Effects of the medical investigation Bijlmermeer aviation disaster on health perception of residents and rescue workers

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Chapter 4

Making a bad thing worse: Effects of communication of results of an epidemiological study after an aviation disaster

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Abstract

Cognitions attributing health complaints to disaster exposure are associated with more severe health complaints and are therefore a promising target for interventions. Little is known about the best strategy to modify such cognitions following exposure to a technological disaster at the community level. In 1992, a Boeing 747 crashed in a residential area in Amsterdam, the Netherlands. Persisting rumours about the possible toxic cargo of the plane led to increasing health concerns among the residents and rescue workers involved in the disaster. The current study investigates (a) the effectiveness of providing information on the health consequences of exposure to the aviation disaster to residents and rescue workers with varying degrees of exposure to the disaster and (b) individual characteristics which may moderate the effectiveness of the health information provided. 1019 rescue workers and 453 residents involved in varying degrees in the disaster participated in an epidemiological investigation and 1736 rescue workers and 339 residents, all involved, participated in an individual medical examination. Participants were assessed at baseline and 6 weeks after communication of the results of the epidemiological study. Main outcome measures evaluated health anxiety, somatic sensitivity, reassurance by a physician, psychopathology, post-traumatic stress symptoms, fatigue and quality of life. All participants reported elevated levels of psychopathology and fatigue, increased anxiety and uncertainties about their health 6 weeks after communication of the study results irrespective of the degree of exposure to the disaster. Especially the conviction that health complaints were caused by toxic exposure was related to more severe health complaints and worries in both rescue workers and residents. Our study shows that communication about the health consequences of exposure to an aviation disaster at the community level has no symptom reducing or reassuring effects. Tailoring of the communication to individual characteristics such as existing expectancies may enhance its impact.

Introduction

Attention for the health consequences of disasters is growing during the last decades. Research studies have shown that in a significant proportion of individuals psychopathological symptoms such as post-traumatic stress, anxiety, depression, substance abuse and physical (somatisation) symptoms may persist for many years (see Foa, Stein & McFarlane (2006) for a review). Establishing a relationship between disaster exposure and persistent higher levels of mental and physical dysfunction is complex, because it remains unclear whether the degree of exposure to the disaster or the degree of exposure to the long-term aftermath of the disaster is

the primary causative factor (Boin, van Duin & Heyse, 2001; Havenaar, de Wilde, van den Bout, Drottz-Sjöberg & van den Brink, 2003; Vasterman, Yzermans & Dirkzwager, 2005; Yzermans & Gersons, 2002). This may be especially true with respect to disasters with real or alleged exposure to hazardous chemicals. This kind of disaster in particular may have a long-lasting impact on the well-being of those involved because of the uncertainty about potential physical and mental health effects (Baum, Fleming & Davidson, 1983; Havenaar & van den Brink, 1997).

It may be assumed that cognitive factors are important putative mediators between trauma exposure and persistent health problems. Havenaar et al. (2003) showed that cognitive variables such as risk perception and sense of control play an important role as mediating factors in the explanation of subjective health differences between exposed and non-exposed victims of the Chernobyl disaster. Also, in a study on self-reported health among residents of a chromium wasted area and a control group, McCarron, Harvey, Brogan and Peters (2000) found no evidence of harm to health from exposure to chromium. However, lower scores on self-reported health in participants who believed chromium to be harmful to health point to the potential importance of perception and possible anxiety.

These studies showed that illness cognitions attributing health complaints to disaster exposure are associated with more severe health complaints and therefore are a promising target for interventions. However, little is known about the best strategy to modify these cognitions at the community level. In one of the few studies in this field, Prince-Embury (1992a) investigated whether six years after the nuclear accident at Three Mile Island a course designed to offer relevant, credible information on health issues of concern in the community affected the level of psychological symptoms and/or perception of control. It was observed that in a selected group of information seekers from the vicinity of the disaster site, greater understanding of the information and education provided was associated with only a slight decrease in psychological symptoms. Moreover, higher perceived reliability of course information that openly acknowledged conditions of uncertainty was associated with less perceived control.

Several theoretical models of risk-communication interventions in health care in general are available and may hold promise in predicting the effectiveness of health communication to individuals that have been exposed to a disaster and worry about their health. According to the Elaboration Likelihood Model (ELM) (Petty & Cacioppo, 1981), communication may be more effective when individuals are more likely to actively and thoughtfully process information that they perceive to be personally relevant and consequential. However, persons respond in various ways to personally relevant health information and several theoretical models might account for this differential feedback acceptance. The motivational biased reasoning model predicts that feedback is more readily accepted if it satisfies a person's striving for

a positive sense of self and for consistency in the sense of self (e.g., Croyle, Sun & Hart, 1993). Alternatively, the cue adaptive reasoning account (Renner, 2004) supposes that negative feedback or unexpected positive feedback which does not agree with existing expectancies generates more elaborate cognitive processing, thereby increasing the likelihood that real or imagined shortcomings of the information are perceived and that the feedback is subsequently rejected.

On October 4th, 1992 a cargo aircraft crashed into the Bijlmermeer district of the city of Amsterdam, the Netherlands. The death count totalled 43, including the four crew members of the plane, and 266 apartments were destroyed. In the years that followed, several studies were carried out to assess the long-term health consequences of this disaster (Boin et al., 2001; Carlier & Gersons, 1997; Donker, Yzermans, Spreeuwenberg & van der Zee, 2002). Boin et al. (2001) pointed out that while the authorities' emergency response to the crash was quite effective, the long-term crisis management performance was considerably less successful. Particularly the persistence of rumours about the possible toxic cargo of the plane led to a growing unease among the residents of the Bijlmermeer district as well as among the rescue workers involved in the disaster. Eventually, in 1999 a Parliamentary Inquiry was held, after which it was decided to start an epidemiological study with the purpose of assessing the relationship between health complaints and exposure to the disaster in order to reduce possible health concerns and uncertainties. In addition, involved rescue workers and residents were offered a medical examination.

In the epidemiological study among rescue workers no clinically relevant differences between occupationally involved and not-involved rescue workers regarding laboratory outcomes and indicators of biochemical exposure in blood and urine were found, although the involved rescue workers reported an impaired health-related quality of life with respect to general, physical, and psychosocial aspects (Slottje et al., 2003; Slottje, Bijlsma et al., 2005; Witteveen et al., 2007). All participants from the epidemiological study and the medical examination received a public summary of the first results of the epidemiological study (obtained among rescue workers involved and not involved in the disaster).

The current study is the first one to (a) study the effectiveness of providing information on the health consequences of exposure to an aviation disaster to residents and rescue workers with varying degrees of disaster exposure and (b) to investigate individual characteristics which may moderate the effectiveness of the health information provided. It was hypothesized that (a) providing information about the absence of serious health risks of exposure to the aviation disaster would not result in a marked reduction of subjective health complaints or health anxiety, and (b) that the effectiveness of the health information would be less pronounced in those participants for which the content of the health information is less personally relevant and not consistent with existing expectancies.

Methods

Procedure

The full project consisted of several parts, which were described in detail elsewhere (Medical Investigation Bijlmermeer Aviation Disaster Website, 2002; Slottje, Huizink et al., 2005). An epidemiological study was performed into medical and psychological outcomes contrasting rescue workers who were and who were not involved in the disaster. Residents involved in varying degrees in the aviation disaster also took part in the epidemiological study. The medical investigation took around two and a half hours and consisted of filling in questionnaires (if necessary assisted by professional interpreters and medical assistants), measuring of body height and weight, and collection of blood, saliva and urine samples. Participants in the epidemiological study did not receive any individual feedback on the results of their medical investigation, unless incidentally the investigation revealed that further medical examinations were necessary.

Rescue workers and residents involved in the disaster were also offered a medical examination. Here, the procedure consisted of an individual medical examination and a consultation with the physician to discuss the results of the examination. The medical examination took around four hours and consisted of completion of questionnaires (if necessary assisted by professional interpreters and medical assistants), an examination of lung function, collection of blood and urine samples and an interview with a medical doctor. At the consultation each participant was given specific advice based on the findings of the examination, for instance that no grounds had been found for further examination, that a further physical examination by their family doctor was warranted or that the participant might benefit from the special aftercare services set up for this purpose. If participants took part in both the epidemiological study and the medical examination, they were included in the group of participants of the medical examination, since they received individual feedback from the physician as opposed to the participants of the epidemiological study. This involved 27.8% of the residents and 35.5% of the rescue workers in the medical examination.

Here we report on the effect of communication of the results of the epidemiological study on rescue workers and residents who participated in the epidemiological study or the individual medical examination. There were measurements at two time points: one during the data collection of the epidemiological study or the medical examination (baseline), and one six weeks after the communication of the findings (follow-up). All participants received a public summary of the first results of the epidemiological study. More information was available on the website and in the newsletter of the project, and questions could be asked at meetings of the soundingboards of rescue workers and residents. The process of publicity was supervised by

a communication expert. Data collection took place eight years after the disaster at a general hospital in Amsterdam (baseline) and by mail (follow-up). The follow-up measurement took place in April, 2003, at least one year after the baseline measurement which took place between December 2000 and March 2002. The research protocol was approved by the Medical Ethics Committee of the Leiden University Medical Center and all participants gave written informed consent.

Participants

In the epidemiological study, 1019 rescue workers completed the baseline measurements, as well as 453 residents who lived in the neighbourhood during the disaster. Of these, 246 randomly selected rescue workers and 263 residents took part in the follow-up measurements. As regards the individual medical examination, 1736 rescue workers and 339 residents completed the baseline measurements. Here, follow-up measurements were collected among 421 randomly selected rescue workers and 144 residents. We investigated whether the results of the present study were affected by selective drop-out. Of the potential participants in the follow-up measurement, 63% of the rescue workers and 59% of the residents in the epidemiological study responded, as well as 71% of the rescue workers and 52% of the residents in the individual examination. Despite this substantial loss to follow-up, there was no selective drop-out of participants apparent. The only difference between those that took part in the follow-up measurement and those that did not, was that rescue workers in the epidemiological study who participated in the follow-up measurement showed less fatigue and a better health-related quality of life ($p<.01$ and $p<.05$ respectively, effect-sizes were small) at baseline, compared to rescue workers who did not complete the follow-up measurement.

A description of the participants is shown in Table 1. The rescue workers in the individual examination were somewhat older than the residents in this examination, but no other differences in age were found. Both groups of rescue workers were predominantly (≥87%) male, whereas among residents the sexes were more or less equally represented. More rescue workers than residents reported a secondary education. Almost all rescue workers were of a western ethnicity, whereas almost half of the residents who participated in the individual examination were of a non-western background (mainly Surinamese, Netherlands Antilles, Ghanaian, Moroccan, and Turkish).

Table 1. Demographic characteristics of participants that took part in the baseline and follow-up measurements

Characteristics	Rescue workers Epidemiological (n = 246)	Residents Epidemiological (n = 263)	Rescue workers Individual (n = 421)	Residents Individual (n = 144)	Total (n = 1074)
Age: mean (SD), years	44.5 (7.3)	44.7 (13.6)	45.3 (7.0)	42.6 (10.6)	F = 2.77*
Sex[a]:					χ^2 = 265.68***
Men, No. (%)	214 (87.0)	108 (41.1)	386 (91.7)	72 (52.2)	
Women, No. (%)	32 (13.0)	155 (58.9)	35 (8.3)	66 (47.8)	
Education[a]:					χ^2 = 70.99***
Primary, No. (%)	66 (29.1)	83 (33.2)	86 (21.8)	60 (46.2)	
Secondary, No. (%)	116 (51.1)	74 (29.6)	214 (54.2)	33 (25.4)	
Higher, No. (%)	45 (19.8)	93 (37.2)	95 (24.1)	37 (28.5)	
Ethnicity[a]:					χ^2 = 274.11***
Western, No. (%)	238 (97.5)	168 (64.4)	410 (97.9)	68 (50.4)	
Non-western, No. (%)	6 (2.5)	93 (35.6)	9 (2.1)	67 (49.6)	

[a]Numbers do not add up because not all the respondents answered these questions.

*p<.05; ***p<.001.

Outcome measures

With regard to health concerns the following questionnaires were filled in. The Dutch version of the Somatosensory Amplification Scale (SAS) (Barsky, Wyshak & Klerman, 1990; Speckens, Spinhoven, Sloekers, Bolk & van Hemert, 1996) measures the tendency to experience somatic sensations as intense and harmful, e.g. 'I am often aware of various things happening within my body'. In this study the SAS has a Cronbach's α of 0.69. From the Illness Attitude Scales developed by Kellner, Abbott, Winslow and Pathak (1987), the Dutch version of the Health Anxiety subscale (HA) (Speckens et al., 1996) was used to study the degree of worry and anxiety about health (for example: 'Does the thought of a serious illness scare you?'). Cronbach's α in the present study was 0.90. To measure the extent to which a patient feels reassured by a physician the Reassurance Questionnaire (RQ) (Speckens, Spinhoven, van Hemert & Bolk, 2000) was administered, which includes items such as: 'If you initially feel reassured by a visit to your physician, does your anxiety return later on?'. In this study the RQ had a Cronbach's α of 0.79.

In addition, various aspects of participants' physical and psychological health

were investigated. To measure the general level of psychopathology the Dutch version of the General Health Questionnaire (GHQ) (Goldberg, 1972) was used. Respondents are asked to compare their current state with their 'normal' state, e.g. 'Have you recently been able to face your problems?'. Cronbach's α for the GHQ in the present study was 0.89. Post-traumatic stress symptoms related to the air disaster were investigated with the Dutch version of the Impact of Event Scale (Horowitz, Wilner & Alvarez, 1979). The IES is composed of 15 items on experiences of intrusion and avoidance commonly reported following traumatic events, e.g. 'Images of it kept passing through my mind'. The IES had a Cronbach's α of 0.95 in this study. The Checklist Individual Strength (Vercoulen et al., 1994) measures several aspects of fatigue, including 'Subjective fatigue', 'Concentration', 'Motivation' and 'Activity' (for example, 'I feel physically exhausted'). For the current study we used the total score on the CIS, with a Cronbach's α of 0.95. Health-related quality of life was measured with the EQ-5D, developed by the EuroQol Group (2001). It consists of five dimensions of possible health problems such as 'Mobility (walking)', to be answered with 1 (no problems), 2 (some problems) and 3 (extreme problems). 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).

In addition to these standardized measures, participants were asked six questions referring to the communication of the first results of the epidemiological study. Four questions evaluated (1) knowledge of the results of the epidemiological study of rescue workers, (2) satisfaction with the way in which the study has been carried out, (3) the conviction that their health complaints were caused by toxic exposure during the disaster, and (4) the belief that their complaints were in any other way connected to the disaster and its aftermath. Two additional questions assessed changes in the complaints participants mentioned during their first visit and changes in the worries about their complaints after communication of the results of the epidemiological study. Answers were given on a five point Likert-type scale ranging from 1 to 5, with higher numbers indicating more knowledge, more satisfaction, stronger conviction of toxic exposure or of another connection to the disaster, fewer complaints and more worries, respectively.

Statistical analysis

To measure changes in health experience between the baseline and follow-up measurement in the participants of the epidemiological study, repeated measures analyses of variance were performed that compared different groups according to their level of involvement in the disaster. Similarly, repeated measures analyses of variance were used to assess changes over time among the participants of the individual study. In order to quantify the magnitude of changes standardized effect-sizes

(Cohen's *d*) were calculated. Cohen's *d* is the difference between pre and post means divided by the pooled standard deviation. Effect sizes <.15 are considered negligible, between .15 and .40 small, between .40 and .75 medium, and ≥.75 large.

One-way analyses of variance were performed to compare all four groups on the effects of the communication of the results of the epidemiological study. Games-Howell post-hoc tests for multiple comparisons were used to correct for heterogeneity of variance and unequal sample sizes.

Hierarchical linear regression analyses were conducted to predict the scores for health experience on the follow-up measurement on the basis of the corresponding baseline scores and the four questions referring to the communication of the first results of the epidemiological study. First, the baseline scores were forced into the regression equation in order to create residualized gain scores. In the next step the four questions were entered into the equation. This was done to sort out the unique contribution of these questions over and above the variance explained by the baseline scores. In this way we could trace the most important predictors for gain scores at follow-up corrected for any differences in dependent variables at baseline.

Results

Changes in health experience after communication of epidemiological study results
Of the rescue workers participating in the epidemiological study, 25% were involved in the disaster and 75% constituted a control group of rescue workers that were not involved. Overall, a repeated measures analysis of variance with exposure to the disaster as between subjects variable and time as within subjects variable revealed neither significant main effects for condition nor significant time x condition interaction effects. Only for the IES ($F = 6.9$, $p < .01$) and the EQ-5D ($F = 5.1$, $p < .05$) a small interaction effect was observed. A post hoc analysis of these interaction effects with an analysis of co-variance statistically correcting for between group differences in baseline scores however showed that differences between groups at follow-up on the EQ-5D ($F = 2.591$, $p = .109$) and the IES ($F = 1.741$, $p = .188$) were not statistically significant. Main effects for time, however, were significant for the other five dependent variables (see Table 2).

Repeating these analyses among residents participating in the epidemiological study, some significant main effects for condition were found. The residents that were most involved in the disaster (43%) reported the highest levels of psychopathology (GHQ), post-traumatic stress symptoms (IES) and somatic sensitivity (SAS) and were least reassured by a physician (RQ) at both measurements, compared to the residents that were intermediately (30%) or least involved (27%). Again, no significant interaction effect for time x condition was found. Main effects for time, however, were significant for six of the seven dependent variables (see Table 2).

Table 2. Changes in health experience between baseline and follow-up measurement among participants of the epidemiological investigation

	Rescue workers (n = 246)				Residents (n = 263)			
	baseline M (SD)	follow-up M (SD)	F Time	d	baseline M (SD)	follow-up M (SD)	F Time	d
GHQ	0.7 (1.5)	1.0 (2.0)	4.5*	.17	2.3 (3.4)	3.5 (4.1)	24.8***	.32
IES	0.7 (3.1)	1.1 (3.7)	0.0	.12	11.3 (16.7)	14.7 (18.2)	11.6**	.20
CIS	39.4 (17.5)	47.4 (20.8)	35.5***	.42	63.5 (29.5)	68.2 (30.7)	11.5**	.16
EQ-5D	0.93 (0.1)	0.94 (0.1)	1.1	.10	0.77 (0.3)	0.76 (0.3)	0.2	.03
HA	4.7 (4.8)	6.5 (6.0)	37.1***	.33	9.3 (8.2)	13.1 (10.1)	70.5***	.41
RQ	6.4 (4.8)	7.3 (5.2)	8.9**	.18	9.4 (7.0)	11.2 (8.1)	19.1***	.24
SAS	7.7 (3.6)	8.9 (4.2)	17.3***	.31	11.6 (5.9)	14.5 (6.5)	77.2***	.47

M = mean; SD = standard deviation; d = effect-size. *p<.05; **p<.01; ***p<.001.

GHQ = General Health Questionnaire; IES = Impact of Event Scale; CIS = Checklist Individual Strength; EQ-5D = EuroQol-5 Dimensions; HA = Health Anxiety Scale; RQ = Reassurance Questionnaire; SAS = Somatosensory Amplification Scale.

So, on most of the measures of health experience both rescue workers and residents reported a deterioration of health irrespective of the degree of involvement in the disaster. Both groups were more sensitive to somatic sensations (SAS), and showed more health anxiety (HA), fatigue (CIS) and psychopathology (GHQ) at follow-up than at baseline. Moreover, both groups indicated that they felt less reassured by a physician at follow-up compared to baseline (RQ). Furthermore, residents indicated more post-traumatic stress symptoms (IES) at follow-up than at baseline. Effect-sizes were small to medium (range d: .17 - .47).

Table 3 shows the changes in health experience between the time of the individual medical examination (baseline) and 6 weeks after communication of the results of the epidemiological study (follow-up). Both rescue workers and residents were more sensitive to somatic sensations (SAS) and became more anxious about their health (HA) at follow-up than at baseline. In addition, they reported more symptoms of fatigue (CIS) and psychopathology (GHQ) at follow-up compared to baseline. All effect-sizes were small, except for the change in somatic sensitivity among residents which showed a medium effect-size (range d: .17 - .51).

Table 3. Changes in health experience between baseline and follow-up measurement among participants of the individual medical examination

	Rescue workers (n = 421)				Residents (n = 144)			
	baseline M (SD)	follow-up M (SD)	F Time	d	baseline M (SD)	follow-up M (SD)	F Time	d
GHQ	1.3 (2.4)	1.9 (3.1)	17.7***	.22	4.0 (3.6)	5.2 (4.1)	11.3**	.31
IES	3.1 (6.6)	3.3 (8.3)	0.4	.03	25.4 (19.9)	27.3 (20.1)	2.0	.10
CIS	52.4 (27.1)	58.5 (27.3)	36.8***	.22	81.8 (27.5)	87.6 (27.3)	7.5**	.21
EQ-5D	0.85 (0.2)	0.86 (0.2)	2.1	.05	0.61 (0.3)	0.59 (0.3)	0.4	.07
HA	6.7 (5.9)	8.0 (6.2)	33.7***	.22	14.2 (10.2)	16.8 (10.2)	14.1***	.26
RQ	8.1 (5.8)	7.9 (5.2)	0.4	.04	14.9 (7.1)	15.7 (7.9)	1.1	.11
SAS	8.5 (4.0)	9.2 (4.3)	14.8***	.17	14.6 (7.0)	18.2 (7.3)	50.5***	.51

M = mean; SD = standard deviation; d = effect-size. **p<.01; ***p<.001.

GHQ = General Health Questionnaire; IES = Impact of Event Scale; CIS = Checklist Individual Strength; EQ-5D = EuroQol-5 Dimensions; HA = Health Anxiety Scale; RQ = Reassurance Questionnaire; SAS = Somatosensory Amplification Scale.

Participants' evaluation of communication of epidemiological study results

Table 4 shows the results of the questions regarding the communication of the findings of the epidemiological study. Only the means of the answers of the participants that indicated that the questions were applicable to them are shown. Knowledge of the results of the epidemiological study was highest among the rescue workers who took part in the individual examination, followed by the residents in the same examination. Both groups of rescue workers were more satisfied with the way in which the epidemiological study has been carried out, than both groups of residents. Residents in the individual examination were most convinced that their health complaints were caused by exposure to possible harmful substances during the disaster or that these complaints were in any other way associated with the disaster and its aftermath, while rescue workers in the epidemiological study were least convinced. Repeating the analyses controlling for age, sex, education and ethnicity did not change the pattern of results (results not shown).

Table 4. Participants' evaluation of publication of epidemiological study results

	1 Rescue workers Epidemiological M (SD)	2 Residents Epidemiological M (SD)	3 Rescue workers Individual M (SD)	4 Residents Individual M (SD)	*F*	Post-hoc
Knowledge *n*=971	2.84 (1.30)	2.75 (1.34)	3.73 (1.09)	3.26 (1.40)	41.11***	2=1<4<3
Satisfaction *n*=813	3.76 (0.67)	3.31 (0.91)	3.77 (0.96)	3.06 (1.05)	23.56***	4=2<1=3
Toxic exposure *n*=677	2.02 (0.93)	2.91 (1.10)	3.05 (0.95)	4.02 (0.93)	61.25***	1<2=3<4
Other connection *n*=663	1.92 (1.00)	2.90 (1.09)	2.85 (0.96)	3.62 (1.19)	37.84***	1<3=2<4

Score range 1-5; M = mean; SD = standard deviation. ***p<.001.

Prediction of health experience at follow-up by participants' evaluation of study results

The results of the hierarchical regression analyses are presented in Table 5. Only significant predictors of the scores for health experience on the follow-up measurement are shown. For all outcome measures the score on the baseline measurement was a significant predictor of the score on the follow-up measurement, indicating that e.g. a high score on health anxiety at baseline predicted a high score on health anxiety at the follow-up measurement. The only exception to this was the baseline score on the Impact of Event Scale (IES) among rescue workers who took part in the epidemiological investigation, which did not reach significance as a predictor of the IES score on the follow-up measurement ($F(1,144) = 1.23$, $p = .27$). For clarity we did not incorporate all these significant predictors into Table 5. Also, the range of the *R* Square Change refers only to the predictors shown.

The most important predictor of an increase in complaints and concerns on all measures was the belief among all groups except the group of rescue workers from the epidemiological study that their health complaints were caused by toxic exposure. Also, being dissatisfied with the way in which the study was carried out predicted higher levels of complaints and concerns at the follow-up measurement on almost all measures, especially among the rescue workers in the individual examination. The conviction that there was some other connection between their complaints and the disaster and knowledge of the results of the epidemiological study were weak predictors.

Table 5. Prediction of residualized gain scores for health experience at follow-up by participants' evaluation of epidemiological study results

	Rescue workers Epidemiological	Residents Epidemiological	Rescue workers Individual	Residents Individual	Range Δ R^2 Sig. *F* Change
GHQ		3(.27)	3(.14)	1(-.28) 4(.21) 2(-.18)	.02**-.07***
IES		3(.31)	2(-.12)3(.11)	3(.31)	.01*-.09***
CIS		3(.24)	3(.09) 2(-.11) 4(.08)	3(.34) 1(-.17)	.01*-.12***
EQ-5D	2(.19)	3(-.33)	3(-.11) 2(.13) 4(-.10)	3(-.27)	.01*-.11***
HA		3(.27) 1(-.09)	4(.12) 2(-.10)	3(.29)	.01*-.08***
RQ		3(.29)	2(-.31) 3(.28)	3(.47) 2(-.23)	.05**-.23***
SAS		3(.21)	4(.13) 1(-.09)	3(.24)	.01*-.06**

GHQ = General Health Questionnaire; IES = Impact of Event Scale; CIS = Checklist Individual Strength; EQ-5D = EuroQol-5 Dimensions; HA = Health Anxiety Scale; RQ = Reassurance Questionnaire; SAS = Somatosensory Amplification Scale. 1 = Knowledge; 2 = Satisfaction; 3 = Toxic exposure; 4 = Other connection. () = Beta. *p<.05; **p<.01; ***p<.001.

Only significant (p<.05) predictors of the scores on health experience at follow-up are shown.

Rescue workers in the epidemiological investigation who were more satisfied with the way in which the study was carried out, reported a better quality of life at the follow-up measurement. No other predictors of the scores for health experience in this group were found. Hence, after communication of the first results of the epidemiological study among rescue workers, especially dissatisfaction about the execution of the study and belief in toxic exposure predicted health concerns and complaints among the participants that were not involved in that study (residents in both studies and rescue workers in the individual examination). Overall, the four questions evaluating the findings of the epidemiological study explained 6 to 23% of the variance in complaints and concerns at follow-up above and independent of the baseline scores on these outcome measures.

Validity

To investigate whether the results of the standardized measures were supported by answers on the self-report questions that retrospectively measured changes in complaints and worries, changes in scores on the former and latter measures were correlated. A worsening in health experience on almost all outcome measures was associated with an increase in complaints since their first visit to the hospital (range *sr:* -.30 - .32) and with increased worrying about these complaints after communication

of the first results of the epidemiological study (range *sr*: -.16 - .29). So, there is congruence between the subjective experience of change in complaints and worries as retrospectively assessed by the self-report questions at follow-up and the prospective standardized measurements of health experience.

Discussion

The aim of the present study was two-fold: (a) to investigate whether providing of information on the favourable findings of an epidemiological study about the health consequences of exposure to a disaster would influence subjective health complaints and health anxiety among rescue workers and residents with varying degrees of involvement in the disaster and (b) to investigate individual characteristics which may moderate the effectiveness of the health information provided. The hypothesis that providing general information about the health risks of exposure to an aviation disaster would not result in a marked reduction of subjective health complaints or health anxiety, was confirmed. The present study further showed that overall there were no significant differences in the change of health complaints and health anxiety between involved and non-involved residents and rescue workers from the epidemiological studies. Thus, despite the fact that no medical sequelae of the disaster among the rescue workers were found, our study results show that the effect of communicating this positive result to the risk group of exposed participants did not differ from that in non-involved participants. These results are consistent with those of previous studies showing that providing general risk information is not very effective compared to more personalized risk communication in influencing key outcomes such as cognitive measures (e.g. knowledge and risk perception), affective measures (e.g. health anxiety and worries) and behavioural measures (e.g. uptake of screening programmes) (Edwards et al., 2006).

Of note is that both residents and rescue workers who participated in the medical examination or epidemiological study even reported elevated levels of psychopathology and fatigue, increased health anxiety and somatic sensitivity 6 weeks after communication of the first results of an epidemiological study, compared to a baseline measurement that was conducted at least one year before. A possible explanation for this deterioration of health complaints and worries could be that participating in a health epidemiological study affects the mental and physical well-being of study participants due to an increased self-awareness of current physical and mental health problems (e.g. Jacomb et al., 1999; Parslow, Jorm, Christensen & Rodgers, 2004; Turnbull, McLeod, Callahan & Kessler, 1988).

The second aim of the present study was to investigate individual characteristics which may moderate the effectiveness of the health information provided.

Especially residents who had participated in the individual medical examination were less satisfied with the way the epidemiological study was carried out and most strongly attributed their health complaints to toxic exposure. Overall, the conviction that their health complaints were caused by toxic exposure and to a lesser extent dissatisfaction with the way in which the epidemiological study was carried out, were related to more severe health complaints and worries in both rescue workers and residents. According to the Elaboration Likelihood Model (ELM) (Petty & Cacioppo, 1981) communication may be more effective when it is perceived as personally relevant. Although the present health information was given in a kind of one-size-fits-all approach, it may be assumed that the health information provided was more personally relevant especially for rescue workers who participated in the epidemiological study on which the communicated information of the health consequences of disaster exposure was based. Partly in accordance with this presupposition, we found that satisfaction with the way in which the study has been carried out was highest in rescue workers from both studies and that the conviction that health complaints were due to toxic exposure was lowest in the rescue workers in the epidemiological study. Moreover, in the latter group only a positive association of satisfaction with the study execution and quality of life was observed. These data can be interpreted as indicating that because the health information provided was more suited to rescue workers from the epidemiological study, the study results were more favourably received in this sample in particular.

It is remarkable that reassurance by physicians or medical information at follow-up was not reduced in those rescue workers and residents which had been personally informed of the results of their medical investigation six weeks after the medical examination. This result contrasts with the finding that in rescue workers and residents which did not receive personal feedback on their medical investigation and only received the public communication of the study at follow-up reassurance was decreased. This finding underscores the importance of a face-to-face contact with a physician in which individualized information and advice is given. Personalized health information may be more reassuring than general health information (Edwards et al., 2006). The importance of immediate, individualized, and specific (as opposed to delayed, generalized, and global) feedback has also long been recognized in other fields such as behaviour therapy (e.g., Ferster & Skinner, 1957). It is clear that the communication of the epidemiological results in the present study fails to meet all of these characteristics.

The finding that participants who believed their symptoms to be caused by toxic exposure during the disaster were less likely to accept the epidemiological results, is in line with the previously mentioned theoretical notions of motivational biased reasoning (e.g., Croyle et al., 1997) and the cue adaptive reasoning account (Renner, 2004), although these models explain reduced acceptance of the results in differing

ways. According to the motivational biased reasoning perspective, the favourable epidemiological results were unexpected for participants who believed in toxic exposure during the disaster, thus invoking self-defensive processing strategies that undermine the information to preserve consistency in the sense of self. Alternatively, according to the cue adaptive reasoning account, the unexpected favourable results would have invoked an increased amount of cognitive processing in these participants, thereby increasing the likelihood of detecting shortcomings in the information and rejecting the findings. Especially in a context of distrust and reduced faith in experts as also applies to the participants in our study, belief systems may be more immune to change on the basis of objective information (García-Mira, Real, Uzzell, San Juan & Pol, 2006; Prince-Embury, 1992b). Perceptions of trust and credibility in the government depend mainly on public perceptions of commitment (Peters, Covello & McCallum, 1997) and without such trust it is unlikely that institutions can effectively convince the public that e.g. a hazardous waste site is safe again (Williams, Brown & Greenberg, 1999).

Apart from factors included in the theoretical models above, other factors could also have negatively influenced the impact of the health information provided to our study participants. One possible explanation might be the large time-interval between the disaster and communication of the epidemiological findings. In a longitudinal study after an explosion of a fireworks depot, van den Berg, Grievink, Stellato, Yzermans and Lebret (2005) found a gradual decrease in the number of physical symptoms, although the survivors still reported more symptoms than controls four years after the disaster. They argue that no theories about possible exposure to toxic substances developed in the aftermath of this disaster, because of the reassuring results of the blood and urine samples that were obtained as early as three weeks after the disaster. In the years following the Bijlmermeer aviation disaster particularly the persistence of rumours about the possible toxic cargo of the plane led to a growing unease among the residents of the Bijlmermeer district as well as among the rescue workers involved in the disaster (Boin et al., 2001).

Pre-disaster pathology may also have contributed to ineffectiveness of the communication of health information to study participants. In a longitudinal study using medical records of general practitioners after the previously mentioned fireworks disaster, Yzermans et al. (2005) showed that victims with pre-disaster psychological problems were at a greater risk for post-disaster problems and that relocated victims showed an excess of medically unexplained physical symptoms (MUPS) especially in a period of increased media attention. The prevalence of MUPS tended to increase in the two and a half years following the disaster. Although these findings resemble the increase in health complaints in our study, they are unfortunately not fully comparable since in the present study pre-disaster data were not available. Because mental disorders occur more frequently in persons from socio-economically deprived

urban areas (Reijneveld & Schene, 1998) such as the Bijlmermeer district, it is conceivable that especially in residents pre-disaster levels of psychological problems, aggravated by the disaster and associated feelings of lack of recognition or compensation for losses, have fuelled the illness attribution of health complaints being caused by exposure to toxic substances. This selective attribution of elevated and persistent health complaints to toxic effects may reflect a process of 'effort after meaning' making this attribution more immune to correction by objective information, because the attribution of health complaints to a large extent reflects the severity of health complaints (cf. McNally, 2003). This hypothesis is corroborated by the study of Donker et al. (2002) who showed that patients tended to attribute their symptoms to the plane crash in Amsterdam six years later, possibly to maintain self-esteem and perceptions of the world as predictable and controllable, while their GPs related only a small proportion of these symptoms to the disaster. Moreover, one out of nine symptoms attributed to the disaster by the patients, had already been reported to the GP before the disaster took place.

Some limitations of this study should also be mentioned. First, it is questionable whether the baseline measurement can be considered as a true first measurement because of the large time-interval between this measurement and the communication of the results of the epidemiological study. Given the elevated or even higher scores for complaints and concerns at follow-up, regression to the mean is an unlikely alternative explanation of the present findings. Also, we could not completely control for selection bias since some of the participants who were invited to participate in the epidemiological study also applied for participation in the medical examination and in the present study were included in the latter group only. Police officers who voluntarily underwent the medical examination more often reported health complaints and traumatic events than police officers who were invited to participate in the epidemiological study but did not volunteer to have a medical examination (Huizink et al., 2006). Finally, at baseline we did not investigate existing attributions concerning toxic exposure or other connections between complaints and the disaster. We can therefore only conclude that at follow-up the belief in toxic exposure is present, especially among residents, but we cannot detect possible changes in this conviction. However, in the epidemiological study among rescue workers attributions were also measured at baseline (Slottje et al., 2006), showing that 43% to 49% of the rescue workers involved in the disaster with long-term physical complaints somehow attributed these to the disaster and its aftermath. Nevertheless, in that study no explicit questions related to attributions with respect to exposure to toxic substances were asked.

In sum, communication of essentially favourable findings of an epidemiological study on the health consequences of exposure to an aviation disaster among rescue workers did not result in reduction of subjective health complaints or health worries

as hoped for by the Parliamentary Inquiry advising to start this epidemiological study. It could even be argued that the execution of the epidemiological study and the communication of its results to residents and rescue workers may have inadvertently promoted health complaints and worries even though the stated aim was to provide reassurance. Future studies must be more attentive to maximizing the effectiveness of health communication by identifying specific strategies that promote more thoughtful information processing. For health information to have impact on cognition, affect and behaviour individualizing of the communication with respect to characteristics such as pre-existing beliefs or individual cognitive styles (such as need for cognitive closure and ability to tolerate ambiguity) seem to be of paramount importance.

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