Symptoms and Related Functioning in a Traumatized Community

Bellis van den Berg, MA; Linda Grievink, PhD; Rebecca K. Stellato, MS; C. Joris Yzermans, PhD; Erik Lebret, PhD

Background: Traumatic events are described as precipitating factors for medically unexplained symptoms. The aim of this study was to examine the prevalence and course of symptoms reported by disaster survivors and to assess whether the symptoms have features similar to those of medically unexplained symptoms.

Methods: A 3-wave longitudinal study was performed after an explosion of a fireworks depot. As a result of the explosion, 23 people were killed, more than 900 people were injured, and about 500 homes were damaged or destroyed. Respondents completed a set of validated questionnaires measuring their health problems 3 weeks (wave 1), 18 months (wave 2), and 4 years (wave 3) after the disaster. A comparison group was included at waves 2 and 3.

Results: The study population included 815 survivors who participated in the 3 waves. The mean number of symptoms was higher among survivors compared with control subjects at wave 2 (7.5 vs 5.8 symptoms) and at wave 3 (6.1 vs 4.9 symptoms) ($P<.001$ for both). Survivors and control subjects with more symptoms reported significantly lower mean scores on all scales of the Dutch version of the RAND 36-item health survey. Illness behavior and depression and anxiety were associated with the number of symptoms. For example, more than 60% of survivors with 10 or more symptoms reported depression and anxiety, compared with 2.4% of survivors with 0 to 1 symptoms ($P<.001$).

Conclusions: Up to 4 years after the disaster, symptoms were more prevalent among survivors than controls. Although medical disorders cannot be excluded, the reported symptoms showed several features similar to those of medically unexplained symptoms in the general population.

Arch Intern Med. 2005;165:2402-2407

SYMPTOMS SUCH AS HEADACHE, stomachache, fatigue, and pain in joints or muscles are common in the general population. An estimated 80% of the general population experiences at least 1 of these symptoms in any given month.[1,2] When disclosed to a general practitioner (GP), many symptoms cannot be explained by a medical diagnosis and are considered medically unexplained.[3]

Traumatic events such as natural and man-made disasters are often described in the literature as precipitating factors for elevated levels of unexplained physical symptoms.[4-6] A prospective study[7] of a severe flood in Puerto Rico showed a higher number of new physical symptoms among survivors compared with control subjects 1 year after the flood. After disasters, survivors may attribute physical symptoms to suspected exposure to toxic substances, which can lead to amplification of health problems.[8] After an airplane crash in Amsterdam, the Netherlands, many survivors attributed their physical symptoms to the harmful effect of substances from the wreck or cargo such as depleted uranium.[9] Donker et al[10] reported that GPs could not associate most of these symptoms with a medical disorder.

Medically unexplained symptoms (MUS) are seldom studied in the aftermath of disasters.[6] Instead, the literature on traumatic events focuses on mental health problems such as posttraumatic stress disorder, depression, and anxiety. Almost all disaster investigations that examined physical symptoms used questionnaires.[6] Only examination by a physician can rule out an underlying medical explanation for reported symptoms; this is one of the difficulties of studying MUS by means of a questionnaire.[11] To get more insight into the similarities between MUS observed in medical practice and the physical symptoms reported on questionnaires, other characteristics of MUS have to be considered. In the general population, features associated with MUS are functional impairment and increased ill-

Author Affiliations: National Institute for Public Health and the Environment, Bilthoven (Mss van den Berg and Stellato and Drs Grievink and Lebret), and Institute of Risk Assessment Sciences, Utrecht University (Ms van den Berg), and Institute for Health Services Research (Dr Yzermans), Utrecht, the Netherlands.

ness behavior such as sick leave, health care, and medication use.[12-14] In addition, studies[13,14] have shown that patients with MUS have more comorbid psychiatric disorders, especially major depression and anxiety disorder.

To better understand the physical symptoms after disasters and their similarities with MUS in the general population, we explored the data of a longitudinal study[15] that was performed after a man-made fireworks disaster. The following research questions were addressed: (1) What is the course of symptoms over time among survivors of the fireworks disaster? (2) Are symptoms more prevalent among survivors compared with controls? (3) Do the symptoms reported by survivors and controls have features similar to those of MUS in the general population, such as functional impairment, increased illness behavior, and psychological symptoms?

METHODS

PARTICIPANTS AND PROCEDURE

As a result of the explosion of a fireworks depot in a residential area in Enschede, the Netherlands, on May 13, 2000, and the subsequent fire, 23 persons were killed, more than 900 people were injured, and about 500 homes were severely damaged or destroyed. The Dutch government declared this a national disaster and began a longitudinal study of the health consequences of the disaster. An initial survey (wave 1) was commenced 3 weeks after the disaster. On the basis of the list of addresses at the registry office of Enschede, it was confirmed that the total affected group consisted of 4456 adult residents. All adult residents were invited to participate. Data collection took place at an air force base close to Enschede. In total, 1567 survivors (response rate, 35.2%) completed a questionnaire (**Figure**).

Approximately 18 months after the disaster, in November 2001, a second survey (wave 2) was conducted. All wave 1 participants who had given informed consent for future contact received an announcement letter. In addition, a sample of 1600 residents was drawn from the registry office at Tilburg, the Netherlands, to serve as a control group. Tilburg was comparable to the affected area in Enschede with regard to the composition of the population and their general health status. The control sample was stratified according to sex, age, and country of origin to make it comparable to the survivors from wave 1.

To stimulate participation, survivors and controls were telephoned at home after the announcement letter was sent. If a respondent agreed to participate, a questionnaire was sent to his or her home address in the preferred language (Dutch, German, English, or Turkish). Interpreters were available at a community center to assist in completing the questionnaires. In total, 1116 of 1551 survivors (response rate, 72.0%) and 821 controls (response rate, 51.3%) completed a questionnaire at wave 2.

In January 2004, almost 4 years after the disaster, a third survey (wave 3) was taken. Except for participants who were lost to follow-up because we were unable to locate them, all participants of wave 1 who had given written informed consent for future contact received an announcement letter. In the control group, only a small proportion of immigrants (immigrants were defined as respondents who were born in a foreign country of whom at least 1 parent was also born in a foreign country or respondents whose parents were both born in a foreign country) had agreed on the informed consent form to be contacted again. To avoid differences between the 2 groups, 184 immigrants in the original sample who did not participate in the first control survey also received an announcement letter.

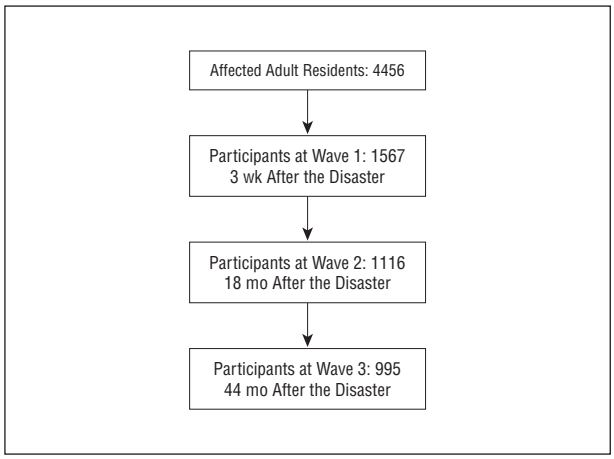

Figure. Flowchart of the study. Sixteen of 1567 participants at wave 1 were lost to follow-up at wave 2, and 51 of 1567 were lost to follow-up at wave 3.

Participation was stimulated by means of home visits and telephone calls. If a respondent agreed to participate, a questionnaire in his or her preferred language was sent or hand delivered. As at wave 2, interpreters were available at the community center to assist in completing the questionnaires. In total, 995 of 1516 survivors (response rate, 65.6%), 587 of the 793 controls who were lost to follow-up (response rate, 74.0%), and 53 of 184 immigrants (response rate, 28.8%) completed a questionnaire at wave 3. Details of the study population, participation, and procedures in the 3 waves have been described elsewhere.[15-19] In this article, we describe 815 survivors who participated in the 3 surveys vs 821 controls at wave 2 and 640 controls at wave 3. The survivors and the control groups were similar in demographic characteristics.[18,19]

MEASURES

The questionnaires were comparable in the 3 surveys for the survivors and in the 2 surveys for the controls. The questionnaires primarily included scales that had been previously validated in the Dutch population, as described in the next subsections.

SYMPTOMS

At wave 1, symptoms were measured by the 13-item Vragenlijst voor Onderzoek naar de Ervaren Gezondheid (VOEG) (Questionnaire into Subjective Health Complaints) scale, a validated questionnaire that has often been used for studies in the Dutch population.[20] The items of this scale ask respondents whether they regularly have symptoms such as stomachache, fatigue, pain in the region of the heart or chest, and pain in the bones and muscles. At the second and third waves, 12 symptoms were added to the questionnaire.

While most symptoms were asked about only once, gastrointestinal and fatigue symptoms were asked about in 3 different ways. In the analysis, these were treated as 1 gastrointestinal symptom and 1 fatigue symptom to avoid giving these 2 symptoms more weight compared with the other symptoms. Therefore, 21 different symptoms were used for the analyses of the symptoms at waves 2 and 3 (**Table 1**).

FUNCTIONAL STATUS

Participants completed the validated Dutch version of the RAND 36-item health survey (RAND-36).[21] This questionnaire com-

Table 1. Prevalence of 21 Symptoms Among Survivors and Control Subjects at Wave 2 and Wave 3*

Symptom	Wave 2			Wave 3		
	Survivors (n = 815)	Controls (n = 821)	OR (95% CI)	Survivors (n = 815)	Controls (n = 640)	OR (95% CI)
Listlessness	48.6	25.5	2.8 (2.2-3.4)	37.9	21.9	2.2 (1.7-2.8)
Fatigue	70.1	49.9	2.4 (1.9-2.9)	61.1	44.2	2.0 (1.6-2.5)
Forgetfulness	46.0	29.2	2.1 (1.7-2.5)	38.2	24.3	1.9 (1.5-2.4)
Ringing in the ears	25.6	16.1	1.8 (1.4-2.3)	20.8	13.8	1.6 (1.2-2.2)
Pain in the chest and the region of the heart	26.4	17.5	1.7 (1.3-2.2)	18.7	17.8	1.1 (0.8-1.4)
Lump in the throat	14.9	9.9	1.6 (1.2-2.2)	11.3	5.6	2.1 (1.4-3.2)
Stomachache	45.6	34.2	1.6 (1.3-2.0)	36.4	31.6	1.2 (1.0-1.6)
Pain in the bones and muscles	52.9	42.4	1.5 (1.3-1.9)	43.8	37.1	1.3 (1.1-1.6)
Nausea	19.3	13.7	1.5 (1.2-2.0)	12.7	11.3	1.1 (0.8-1.6)
Dizziness	27.8	20.9	1.5 (1.2-1.8)	22.9	16.0	1.6 (1.2-2.0)
Pain in the neck and shoulders	56.9	48.0	1.4 (1.2-1.7)	50.6	41.7	1.4 (1.2-1.8)
Cold fingers, hands, and feet	43.0	34.4	1.4 (1.2-1.8)	35.9	32.8	1.1 (0.9-1.4)
Excessive sweating	29.2	22.7	1.4 (1.1-1.8)	21.8	16.1	1.5 (1.1-1.9)
Pain in the back	49.2	41.6	1.4 (1.1-1.7)	45.6	39.1	1.3 (1.1-1.6)
Headache	46.7	39.0	1.4 (1.1-1.7)	39.3	30.4	1.5 (1.2-1.9)
Deafness	19.4	15.3	1.3 (1.0-1.7)	17.5	13.4	1.4 (1.0-1.9)
Tight feeling in the chest	24.0	20.3	1.3 (1.0-1.6)	19.5	16.2	1.3 (1.0-1.7)
Tingling in the arms and legs	38.1	32.4	1.3 (1.0-1.6)	32.3	25.6	1.4 (1.1-1.8)
Poor vision	25.9	22.0	1.2 (1.0-1.6)	20.6	18.6	1.1 (0.9-1.5)
Shortness of breath	33.3	28.8	1.2 (1.0-1.5)	24.6	21.1	1.2 (1.0-1.6)
Fainting	17.0	20.7	0.8 (0.6-1.0)	15.4	12.7	1.2 (0.9-1.7)

Abbreviations: CI, confidence interval; OR, odds ratio.
*Data are given as percentages unless otherwise indicated.

prises the 9 scales of Physical Functioning, Social Functioning, Physical Role Limitations, Emotional Role Limitations, Mental Health, Vitality, Bodily Pain, General Health Perceptions, and Change in Health. All scales were scored from 0 to 100, with higher scores indicating better health.

ILLNESS BEHAVIOR

Participants were asked whether they were currently on sick leave and whether they were currently receiving disability benefits. Participants were asked about their use of any prescription medication from a GP. In addition, participants were asked about the number of visits to their GP in the past 2 months, a period that was chosen to avoid recall bias. The number of visits in the past year was estimated using the 2 months' figures.

PSYCHOLOGICAL SYMPTOMS

Depression and anxiety were measured by the Dutch version of the Symptom Checklist 90.[22] Responses were based on a 5-point Likert scale and assessed the degree of depression and anxiety during the past week.

STATISTICAL ANALYSIS

t Tests were used to test differences in the mean numbers of symptoms reported by survivors at the 3 waves. The prevalences of symptoms among survivors and controls were compared by calculating crude odds ratios and 95% confidence intervals.

To evaluate the associations among the number of symptoms and functional status, illness behavior, and psychological problems, we added the 21 symptoms together and, using cutoff values, categorized the totals into 4 ranges. The cutoffs were based on the distribution of the symptoms reported by the control group at wave 2 and on cutoffs that were previously used for other scales, such as the Symptom Checklist 90.[22] The first range was 0 to 1 symptoms, the second was 2 to 9 symptoms, the third was 10 to 14 symptoms (80th percentile), and the fourth was 15 or more symptoms (95th percentile).

Scores on the depression and anxiety subscales of the Symptom Checklist 90 were dichotomized using the sex-specific normal values for the healthy Dutch population. According to these tables, 20% of the Dutch population scores "high" to "extremely high" on the subscales.[22]

Analysis of variance and χ^2 tests were used to evaluate the associations among the 4 symptom ranges and the 9 scales of the RAND-36, illness behavior, depression, and anxiety. Logistic regression analyses were used to calculate group effects for illness behavior, depression, and anxiety. To determine whether chronic diseases and associated symptoms affected the results, the analyses were repeated for survivors (361 at wave 2 and 402 at wave 3) and for controls (435 at wave 2 and 341 at wave 3) without self-reported chronic diseases.

RESULTS

SYMPTOMS OVER TIME

Three weeks after the disaster, survivors reported a mean±SD number of 5.6±3.3 symptoms on the 13-item VOEG scale. Eighteen months after the disaster, the mean±SD number of symptoms on this 13-item scale was comparable (5.5±3.7 symptoms). Almost 4 years after the disaster, the mean±SD number of symptoms had decreased significantly (4.6±3.6). On the 21-item scale of symptoms, survivors reported a mean±SD of 7.5±4.9 symptoms at wave 2, which was significantly higher than that at wave 3 (6.1±4.7 symptoms).

Table 2. Association Between the Number of Symptoms and Functional Impairment at Wave 2 for Survivors and Control Subjects*

RAND-36 Scale	No. of Symptoms†			
	0-1	2-9	10-14	≥15
Physical Functioning				
Survivors	97.0	86.0	67.5	53.4
Controls	95.2	83.9	64.0	55.0
Social Functioning‡				
Survivors	94.5	80.9	58.5	41.7
Controls	94.7	84.2	67.5	52.6
Physical Role Limitations‡				
Survivors	95.2	73.0	41.8	19.9
Controls	96.2	80.3	54.2	26.5
Emotional Role Limitations‡				
Survivors	96.4	76.1	47.3	24.0
Controls	97.4	86.6	59.1	32.3
Mental Health‡				
Survivors	84.9	72.2	52.1	40.5
Controls	85.2	77.1	59.0	49.1
Vitality‡				
Survivors	75.2	60.3	40.8	31.3
Controls	79.6	66.5	44.6	39.9
Bodily Pain				
Survivors	92.8	79.2	58.6	39.7
Controls	94.2	78.9	62.7	49.7
General Health Perceptions				
Survivors	82.7	67.6	46.1	31.4
Controls	81.7	68.6	47.0	36.6
Change in Health				
Survivors	57.6	53.3	42.9	28.9
Controls	54.1	51.1	46.0	37.2

*Data are given as mean scores on the RAND 36-item health survey (RAND-36) (score range, 0 [poor health] to 100 [good health]). $P<.001$ for all comparisons across rows.

†The numbers of survivors and control subjects are as follows: *0 to 1 symptoms*, 86 survivors (11.0%) and 134 controls (16.8%); *2 to 9 symptoms*, 436 survivors (55.8%) and 499 controls (62.6%); *10 to 14 symptoms*, 181 survivors (23.1%) and 121 controls (15.2%); and *15 or more symptoms*, 79 survivors (10.1%) and 43 controls (5.4%). To categorize the number of symptoms, we added the 21 symptoms together and subsequently divided this scale into 4 categories. Survivors who had 2 or more items on the 21-symptom scale missing were excluded from the analyses involving the associations among the 4 symptom ranges and the 9 scales of the RAND-36, illness behavior, depression, and anxiety.

‡Mean score of control subjects greater than that of survivors, $P<.001$.

Table 3. Association Between the Number of Symptoms and Increased Illness Behavior at Wave 2 for Survivors and Control Subjects*

Behavior	No. of Symptoms†			
	0-1	2-9	10-14	≥15
Currently on sick leave				
Survivors	1.3	7.2	20.0	31.0
Controls	1.8	5.9	14.4	18.5
Currently receiving disability benefits				
Survivors	1.2	3.8	18.9	28.4
Controls	<1.0	4.5	14.7	30.0
Painkiller use				
Survivors	6.0	17.5	37.7	62.5
Controls	4.6	19.7	37.7	51.3
Sedative use‡				
Survivors	3.6	7.0	24.2	41.2
Controls	<1.0	3.5	23.2	31.6
Visits to general practitioner in the past year, mean No.				
Survivors	2.6	7.3	12.5	17.5
Controls	3.1	6.6	14.1	18.4

*Data are given as percentages unless otherwise indicated. $P<.001$ for all comparisons across rows.

†The numbers of survivors and control subjects are the same as in Table 2.

‡Percentage of survivors greater than that of control subjects, $P<.05$.

SYMPTOMS AMONG SURVIVORS AND CONTROLS

Symptoms were prevalent among survivors and controls. However, 18 months after the disaster, the mean number of symptoms was higher among survivors than controls (7.5 vs 5.8; $P<.001$, t test). Fifteen of 21 symptoms were significantly more prevalent among survivors (Table 1). The most prevalent symptoms were similar among survivors and controls, with higher prevalence rates among survivors for fatigue (70.1% vs 49.9%), pain in the neck and shoulders (56.9% vs 48.0%), and pain in the bones and muscles (52.9% vs 42.4%).

At wave 3, survivors reported a mean number of 6.1 symptoms, which was higher than the mean number of 4.9 symptoms among controls ($P<.001$). Twelve of the 21 symptoms were significantly more prevalent among survivors. The most prevalent symptoms were similar among survivors and controls, with higher prevalence rates among survivors.

At wave 2, 33.3% of survivors reported 10 or more symptoms compared with 20.6% of controls ($P<.001$, χ^2 test). At wave 3, the proportion of survivors who reported 10 or more symptoms was still higher than among controls (26.2% vs 17.7%; $P<.001$, χ^2 test).

ASSOCIATED FEATURES

The symptoms reported at wave 2 were associated with functional impairment. With increasing numbers of symptoms, the mean scores of all 9 scales of the RAND-36 decreased considerably for survivors and controls. Despite reporting the same number of symptoms, survivors had significantly lower mean scores than controls on 5 of the 9 scales of the RAND-36 (**Table 2**).

In **Table 3**, the association between symptoms at wave 2 and increased illness behavior is summarized. Among survivors and controls, a higher number of symptoms was associated with a higher proportion of participants currently on sick leave. For both groups, having more symptoms was associated with receiving disability benefits. Moreover, the use of medication increased significantly with an increasing number of symptoms, with a stronger association among survivors for the use of sedatives. The number of symptoms was also associated with health care use. For the survivors and controls, the mean number of visits to the GP increased from 3.1 visits a year for those with 0 to 1 symptoms to 18.4 visits a year for those with 15 or more symptoms.

Table 4. Association Between the Number of Symptoms and the Prevalence of Depression and Anxiety at Wave 2 Among Survivors and Control Subjects*

Variable	No. of Symptoms†			
	0-1	2-9	10-14	≥15
Depression‡				
Survivors	2.4	19.4	68.4	89.0
Controls	6.2	17.3	52.1	71.4
Anxiety§				
Survivors	2.4	16.1	62.3	86.7
Controls	2.3	6.7	41.2	59.5

*Data are given as percentages. $P<.001$ for all comparisons across rows.
†The numbers of survivors and control subjects are the same as in Table 2.
‡Percentage of survivors greater than that of control subjects, $P<.05$.
§Percentage of survivors greater than that of control subjects, $P<.001$.

Participants reporting more symptoms had significantly more depression and anxiety (**Table 4**). This association was stronger for survivors. Compared with controls, survivors with 10 or more symptoms had high scores 1.3 times more often on the depression subscale and 1.5 times more often on the anxiety subscale. Exclusion of respondents with chronic diseases did not change the odds ratios or any of the associations (data not shown).

COMMENT

In contrast to many studies in the aftermath of disasters, this study focused on physical symptoms among survivors rather than on mental health problems. Symptoms were more common among survivors compared with controls. Eighteen months after the disaster, 33.3% of survivors reported 10 or more symptoms compared with 20.6% of controls. Although the results showed a gradual decrease in the number of symptoms, survivors reported significantly more symptoms than controls 4 years after the disaster.

Despite the elevated number of symptoms among survivors, no theories about possible exposure to toxic substances developed in the aftermath of the fireworks disaster. The absence of such a theory might be explained by the reassuring results of the blood and urine samples that were obtained 3 weeks after the disaster, in which no elevated body burden was detected.[16]

Symptoms in this study were similar to MUS in the general population.[12-14] With increasing numbers of symptoms, we found a decrement of 10 points or more among the scores on the 9 scales of the RAND-36. This decrement is similar to that seen with chronic disorders such as arthritis, diabetes mellitus, and gastrointestinal disorders,[23] as well as with MUS observed in general population studies.[12,13] Respondents with increasing numbers of symptoms also reported increased use of sick leave, health care, and medications.

The symptoms in this study were strongly associated with depression and anxiety, which is also similar to MUS in the general population.[13,14] The association was stronger for survivors than controls, despite their reporting the same number of symptoms. This effect was also found for 5 of the 9 scales of the RAND-36 and for the use of sedatives. These stronger effects among survivors may reflect the higher level of distress due to the traumatic event. They might also suggest worse severity of symptoms in the survivor group, which was not measured in our study.

Because only 35.2% of all affected residents participated in the first wave of the survey, participation may have been biased toward those with or without health problems. Shortly after the disaster, all affected adult residents registered at an information and advice center that was established to supply information to survivors and to coordinate their needs. To detect possible selection bias, the database of the information and advice center was used to compare demographic characteristics of the participants with those of the nonparticipants. The analysis showed that participation was somewhat biased. Fewer men and fewer younger (18-24 years) and older (≥65 years) residents but more immigrants participated at the first wave.[17,24] To study the magnitude of the selection bias, analyses of multiple imputations were used to fill in missing data of nonparticipants. The prevalence estimates of postdisaster health problems were unaffected (L.G., unpublished data, June 2005). At wave 2, fewer men, fewer younger survivors, and fewer survivors with more health problems at wave 1 participated. Despite this selection bias, no significant differences in the estimated prevalence rates of health problems were observed after multiple imputations.[18,25] Analyses indicate that the effect of the selection bias on the outcomes of interest was limited. Although the prevalence rates of symptoms among controls decreased between wave 2 and wave 3, additional analysis showed that this was not the result of nonparticipation at wave 2 among controls with high symptom levels.

As in most disaster studies, physical symptoms were based on self-reporting rather than physical examination; therefore, we could not assess the presence of medical disorders. However, excluding the respondents with self-reported chronic diseases did not affect our results. In addition, analyses of the blood and urine samples demonstrated no elevated body burden due to the fireworks disaster.[16] This makes it unlikely that the higher prevalence of symptoms among survivors is the result of exposure to toxic substances. In addition, many survivors and controls reported 10 or more symptoms in different organ systems, making it unlikely that all of these symptoms were the result of a medical disorder or toxic exposure. The study[9] of the airplane crash in Amsterdam confirmed that GPs associated only 40% of reported symptoms with a medical diagnosis, leaving 60% unexplained. The reported symptoms in this study show many similarities with MUS. Therefore, the term *medically unexplained symptoms* may be used to refer to symptoms that are common, persistent, and related to functional impairment, increased illness behavior, and comorbid psychological symptoms.

Because only a few disaster studies have focused on MUS, little is known about the contribution of precipitating factors, such as damage to house and property, and perpetuating factors, such as lack of social support and

mental health problems, to the development and persistence of MUS after disasters.[6] Because knowledge of these factors may facilitate detection of vulnerable individuals and optimize care delivery by clinicians after a disaster, future studies should focus on factors that might be responsible for MUS among survivors of disasters.

Accepted for Publication: July 14, 2005.
Correspondence: Bellis van den Berg, MA, National Institute for Public Health and the Environment, PO Box 1, Postbox 10, 3720 BA Bilthoven, the Netherlands (bellis.van.den.berg@rivm.nl).
Financial Disclosure: None.
Additional Information: This longitudinal study was part of the Enschede Firework Disaster Health Monitoring Project and was performed under the authority of the Ministry of Health, Welfare, and Sport in the Netherlands. Several research institutes cooperated in this study, including the National Institute for Public Health and the Environment, the Institute for Psychotrauma, the Netherlands Institute for Health Services Research, and the Department of Youth Health Care of the Regional Health Authority (Gemeentelijke Gezondheids Dienst) Regio Twente. For the comparison group in Tilburg, the Regional Health Authority "Hart voor Brabant" was involved.
Acknowledgment: We thank Hendriek Boshuizen, PhD, for her statistical advice and Peter Van der Velden, PhD, for his critical review of the manuscript.

REFERENCES

1. Green LA, Fryer GE, Yawn BP, Lanier D, Dovey SM. The ecology of medical care revisited. *N Engl J Med*. 2001;344:2021-2025.
2. Kroenke K, Arrington ME, Mangelsdorff AD. The prevalence of symptoms in medical outpatients and the adequacy of therapy. *Arch Intern Med*. 1990;150:1685-1689.
3. Kroenke K. Patients presenting with somatic complaints: epidemiology, psychiatric comorbidity and management. *Int J Methods Psychiatr Res*. 2003;12:34-43.
4. Yzermans CJ, Donker GA, Kerssens JJ, Dirkzwager AJ, Soeteman RJ, ten Veen PM. Health problems of victims before and after disaster: a longitudinal study in general practice. *Int J Epidemiol*. 2005;34:820-826 15860632.
5. Engel CC. Somatization and multiple idiopathic physical symptoms: relationship to traumatic events and posttraumatic stress disorder. In: Schnurr PP, Green BL, eds. *Trauma and Health: Physical Health Consequences of Exposure to Extreme Stress*. Washington, DC: American Psychological Association; 2003:191-215.
6. Van den Berg B, Grievink L, Yzermans J, Lebret E. Medically unexplained physical symptoms in the aftermath of disasters. *Epidemiol Rev*. 2005;27:92-106.
7. Escobar JI, Canino G, Rubio-Stipec M, Bravo M. Somatic symptoms after a natural disaster: a prospective study. *Am J Psychiatry*. 1992;149:965-967.
8. Engel CC Jr, Adkins JA, Cowan DN. Caring for medically unexplained physical symptoms after toxic environmental exposures: effects of contested causation. *Environ Health Perspect*. 2002;110(suppl):641-647.
9. Yzermans CJ, Gersons BPR. The chaotic aftermath of an airplane crash in Amsterdam. In: Havenaar JM, Cwikel JG, Bromet EJ, eds. *Toxic Turmoil: Psychological and Societal Consequences of Ecological Disasters*. New York, NY: Kluwer Academic/Plenum Publishers; 2002:85-99.
10. Donker GA, Yzermans CJ, Spreeuwenberg P, van der Zee J. Symptom attribution after a plane crash: comparisons between self-reported symptoms and GP records. *Br J Gen Pract*. 2002;52:917-922.
11. North CS. Somatization in survivors of catastrophic trauma: a methodological review. *Environ Health Perspect*. 2002;110(suppl 4):637-640.
12. Kroenke K, Spitzer RL, deGruy FV, et al. Multisomatoform disorder: an alternative to undifferentiated somatoform disorder for the somatizing patient in primary care. *Arch Gen Psychiatry*. 1997;54:352-358.
13. Feder A, Olfson M, Gameroff M, et al. Medically unexplained symptoms in an urban general medicine practice. *Psychosomatics*. 2001;42:261-268.
14. Katon W, Sullivan M, Walker E. Medical symptoms without identified pathology: relationship to psychiatric disorders, childhood and adult trauma, and personality traits. *Ann Intern Med*. 2001;134:917-925.
15. Roorda J, van Stiphout WA, Huijsman-Rubingh RR. Post-disaster health effects: strategies for investigation and data collection: experiences from the Enschede firework disaster [published correction appears in *J Epidemiol Community Health*. 2005;59:251]. *J Epidemiol Community Health*. 2004;58:982-987.
16. RIVM Project Team. *Firework Disaster Enschede: Components in Blood and Urine* [in Dutch]. Bilthoven, the Netherlands: National Institute for Public Health and the Environment; 2001.
17. Van Kamp I, Van der Velden PG, Stellato RK, et al. Physical and mental health shortly after a disaster: first results from the Enschede firework disaster study. *Eur J Public Health* [serial online]. 2005:doi:10.1093/europub/cki188. Available at: http://eurpub.oxfordjournals.org/cgi/content/abstract/cki188?ijkey=u5eaOFFm1YLzqfG&keytype=ref. Accessed July 20, 2005.
18. Dijkema MB, Grievink L, Stellato RK, Roorda J. Determinants of response in a longitudinal health study following the firework-disaster in Enschede, the Netherlands. *Eur J Epidemiol*. In press.
19. Grievink L, Van der Velden PG, Christiaanse B, et al. *Firework Disaster Enschede: Health of Survivors Four Years After the Disaster* [in Dutch]. Bilthoven/Zaltbommel, the Netherlands: National Institute for Public Health and the Environment/Institute for Psychotrauma; 2004:1-B52.
20. Van Sonsbeek LJA. *The VOEG: List With Complaints or Instrument for Health Problems* [in Dutch]? Heerlen/The Hague, the Netherlands: Dutch Office for Statistics; 1990.
21. Van der Zee KI, Sanderman R. *Measuring General Health With the RAND-36: A Manual: Dutch Version*. Groningen, the Netherlands: Noordelijk Centrum voor Gezondheidsvraagstukken; 1993.
22. Arrindell WA, Ettema JHM. *SCL-90: Manual for a Multidimensional Psychopathology Indicator: Dutch Version*. Lisse, the Netherlands: Swets & Zeitlinger; 1986.
23. Stewart AL, Greenfield S, Hays RD, et al. Functional status and well-being of patients with chronic conditions: results from the Medical Outcomes Study. *JAMA*. 1989;262:907-913.
24. Den Boer JM, Claessens MJ, Roorda J. *(Non)-response Research for the Enschede Fireworks Disaster Health Survey* [in Dutch]. Arnhem/Enschede, the Netherlands: Reinoud Adviesgroep/Regional Health Authority "GGD Regio Twente"; 2001:1-44.
25. Stellato R, Grievink L, Lebret E. Effects of dropout and item nonresponse in the follow-up of the victims of the Enschede firework disaster [abstract]. *Epidemiology*. 2003;14:S108.