Predictors of Fatigue in Rescue Workers and Residents in the Aftermath of an Aviation Disaster: A Longitudinal Study

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Objectives: Although medically unexplained physical symptoms such as fatigue are frequently observed after exposure to trauma, the vast majority of health outcomes studies in trauma and disaster research relates to the psychological and psychiatric problems met by victims. The objectives of this study were to investigate the prevalence of (persistent) fatigue in the aftermath of a disaster and to analyze the predictive value of sociodemographic and various health-related variables for fatigue among both rescue workers and residents. **Methods:** A total of 1951 rescue workers and 753 residents involved in the Bijlmermeer aviation disaster participated in this study. Follow-up data were gathered in 70% of randomly selected rescue workers and 53% of the residents. Multiple regression analyses, multivariate logistic regression analyses, and crosslagged panel analyses examined sociodemographic variables and self-report measures for psychopathology, posttraumatic stress reactions, quality of life, somatosensory amplification, health anxiety, and tendency to be reassured by a physician as predictors of fatigue at baseline and fatigue from baseline to 13 to 28 months follow up. **Results:** Elevated levels of fatigue are common after involvement in a disaster in rescue workers (20.6%) and residents (45.4%). Higher levels of psychopathology, lower quality of life, and the tendency to be less reassured were multivariate predictors of both elevated and persistent fatigue. Tendency to be reassured was the most important causal factor for fatigue. **Conclusions:** These results suggest that early identification, adequate reassurance, and treatment of individuals at risk may be worthwhile to prevent chronic fatigue. **Key words:** disaster, trauma, fatigue, psychopathology, quality of life, health anxiety.

MUPS = medically unexplained physical symptoms; **CFS** = chronic fatigue syndrome; **MOVB** = Medisch Onderzoek Vliegramp Bijlmermeer (Medical Investigation Bijlmermeer Aviation Disaster); **ESADA** = Epidemiological Study Air Disaster Amsterdam; **CIS: Fa** = Checklist Individual Strength; Fatigue; **GHQ** = General Health Questionnaire; **IES** = Impact of Event Scale; **EQ-5D** = EuroQol-5 Dimensions; **SAS** = Somatosensory Amplification Scale; **IAS: HA** = Health Anxiety subscale of the Illness Attitude Scale; **RQ** = Reassurance Questionnaire.

INTRODUCTION

Somatic symptoms are the leading cause of outpatient medical visits. At least 33% of somatic symptoms are medically unexplained (1). Medically unexplained physical symptoms (MUPS) constitute an important public health problem that is associated with considerable personal suffering, loss of productivity, and decreased quality of life (2). Many patients present with individual somatic symptoms such as back pain, headache, dizziness, and dyspnea. However, others present functional syndromes characterized by constellations of somatic symptoms such as chronic fatigue syndrome (CFS). Fatiguing illnesses, including CFS, are unlikely to be caused or maintained by a single factor, but can be better conceived as multifactorial disorders with several etiologic and maintaining factors interacting (3).

Some studies have yielded evidence that abusive victimization in childhood may induce vulnerability for later onset of fatiguing illnesses (4). In addition, interest in the incidence and perpetuation of fatigue after trauma exposure in adult life has been growing after the observation that an unexpectedly high number of Gulf War veterans reported medical conditions of uncertain etiology (i.e., fatigue, bronchitis, and asthma) (5). There is a dearth of studies into the prevalence of MUPS after trauma exposure because most trauma and disaster research only investigates the psychological and psychiatric problems (such as posttraumatic stress, anxiety, and depressive symptoms). Moreover, most studies only involved the direct victims of disasters, and remarkably few studies have addressed the possible health consequences for rescue workers involved in the aftermath of disasters (6,7).

Also, little is known about factors that could account for a relationship of trauma with MUPS. It has been proposed that a distinction should be drawn among MUPS that are: a) the physiological components of anxiety and depression (presenting somatization), or b) normal bodily sensations or minor pathologic events that are misinterpreted as signs of serious illness (hypochondriac somatization) (8). Because anxiety and depression are common sequelae of experiencing trauma, the association of trauma with MUPS could be the result of the presence of these affective complaints. Moreover, MUPS after either documented environmental toxicity or rumors of such exposure may result in attributing normal and benign physical symptoms to an external, physical cause among civilian (9) or military victims (5) (see (10) for a review).

On October 4, 1992, an El-Al Boeing 747-F cargo aeroplane crashed into two apartment buildings in a densely populated suburb, the Bijlmermeer district of Amsterdam, The Netherlands. Forty-three people were killed and 266 apartments were destroyed. In the first period after the crash, 1992 to 1995, the emphasis in public information, media coverage, aftercare, and monitoring was on the mental health effects. In the second period, 1995 to 1999, more attention was paid to possible physical health effects, because rumors and questions arose about the cause of the accident, the contents of the cargo, and possible acute and future health risks. Gradually, an increasing number of rescue workers and residents attributed physical signs and symptoms to their presence at the disaster scene and exposure to (potentially) toxic substances (11). Moreover, there was a great sense of distrust, because the government was accused of withholding vital information about the cargo, and in 1998, a Parliamentary Inquiry was held to learn lessons for the future. One of the recommendations of

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the parliamentary commission was to conduct a medical examination for the benefit of people who were still experiencing the consequences of the disaster (Medisch Onderzoek Vliegramp Bijlmermeer [MOVB] study).

The MOVB study provided a welcome opportunity to investigate the prevalence of (persistent) fatigue in the aftermath of a manmade disaster and to analyze cross-sectionally and longitudinally the predictive value of sociodemographic, trauma- and health-related variables for fatigue among both rescue workers and residents. More specifically, the MOVB study allowed us to study whether (persistent) fatigue primarily constitutes a form of presenting or hypochondriac somatization.

METHODS

Design and Participants

The MOVB consisted of an individual medical examination and an epidemiologic study among residents and rescue workers (i.e., police officers, firefighters, and accident and wreckage investigators) investigating the association of exposure to the disaster and subjective and objective health effects (Epidemiological Study Air Disaster Amsterdam [ESADA] study) (12). Participants in both epidemiologic studies were selected by the researchers and invited to participate to compose representative groups, whereas every rescue worker or resident being of the opinion that they were in some way involved in the disaster could apply for the individual medical examination. As a consequence, a substantial number of involved subjects from the epidemiologic study also volunteered for the individual medical examination. The baseline measurements of the present study were collected between December 4, 2000 (11 months after the start of the MOVB study in January 2000) and March 12, 2002. Although the epidemiologic study among residents was canceled in June 2001, because in particular no representative groups of noninvolved residents could be collected, data of involved residents were retained for further analysis in the present study. The follow-up measurement took place in April 2003, 13 to 28 months later, depending on the moment of inclusion in the study.

For the present study, only subjects who were occupationally or personally involved in the disaster were included: a) residents from the epidemiologic study, who were living in the area in the Bijlmermeer district affected by the plane crash; b) residents who volunteered for the individual medical examination; c) rescue workers from the epidemiologic study who were professionally involved in the disaster; and d) rescue workers who volunteered for the individual medical examination. Because 11.7% of the residents and 30.6% of the rescue workers participated in both the epidemiologic study and the individual medical examination, data were collapsed among studies for rescue workers and residents separately.

For the purpose of the present study, the following two measurements were selected: a baseline measurement before the medical examination and a follow-up measurement after 13 to 28 months. All residents who completed the baseline assessment were also invited to complete the follow-up assessment. Because of the relatively large sample size, only a randomly selected subgroup of rescue workers who completed the baseline assessment was also invited to complete the follow-up assessment.

Instruments

Fatigue severity was assessed by the eight-item subscale of the Checklist Individual Strength (CIS) (13), which asks about fatigue in the 2 weeks before the assessment. The CIS has good reliability and discriminative validity. Based on scores of healthy controls, a score between 27 (mean score for healthy adults plus 1 standard deviation) and 35 indicates heightened experience of fatigue (14). Based on research in patients with CFS, a score of 35 or higher indicates severe feelings of fatigue (13).

To measure the general level of psychopathology, a short (Dutch) version of the 12-item General Health Questionnaire (GHQ) (15) was used. Of note is that the 12-item version of the GHQ does not contain any question concerning the experience of fatigue. We used the population-based cutoff score of 1/2 to define a GHQ case.

Posttraumatic stress complaints with explicit reference to the air disaster in Amsterdam were investigated with a Dutch version of the 15-item Impact of Event Scale (IES) (16), which measures both experiences of intrusion and avoidance. A score of 26 or higher gives a strong indication for the presence of posttraumatic stress problems.

Health-related quality of life was measured with the EuroQol-5 Dimensions (EQ-5D) (17). The EQ-5D comprises five dimensions of health (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) and the combination of answers on the dimensions leads to an index score of quality of life between 0 (equal to death) and 1 (best imaginable health).

The Dutch version of the 10-item Somatosensory Amplification Scale (SAS) (18,19) measures the tendency to experience somatic sensations as intense and harmful. A cutoff score of 10/11 has the highest sensitivity and specificity in detecting hypochondriasis (20).

From the Illness Attitude Scale (IAS) (21), the Dutch version of the 11-item Health Anxiety (HA) subscale (19) has been used. A cutoff score of 13/14 has the highest sensitivity and specificity in detecting hypochondriasis (20).

To measure the general tendency to be reassured by medical information provided by a physician, we used the complete 10-item Reassurance Questionnaire (RQ) (22). A cutoff score of 13/14 has the highest sensitivity and specificity in detecting hypochondriasis.

Trauma exposure was measured with a self-report list containing several events. According to a Dutch panel of five experts on the field of posttraumatic stress (12), the following events were likely to meet criterion A1 for posttraumatic stress disorder (23): a) immediate family member (partner, children) died, b) injured, or c) in life-threatening danger as a result of the disaster; d) other family members died as a result of the disaster; e) personal injuries resulting from the disaster; f) having been in life-threatening danger during the disaster; g) own apartment damaged as a result of the disaster; h) witnessed dead or injured bodies; or i) having been in or near one of the destroyed buildings at the time of the disaster. For rescue workers, the following disaster-related tasks were also considered to be traumatic: a) identification of victims, and b) rescue of victims.

Procedure

The baseline assessments of all participants took place during the medical examination of approximately 2.5 to 3 hours at the Onze Lieve Vrouwe Gasthuis Hospital at Amsterdam. Each participant was assisted by a medical assistant who also checked whether all questionnaire items had been answered. Six weeks after the medical examination, participants of the individual medical examination were invited to discuss the results of their examination with a doctor. Participants who only took part in the epidemiologic study had no follow-up interview with a doctor about the results of their examination.

Eleven to 26 months after their medical examination, all participants received a written summary on the first results of the completed epidemiologic study among rescue workers. The results of this study showed that occupationally involved workers reported a higher level of subjective health complaints (including fatigue) compared with the reference group of noninvolved colleagues. However, no clinically relevant differences were found between the occupationally involved and noninvolved reference groups regarding laboratory outcomes and indicators of biochemical exposure in blood and urine (24).

Six weeks after having received this written summary, all participants were sent the follow-up measures by mail with the request to send them back with the aid of an enclosed stamped envelope. In case subjects did not return the envelope within 4 weeks, research assistants tried to phone them on one or more occasions if necessary to enhance compliance. All participants gave their informed consent. The study was approved by the Medical Ethics Committee of the Leiden University Medical Center at Leiden, The Netherlands.

TABLE 1. Sociodemographic Characteristics

	Rescue Workers (n = 1951)	Residents (n = 753)
Age: mean (standard deviation)	45.0 (6.8)	41.9 (12.9)
Recruitment source		
Percent individual medical examination	55.8	30.2
Percent epidemiologic study	13.5	58.0
Percent both	30.6	11.7
Gender		
Percent male	92.3	44.6
Percent female	7.7	55.4
Education level		
Percent primary	26.2	38.5
Percent secondary	51.1	30.0
Percent higher	22.7	31.5
Ethnicity		
Percent western	97.6	51.4
Percent nonwestern	2.4	48.6
Exposure to trauma		
Percent no	57.4	27.1
Percent yes	42.6	72.9
Follow-up visit		
Percent no	49.0	83.1
Percent yes	51.0	16.9

Statistical Analysis

Differences in sociodemographic and self-report variables between groups were analyzed with t tests for independent groups or chi-squared analyses if appropriate. The relationship of fatigue severity with sociodemographic, psychopathology and quality of life, and health concern variables was analyzed with hierarchical multiple regression analyses to analyze the contribution of health concern variables in explaining the variance in scores for fatigue severity over and above the effects of sociodemographic and psychopathology and quality-of-life variables.

Using baseline and follow-up measurements on the CIS, participants were divided into three mutually exclusive and exhaustive categories: a) persistent fatigue (CIS score of 35 or more on both assessments); b) intermittent fatigue (CIS score of 35 or more on one of both assessments); and c) no fatigue (CIS score of less than 35 on both assessments). Differences with respect to sociodemographic and self-report variables at baseline between these three outcome groups were first analyzed with one-way analyses of variance or chi-squared analyses. In addition, logistic regression analyses were used to analyze sociodemographic and self-report variables at baseline predictive of persistent fatigue versus no or intermittent fatigue during the follow-up period.

To analyze the nature of the temporal association between relevant predictor variables and fatigue symptoms, path modeling was used to conduct crosslagged panel analyses. To this end, a series of multivariate regression models was estimated to obtain the components of a crosslagged path analytic model.

All statistical analyses were performed using SPSS for Windows, version 11.5. Significance was determined at a p value of $<.05$.

RESULTS

Subject Characteristics

Sample characteristics of participating rescue workers (N = 1951) and residents (N = 753) are presented in Table 1. As can be derived from this table, most of the rescue workers (57.4%) did not report to be confronted with a traumatic event during their professional activities at the place of the disaster, whereas the great majority of the residents reported exposure to one or more traumatic events (72.9%).

Measurements for fatigue, psychopathology, quality of life, and health concerns in both samples are presented in Table 2. As can be derived from this table, the percentages of residents with deviant scores (see "Instruments" for a description of cutoff scores used) are rather high (range of deviant scores: 33–63%). Also, in rescue workers, the percentages of deviant scores are elevated (range of deviant scores: 2.2–23%). The difference in the proportion of participants with deviant scores for posttraumatic stress complaints is especially striking (33% in inhabitants vs. 2.2% in rescue workers).

Among the residents, 399 of the 753 participants at baseline participated at the follow-up assessment (53%). Responders at follow-up were older ($p < .001$), predominantly from a western background ($p < .001$), and more reassured by information by a physician (RQ) ($p < .05$). For 470 (70%) of the 675 rescue workers randomly selected to answer the follow-up assessment, follow-up data are available. Responders were somewhat older than nonresponders and more from a western background (all $p < .01$). Because approximately 19% of the residents could not be traced by mail or telephone, the response rate in residents is lower than in rescue workers.

Relationship of Fatigue With Sociodemographic and Self-Report Variables in Residents at Baseline

To analyze the association of fatigue with sociodemographic and self-report variables in residents, a hierarchical multiple regression analysis was calculated with CIS scores as the dependent variable. Age, gender, education, ethnicity, exposure to trauma, and a follow-up visit to the MOVB

TABLE 2. Mean Baseline Measurements for Fatigue, Psychopathology, Quality of Life, and Health Concerns (standard deviations in parentheses)

	Rescue Workers (n = 1951)	Percent Deviant Scores	Residents (n = 753)	Percent Deviant Scores
Checklist Individual Strength; Fatigue	22.0 (12.8)	20.6	31.8 (14.6)	45.4
General Health Questionnaire	1.2 (2.2)	22.7	3.1 (3.6)	42.5
Impact of Event Scale: intrusions	2.2 (4.1)	—	9.1 (9.7)	—
Impact of Event Scale: avoidance	0.9 (3.1)	—	8.5 (10.20)	—
Impact of Event Scale: total	3.1 (6.6)	2.2	17.6 (19.0)	33.0
EuroQol-5 Dimensions	0.86 (0.16)	—	0.71 (0.28)	—
Somatosensory Amplification Scale	7.9 (4.1)	21.9	12.8 (6.2)	62.8
Health Anxiety subscale of the Illness Attitude Scale	6.3 (5.9)	12.1	11.5 (9.2)	35.9
Reassurance Questionnaire	7.5 (5.4)	13.6	12.2 (7.6)	42.2

physician were forced into the equation in the first step; GHQ, IES subscales, and EQ-5D scores were entered in the second step; and SAS, IAS, and RQ scores in the final third step. Sociodemographic variables accounted for 10% of the variance in CIS scores (F [6, 746] = 14.299, $p < .001$) with gender (beta = 0.124, $p < .001$) and ethnicity (beta = −0.062, $p < .05$) being the only significant predictors. Psychopathology and quality-of-life variables explained an additional 36% of the variance (F change [4, 742] = 122.306, $p < .001$) mainly accounted for by GHQ scores (beta = 0.303, $p < .001$) and EQ-5D scores (beta = −0.276, $p < .001$). Health concern variables forced into the equation in the third and final step explained a small although significant additional amount of 3% of the variance independent of and in addition to sociodemographic and psychopathology and quality-of-life variables (F change [3, 739] = 13.377, $p < .001$). Only RQ scores were a significant predictor in the final model (beta = 0.177, $p < .001$). Of note is that the significant bivariate relationship of CIS with IES: intrusions ($r = 0.43$, $p < .001$) and IES: avoidance scores ($r = 0.38$, $p < .001$) was no longer significant after statistically controlling for the effect of the other predictor variables. These results indicate that especially residents with a female gender, nonwestern background, higher levels of psychopathology, lower quality of life, and not feeling adequately reassured by a physician report higher levels of subjective fatigue.

Relationship of Fatigue With Sociodemographic and Self-Report Variables in Rescue Workers at Baseline

Next, a similar hierarchical multiple regression analysis was calculated among rescue workers. Sociodemographic variables accounted for 3% of the variance in CIS scores (F [6, 1944] = 8.787, $p < .001$) with age (beta = −0.054, $p < .01$) and gender (beta = 0.051, $p < .01$) being the only significant predictors. Psychopathology and quality-of-life variables explained an additional 36% of the variance (F change [4, 1940] = 281.173, $p < .001$) mainly accounted for by GHQ scores (beta = 0.320, $p < .001$) and EQ-5D scores (beta = −0.303, $p < .001$). Health concern variables forced into the equation in the third and final step explained a small although significant additional amount of 4% of the variance independent of and in addition to sociodemographic and psychopathology and quality-of-life variables (F change [3, 1937] = 48.863, $p < .001$). SAS (beta = 0.086, $p < .001$), IAS (beta = 0.059, $p < .01$), and RQ scores (beta = 0.151, $p < .001$) were significant predictors in the final model. Of note is that the significant bivariate relationship of CIS with IES: intrusions ($r = 0.21$, $p < .001$) and IES: avoidance scores ($r = 0.19$, $p < .001$) was no longer significant after statistically controlling for the effect of the other predictor variables. These results indicate that especially younger rescue workers with a female gender, higher levels of psychopathology, lower quality of life, and higher levels of health concerns report higher levels of subjective fatigue.

Predictors of Persistent Fatigue During the Follow-Up Period in Residents

T tests for paired samples revealed negligible small but statistically significant differences in CIS fatigue scores between baseline (mean = 32.0; standard deviation [SD] = 15.0) and follow-up (mean = 33.7; SD = 14.7) (t [389] = 2.767, $p < .01$) (Cohen's d = 0.11) in residents. Of the residents with elevated fatigue ($N = 179$), 73.2% showed persistent elevated fatigue. Of the residents with CIS fatigue scores below the cutoff ($N = 210$), 31.9% reported elevated fatigue levels at follow-up.

A subsequent hierarchical logistic regression analysis to identify predictors of persistent fatigue versus no or incidental fatigue showed that the sociodemographic (age, gender, education, ethnicity, exposure to trauma, follow-up visit to a physician), psychopathology and quality of life (GHQ, IES, and EQ-5D scores), and health concern variables (SAS, IAS, and RQ scores) entered as a group in each consecutive step were predictive of the criterion variable. In the final prediction model, GHQ (beta = 0.156, $p < .001$), EQ-5D (beta = −2.028, $p < .001$), and RQ scores (beta = 0.066, $p < .05$) were the only significant predictor variables, indicating that especially higher levels of psychopathology, an impaired quality of life, and a tendency not to be reassured predict persistent fatigue. Of note is that the significant bivariate relationship of persistent fatigue with IES: intrusions ($p < .001$) and IES: avoidance scores ($p < .001$) was no longer significant after statistically controlling for the effect of the other predictor variables. Table 3 displays the odds ratios with their probability values for each predictor variable in the final model (chi-square = 36.704, $df = 13$, $p < .001$).

Predictors of Persistent Fatigue During the Follow-Up Period in Rescue Workers

T tests for paired samples also showed a relatively small but statistically significant increase with respect to CIS fatigue scores between baseline (mean = 21.9; SD = 13.5) and follow up (mean = 24.7; SD = 12.9) (t [459] = 5.781, $p < .001$) (Cohen's d = 0.21) in rescue workers. Of the rescue workers with elevated fatigue ($N = 97$), 74.2% showed persistent elevated fatigue. Of the rescue workers with CIS fatigue scores below the cutoff ($N = 363$), 12.9% reported elevated fatigue levels at follow-up.

A subsequent hierarchical logistic regression analysis showed that the sociodemographic, psychopathology and quality of life, and health concern variables entered as a group in each consecutive step were predictive of the criterion variable. In the final prediction model, GHQ (beta = 0.141, $p < .05$), EQ-5D (beta = −7.195, $p < .001$), and RQ scores (beta = 0.100, $p < .01$) were the only significant predictor variables (chi-square = 122.869, $df = 13$, $p < .001$) (see Table 3). Of note is that the significant bivariate relationship of persistent fatigue with IES: intrusions ($p < .05$) and IES: avoidance scores ($p < .05$) was no longer significant after

TABLE 3. Odds Ratios for Predictor Variables of Persistent Chronic Fatigue Among Residents (n = 390) and Rescue Workers (n = 460)

Model	Residents		Rescue Workers	
	Exp(B)	p Value	Exp(B)	p Value
Step 1				
Age	1.006	.642	0.995	.827
Gender (% male)	0.584	.080	0.490	.147
Education	0.737	.096	0.718	.183
Ethnicity (% western)	1.096	.779	2.220	.501
Trauma (% yes)	0.880	.717	1.171	.656
Follow-up visit to physician (% yes)	0.936	.874	0.701	.338
	χ^2 (6) = 39.954**		χ^2 (6) = 14.750*	
Step 2				
General Health Questionnaire	1.169	<.001	1.151	.029
Impact of Event Scale: intrusions	1.057	.063	1.011	.810
Impact of Event Scale: avoidance	0.978	.423	0.950	.378
EuroQol-5 Dimensions	0.132	<.001	0.001	<.001
	χ^2 (4) = 88.247**		χ^2 (4) = 88.046**	
Step 3				
Somatosensory Amplification Scale	1.022	.454	1.090	.063
Health Anxiety subscale of the Illness Attitude Scale	0.995	.804	1.006	.860
Reassurance Questionnaire	1.069	.011	1.105	.002
	χ^2 (3) = 8.503*		χ^2 (3) = 20.072**	

* $p < .05$.
** $p < .001$.

statistically controlling for the effect of the other predictor variables.

Crosslagged Path Coefficients for Fatigue, Psychopathology, Quality of Life, and Tendency to be Reassured at Follow-Up

To analyze into more detail whether baseline GHQ, EQ-5D, and RQ scores actually predicted fatigue at follow-up and also whether the converse associations held, a series of multivariate regression analyses were performed to obtain the components of a crosslagged path analytic model. A total of four models was estimated in residents and rescue workers separately. The set of independent variables for each model was identical. Models only differed with respect to the dependent variable, which included one of each of the follow-up measures for fatigue, psychopathology, quality of life, and tendency to be reassured. Independent variables in each of the four models included baseline measurements of fatigue, psychopathology, quality of life, and tendency to be reassured. Because persistent fatigue was not related to any of the other sociodemographic variables or any of the other self-report variables (see previously), we did not include additional covariates in our models.

Table 4 lists the path coefficients of interest and their significance level. All four stability effects were strong and highly significant ($p < .001$). The crosslagged results of fatigue with psychopathology, quality of life, and tendency to be reassured revealed an absent or reciprocal relationship. In both samples, a lower tendency to be reassured at baseline was predictive of higher levels of fatigue and psychopathology and a lower quality of life at follow-up. Conversely, higher levels of fatigue at baseline predicted higher levels of psychopathology in both samples as well as a lower quality of life and less reassurance in rescue workers. Of note is that in both samples, psychopathology and quality of life at baseline were not associated with any of the dependent variables at follow-up.

TABLE 4. Crosslagged Path Coefficients for Fatigue, Psychopathology, Quality of Life, and Tendency to be Reassured at Follow-Up Among Rescue Workers (n = 460) and Residents (n = 390)

Baseline	Rescue Workers				Residents			
	CIS: Fa	GHQ	EQ-5D	RQ	CIS: Fa	GHQ	EQ-5D	RQ
CIS: Fa	0.62***	0.16**	−0.18***	0.20***	0.51***	0.12*	−0.10	0.10
GHQ	0.01	0.31***	−0.07	0.01	−0.01	0.29***	−0.08	0.03
EQ-5D	−0.07	−0.01	0.38***	−0.04	−0.09	−0.09	0.39***	−0.10
RQ	0.10**	0.17***	−0.12**	0.40***	0.17***	0.17***	−0.20***	0.49***

* $p < .05$.
** $p < .01$.
*** $p < .001$.
CIS: Fa = Checklist Individual Strength: Fatigue; GHQ = General Health Questionnaire; EQ-5D = EuroQol-5 Dimensions; RQ = Reassurance Questionnaire.

DISCUSSION

Our study results show high prevalence rates of elevated fatigue according to the CIS in rescue workers (20.6%) and especially residents (45.4%) at baseline. In the controlled epidemiologic ESADA study, the prevalence of elevated levels of fatigue according to the CIS in a large and representative group of occupationally involved rescue workers (N = 1567 of which 862 also participated in the present study) was comparable (18.7%) and significantly higher than in a reference group of 932 colleagues who were not involved in the Bijlmermeer air disaster (9.4%) (24,25). Because the controlled epidemiologic study among residents involved in the disaster was canceled, it remains undecided whether the very high prevalence of elevated fatigue in residents in the present study is also the result of involvement in the air disaster or primarily reflects high predisaster levels of psychopathology and a lower quality of life in a socioeconomically disadvantaged group with a mixed western and nonwestern background. We were also able to study the course of persistent elevated levels of fatigue. Persistent fatigue was observed in a large majority of rescue workers (74.2%) and residents (73.2%). These persistence rates are very high compared with the average persistence rates of unexplained physical symptoms of approximately 25% with follow-up intervals as long as 5 years (1).

Using multivariate analyses, higher as well as persistent levels of fatigue were especially found in residents and rescue workers with higher levels of psychopathology, an impaired quality of life, and a tendency of feeling less reassured by medical information provided by a physician. Results of a path analytic model failed to show evidence for causal relationships of baseline scores for psychopathology and quality of life with fatigue severity at follow up. On the contrary, higher levels of fatigue at baseline predicted higher levels of psychopathology in both samples as well as a lower quality of life and less reassurance in rescue workers. Taken together, these results seem to imply that severe and persistent fatigue can only partly be regarded as a form of presenting somatization whereby fatigue constitutes the physiological component of anxiety and depression. These results are in accordance with those of a recent meta-analysis of 244 studies examining the role of anxiety and depression in MUPS, including CFS. This review confirmed that chronic fatigue was strongly related to (but not fully dependent on) depression and to a lesser extent anxiety (26). Fatigue can best be described as constituting one dimension of common distress disorders alongside depression and anxiety without assuming a primacy of mental over physical symptoms (26).

We also tried to investigate whether fatigue can be conceptualized as a form of hypochondriac somatization. Severe and persistent fatigue was only marginally related to somatosensory amplification and health anxiety after accounting for level of psychopathology and quality of life, suggesting that fatigue was not primarily the result of attention for or misinterpretation of bodily symptoms as a sign of a serious illness. However, the general tendency of feeling less reassured by medical information provided by a physician at baseline predicted severity and course of fatigue also after accounting for level of psychopathology and quality of life. Tendency to be reassured was also the most important causal factor for fatigue severity as well as psychopathology and impaired quality of life at follow up. Of note is that making use of the possibility to come to visit the physician of the MOVB to discuss the results of the individual medical examination after 6 weeks did not affect this long-term outcome of fatigue. Because effective reassurance depends both on one's tendency to have difficulty accepting reassurance as well as the physician's skill in providing reassurance (27), unfortunately, these data remain silent on the relative contribution of both factors. So, fatigue in the present study can partly be conceptualized as a form of hypochondriac somatization in the sense that doubt and discontent about medical diagnosis and treatment are associated with more severe and persistent fatigue. These results concur with those of a previous study (28) showing that of the symptoms attributed by patients to the Bijlmermeer aviation disaster, the general practitioner related only a small proportion to the disaster. Such discrepancies between the symptom attribution of patient and physician in MUPS and hypochondriasis are common (2) and may contribute to doubt and discontent about medical diagnosis and treatment (29).

Also, the finding that the significant association of posttraumatic stress complaints with severity and course of fatigue disappeared both in residents and rescue workers after accounting for the effect of especially psychopathology and quality of life warrants some comments. Because the present study was conducted more than 8 years after the aviation disaster, it cannot be excluded that trauma exposure and traumatic stress reactions may have been a primary cause in the incidence of fatigue and other complaints, but apparently posttraumatic stress complaints play no unique role in the persistence of these complaints. Future longitudinal research directly after a disaster is necessary to further disentangle causative and maintaining factors of postdisaster complaints.

There are at least three reasons to think that the current data merit serious consideration. First, this is to our knowledge the first study to examine MUPS in relation to psychopathology, quality of life, and health anxiety in the aftermath of an aviation disaster possibly involving exposure to toxic substances. Second, in addition to studying residents involved in the disaster, we also investigated rescue workers who were occupationally involved, and the similarity of the pattern of results in both groups is striking given possible differences in prior trauma exposure and the experience of the plane crash between groups and provided crossvalidation of our study results. Finally, the use of a longitudinal design with a long follow-up period of more than 1 year allowed us to preclude the problem of accurate recall of "lifetime" symptoms (30) and to identify predictors of outcome in a more reliable way.

Finally, at least four limitations of this study have to be mentioned. A first limitation relates to the assessment of trauma exposure by self-report and the average time lag of

more than 8 years between the aviation disaster and the first baseline assessment. This long time lag between the disaster and the trauma assessment may have resulted in recall bias and (non)differential misclassification of trauma exposure of residents and rescue workers. A second limitation is the exclusive reliance on self-report measures. In the absence of results of a medical examination to confirm the presence, persistence, and onset of self-reported fatigue symptoms after the aviation disaster and to rule out a medical diagnosis accounting for the fatigue symptoms, our group of participants with persistent elevated fatigue probably will have included a minority of participants with medically explained illnesses underlying their persistent fatigue complaints. However, all the measures for psychopathology, quality of life, and health concerns that we used have been thoroughly validated and, with the exception of the Reassurance Questionnaire, are widely used for research purposes. Third, we acknowledge the fact that our study groups were partly the result of self-referral for an individual medical examination. However, our total sample of rescue workers proved to be highly comparable to the representative group of professionally involved rescue workers from the ESADA study (of which a small majority also participated in the present study) with regard to sociodemographic (age, gender, education, ethnicity, trauma exposure) and psychopathology variables (CIS, GHQ, IES) (25). Although conclusions about the selectivity of our sample of residents are precluded because the epidemiologic study among residents was prematurely terminated, the very similar pattern of predictors of fatigue in rescue workers and residents does not suggest a strong effect of selection bias. Finally, it can be questioned whether the fact that all participants had received a written summary on the first results of the completed epidemiologic ESADA study among rescue workers 6 weeks before the follow-up assessment may have influenced the follow-up measurements. However, it should be realized that this epidemiologic study had a different research goal in investigating the causal role of professional involvement in the disaster in developing health complaints by contrasting involved with noninvolved rescue workers at baseline. Moreover, the statistically significant although small increase in fatigue scores at follow up in both residents and rescue workers compared with baseline in the present study does not suggest that the summary information on the ESADA study resulted in reassurance and a consequent reduction of fatigue.

In summary, elevated levels of fatigue are common after involvement in a disaster and can only partly be accounted for by higher levels of psychopathology and a lower quality of life. Doubt and discontent about medical diagnosis and treatment was predictive of more severe and persistent fatigue complaints. These results suggest that early identification, adequate reassurance, and treatment of individuals at risk may be worthwhile to prevent chronic fatigue. Especially psychological treatments, which do not only focus on fatigue as a bodily expression of anxiety and depression, but also emphasize the causal attributions of the patients and their activity levels (31), may break the vicious circle in which fatigue, psychopathology, lower quality of life, and distrust of the medical profession mutually interact (3).

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