, the percentage increased nine-fold. For anomie, the percentage of variance explained doubled. This was due mostly to the postdisaster risk factors. For somatization, the increase was also substantial, due primarily to mental health history assessed before the disaster.

Discussion

This study represents one of the rare opportunities in which baseline data had been collected prior to the occurrence of a community-wide disaster. To our knowledge, it is the first pre–post study to be conducted in a former Soviet Union setting. Previous research after the Chernobyl disaster in Belarus (6, 23), Ukraine (7), and Russia (8) has shown that it is quite feasible to achieve high standards of scientific rigor and reliability of standardized assessments in these settings.

In this study we demonstrated that the Lviv air show disaster had a considerable effect on the severity of post-traumatic stress symptoms in the Lviv sample and on diagnosable psychopathology. The unexpected finding that the degree of anomie was lower in the Lviv sample than in the control group may have resulted from the increased attention given to Lviv after the accident. Two decades ago, Quarantelli (24) postulated that disasters may have positive (e.g. on social coherence) as well as negative effects, but to our knowledge, no earlier study has actually documented any evidence to support this. Thus, our finding on anomie, while extremely interesting, needs to be confirmed by future disaster research.

Even though the Lviv sample was mostly composed of secondary disaster victims, i.e. people indirectly exposed, the postdisaster prevalence rate was close to 15% and the postdisaster incidence rate was 8%. Although not statistically significant, the cases were mostly concentrated in the subgroup of primary disaster victims. These results were remarkably similar to our findings for mothers of young children during the year following the Three Mile Island accident, for whom the 1-year prevalence rate was 14% and the 1-year incidence rate was 11% (25). More importantly, this finding confirms prospectively that the disaster had an influence on diagnosable disorder, which previous prospective reports found to be a trend (12, 13).

In contrast to the findings of Escobar et al. (14), we did not find a significant difference in somatic symptoms. We note that the Lviv group did have slightly higher scores than the controls, but both groups were elevated compared with Western samples (21). However, we did find a significant difference for the item which most appropriately expresses the local idiom of distress ('heart pain'). The most parsimonious explanations for our failure to detect a significant difference in somatic symptom severity overall are the higher base rates, the modest sample size, and perhaps more importantly, the fact that, in contrast to toxic disasters,

the event did not threaten the physical health of the general community (26).

The most important predisaster risk factor was having a history of mental disorder, as has been shown in several other studies (11, 25, 27). The fact that this remained significant in the final model confirms that when identifying at-risk cases after a disaster, e.g. for prevention or early intervention, such individuals should be a primary target, even in non-Western settings. Age was not a risk factor for postdisaster symptomatology although in previous studies, age was a protective factor. Although gender and financial adequacy were significant risk factors for postdisaster mental health in many previous studies (1), they too were not significant in this study.

In contrast, feeling threatened by the event and perceiving it as an occurrence that significantly influenced one's life were the two most significant postdisaster risk factors. This supports the increasing awareness of the importance of risk perception and hazard perception as moderators of postdisaster psychopathology (e.g. 27, 28), although one might argue that perceiving an event as a threat is almost tantamount to an anxiety-related outcome variable, rather than being a risk factor.

An inherent weakness of our study, and indeed all pre–post studies to date, is the modest sample size. This was particularly relevant to our analysis of diagnosable disorders for which we combined several disorders and could not examine disaster risk factors. A second weakness was that follow-up interview took place 6 months after the disaster, i.e. too late to capture immediate stress reaction in the population. Other weaknesses include lack of dimensional symptom data at baseline, potential recall bias of the postdisaster risk factors, and the lack of information on resilience factors.

In conclusion, the community surrounding the Lviv air show disaster had more severe PTSD symptomatology 6 months after the event, but the controls reported a greater sense of anomie in the wake of the disaster. The key risk factors were having a history of mental illness or substance abuse, perceiving the event as threatening, and perceiving it as having a major influence on one's life. Our findings in western Ukraine confirm that persons with a history of mental disorder should be a primary target for research on the effectiveness of early interventions. In light of the debate about the usefulness of early interventions, future research on the effectiveness of such interventions should perhaps focus on this high risk group. With respect to the prevention of mental health consequences of disasters, our findings suggest that the influence of the media may not be readily generalizable across

events and cultural contexts. In the current age of terrorist threat, it may be particularly relevant to seek new ways to mitigate the wider sense of insecurity and anomie that events like these can have on the population at large by focusing more broadly on people's perceptions of these events in addition to addressing their symptomatology.

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