

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

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Chapter 3

Participation in a trauma-focused epidemiological investigation may result in sensitization for current health problems



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Abstract

Objective Participation in health survey research may result in a worsening of self-assessed health status and enhanced service-use by increasing self-awareness of current health status. The present study investigated whether participation in a trauma-focused epidemiological study sensitized participants for health problems irrespective of trauma exposure.

Method 1019 rescue workers and 453 residents involved in varying degrees in a large scale aviation disaster participated. Data collection took place between December 2000 and April 2003. There were two measurements: one during the epidemiological investigation at a general hospital and one 12 weeks after the first measurement. Follow-up data were gathered in 80% of a randomly selected group of rescue workers and in 62% of the residents. Main outcome measures were: health anxiety, somatic sensitivity, the tendency to be reassured by a physician, psychopathology, post-traumatic stress symptoms, fatigue and quality of life.

Results Both rescue workers and residents reported less reassurance, and increased health anxiety and somatic sensitivity 12 weeks after the investigation compared to the first measurement. Exposure to the aviation disaster was not predictive of these changes in health perception, but higher levels of psychological and physical symptoms at baseline were. Only 0.2% to 1.6% of the residents and rescue workers indicated at baseline that the investigation had had a very negative impact on their mental and/ or physical well-being. No evidence for systematic trends or changes in baseline scores for anxiety about health or subjective complaints during the 15 months inclusion period were found.

Conclusions Participation in an epidemiological study of the long term sequelae of disaster exposure does not lead to very strong negative reactions in most of the participants, but can result in an increased awareness of somatic sensations, enhancement of health worries and lowered reassurability by physicians, especially in participants with higher levels of psychological and physical symptoms at baseline. Future studies are needed to investigate the temporal stability of these inadvertent and unobtrusive negative consequences.

Introduction

In epidemiological studies on mental health, participants are questioned with the use of interviews or self-report scales about potentially sensitive aspects of their lives, which could result in distress, resentment and other negative feelings. Both ethical codes and government regulations require researchers to identify risks and benefits of participating in research so that potential participants can make an informed judg-

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ment about participation based on knowledge of potential positive and negative consequences. Given the great relevance of this issue for mental health, it is striking that only very few studies have empirically investigated the effects of participating in health studies on the mental and physical well-being of study participants [e.g. 12, 14, 15, 22, 31]. The results of these studies suggest that although only a very small minority of approximately 5% of the participants report negative effects of completing questionnaires or interviews on their health status, participation may result in a worsening of self-assessed health status and increased service-use. Pre-existing childhood adversity, anxiety and dysfunctional personality characteristics may increase the likelihood of these negative reactions to study participation [12, 14, 31]. Possibly these risk factors predict adverse reactions to research participation because they all converge to an increased self-awareness of current physical and mental health problems [cp. 22]. Whether such an increased awareness indeed underlies negative reactions to participation in health surveys has never been systematically investigated however.

Specifying the risks associated with participation in trauma-focused studies is even more complicated, because this kind of research may cause additional distress to participants as a result of their being asked to recall details of their trauma [23]. In addition, potential participants may struggle with various psychological, medical, economic, and social difficulties secondary to the trauma [7, 20]. In a recent review on the risks and benefits of participating in trauma-focused research studies [20], it was concluded that the limited available evidence suggests that although a small subset of participants report strong negative emotions or unanticipated distress, the majority of these participants do not regret or negatively evaluate the overall experience of research participation.

Of the twelve studies reviewed by Newman and Kaloupek [20] only one study investigated the impact of research participation following exposure to a large-scale traumatic event. Galea et al. [8] surveyed 5,774 individuals of the general population in New York City 1 to 9 months after the terrorist attacks on September 11, 2001. The prevalence of upsetting emotional distress after the assessments conducted within a year of the terrorist attacks was relatively modest (13%) and negative reactions were short-lived and rarely persisted beyond the assessment itself. The following factors were predictive of being upset by the assessments: being aged 45-64, female gender, not being married, not having health insurance, being directly affected, having current mental health problems, and having mental health problems since the attacks. Up till now no studies exist which have investigated the impact of participation in research conducted in the long-term aftermath of large-scale disasters, although a large proportion of disaster research is conducted at substantial post-disaster time intervals [21].

On October 4th 1992 a freight Boeing 747 crashed in the Bijlmermeer district of

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Amsterdam, the Netherlands. The death count totalled 43 (including the plane's crew) and 266 apartments were destroyed. Discussions ensued about the health consequences for surviving residents and rescue workers, fuelled by speculations about the possible toxic cargo of the airplane. These growing uncertainties resembled the concerns among survivors of toxicological disasters [10]. In their article about toxic fear, Boin, van Duin and Heyse described how the Bijlmermeer air disaster developed into a public health crisis [3]. The governmental reaction of crisis termination, combined with a collective underestimation of the possible effects of 'toxic fear' resulted in heightened public concern. Instigated by a Parliamentary Inquiry, political pressure in January 2000 led to a large-scale controlled epidemiological study, which had to investigate whether the long term health effects could be attributed to exposure to this disaster both in residents of the Bijlmermeer and in occupationally involved rescue workers.

The Medical Investigation Bijlmermeer Aviation Disaster project was executed more than 8 years after the aviation disaster. It therefore provided a unique opportunity to assess the impact of participating in an epidemiological study of the long term consequences of exposure to a large-scale disaster in both victims of this disaster and professionally involved rescue workers. The project enabled us to replicate previous findings on the impact on health functioning of participating in an epidemiological study of the short term consequences of trauma exposure in a study of the long term consequences of trauma exposure. In addition, it allowed us to expand previous knowledge by (a) using a prospective design to study possible longer lasting effects of research participation on psychological and physical health; (b) including residents with various degrees of disaster involvement as well as professionally involved rescue workers; (c) including a non-exposed reference group to investigate whether the impact of research participation depends on trauma exposure; and (d) including measures for increased self-awareness of health problems to investigate the mechanism underlying an adverse reaction to participation in traumafocused epidemiological research. Based on Parslow et al. [22], discussed above, it was hypothesized that participation in an epidemiological study so many years after trauma exposure would result in an enhanced and persistent awareness of current psychological and physical health problems irrespective of (the degree of) disaster exposure. In addition, findings by Galea et al. [8] led to the second hypothesis that this effect would be more pronounced in participants with higher current levels of psychological and physical health problems.

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Method

Overview

The full project consisted of several studies of which the purpose and methods are described elsewhere [19, 26]. Previous reports of the Medical Investigation Bijlmermeer Aviation Disaster have already shown that exposed rescue workers reported more subjective physical and psychological health complaints than non-exposed colleagues [25, 27, 35]. However, no consistent significant differences between exposed and non-exposed workers were found with regard to several clinical parameters in urine and blood samples, such as blood cell counts, creatinine clearance, and autoantibody serology.

The present study is a prospective longitudinal study in which both residents and rescue workers were assessed at two time points: during the medical investigation (baseline, between 8 and 10 years after the disaster) and 12 weeks after the first examination (follow-up measurement). The last measurement was executed by mail. The research protocol was approved by the Medical Ethics Committee of the Leiden University Medical Center, and after having been informed about the purpose of the study and the (re-)assessments all participants gave written informed consent.

Participants and procedure

The present study took place between December 2000 and April 2003 at a general hospital in Amsterdam, the Netherlands. An epidemiological study was performed into medical and psychological outcomes in which rescue workers who were and who were not involved in the disaster were compared, as well as residents with varying involvement in the disaster. The group of rescue workers consisted of professional fire-fighters employed in the Amsterdam fire department at the time of the disaster (almost all involved) and a control group employed afterwards, police officers from the regional police force all employed on the date of the disaster and still employed at the start of this study, and accident and wreckage investigators both involved and not involved in the transport, security and sorting of the wreckage. At the time of the disaster, all residents were at least 16 years of age and registered as living in the Bijlmermeer district of the city of Amsterdam.

All participants were invited to participate in this 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), measurement of body height and weight, and collection of blood, saliva and urine samples. Because the last measurement was executed by mail, all participants that were unable to fill in Dutch or English versions of the questionnaires at baseline without assistance were excluded from this study. Most questionnaires are validated in both Dutch and English populations, except for the Reassurance Questionnaire and the

Checklist Individual Strength, which are only validated in Dutch. Only five (0.49%) rescue workers and one (0.22%) resident were English-speaking. The procedure of the medical investigation was described in more detail by Slottje, Huizink et al. [26]. Participants in the present study did not receive any individual feedback on the results of their medical investigation, unless the medical investigation revealed that further medical examinations were necessary.

Outcome measures

To measure awareness of current health status we used the Dutch version of the Somatosensory Amplification Scale [2,29] which measures the tendency to experience somatic sensations as intense and harmful; the Dutch version of the Health Anxiety subscale [29] adapted from the Illness Attitude Scales [16] to measure the degree of worry and anxiety about health; and the Reassurance Questionnaire to measure the extent to which a patient generally feels reassured by medical information provided by physicians [28].

Subjective complaints about physical and psychological health were investigated using the Dutch version of the General Health Questionnaire-12 to measure the general level of psychopathology [9,17]; the Dutch version of the Impact of Event Scale to assess post-traumatic intrusion and avoidance symptoms related to the air disaster [4, 13]; the total score on fatigue of the Checklist Individual Strength (CIS) [33]; and the EQ-5D, developed by the Euroqol Group [6] to measure health-related quality of life.

Rescue workers were considered involved in the disaster when they had performed at least one of the following tasks: rescuing people, fire-extinguishing, providing security, providing first aid or support, cleaning up of destructed area, transport of injured, identification of victims, sorting of possible contaminated wreckage, transport of wreckage, burning of contaminated soil, or other disaster-related tasks (e.g. traffic management, or other tasks in hangar in the presence of the wreckage). Residents were divided into three groups on the basis of the distance of their homes to the disaster site, as a proxy of their degree of involvement in the disaster. The residents who lived in one of the three struck apartment buildings were considered most involved. The second group of residents, while still living in the district, lived at maximum distance from the disaster site, and was considered least involved. The third group consisted of residents who lived in between the two other areas, and was considered to be intermediately involved.

In addition to this objective measure of involvement, residents were asked whether they had experienced one or more of the following events during the disaster: being present in struck apartments, witnessing dead or injured people, being in danger of life, becoming injured, having one's apartment damaged, having one's partner or children in danger of life, injured or died, or having other family mem-

bers died. These events are likely to meet criterion A1 of the diagnostic criteria for Post Traumatic Stress Disorder [1], which defines potentially traumatic events [26].

Finally, participants were asked two questions about the influence of participating in the investigation on their psychological and physical condition at baseline. Answers were given on a 5-point Likert scale ranging from 1 ('in a very negative way') to 5 ('in a very positive way').

Analyses

To measure changes in health experience between baseline and follow-up, repeated measures analyses of variance were performed with exposure to the disaster as between subjects variable and time as within subjects variable. 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 \geq .75 large [30].

Because it was hypothesized that changes in self-awareness of health status (as assessed with the SAS, HA subscale of the IAS and RQ) will be correlated, it was first investigated whether the changes on these variables could be transformed in one principal component accounting for as much of the variability in the data as possible. To this end a principal component analysis was conducted on the 12 week follow-up residualized change scores on these measures (obtained by statistically correcting the follow-up scores for any baseline differences on these measures). Next, using the regression method a composite factor score for change in self-awareness of current health problems was calculated. The association of this change score with demographic and clinical variables was investigated with Pearson correlation coefficients or *t*-tests for independent samples as appropriate. Finally, Chi-square analyses were performed to analyze in residents the association of our objective measure of trauma involvement (i.e. place of domicile) with subjective self-reports of trauma exposure.

Results

Study group

1019 rescue workers participated, including 143 fire-fighters, 685 police officers and 191 accident and wreckage investigators. 254 rescue workers (25.2%) were directly involved in the disaster by having performed disaster-related tasks. In addition, 453 residents who lived in the neighborhood during the disaster participated. The most involved group consisted of 195 residents (43.6%), the least involved group of 123 residents (27.5%) and the intermediately involved group of 129 resi-

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dents (28.9%). Of the potential participants in the follow-up measurement, 501 (80%) of the randomly selected rescue workers and 278 (62%) of the residents responded. A description of the participants in valid percentages is shown in Table 1. The rescue workers were predominantly male, whereas among residents women were somewhat overrepresented. Most rescue workers had completed secondary education, while residents reported more primary as well as higher education. Almost all rescue workers were of a western ethnicity, whereas almost half of the residents were of a non-western background (mainly Dutch-speaking Surinamese and Netherlands Antilles).

Characteristics	Rescue workers ($n = 1019$)	Residents $(n = 453)$
Age: mean (SD), years	43.6 (7.7)	42.3 (13.8)
Gender *:		
Men, No. (%)	923 (90.7)	188 (41.5)
Women, No. (%)	95 (9.3)	265 (58.5)
Education *:		
Primary, No. (%)	276 (28.7)	147 (34.0)
Secondary, No. (%)	496 (51.6)	133 (30.8)
Higher, No. (%)	189 (19.7)	152 (35.2)
Ethnicity *:		
Western, No. (%)	985 (97.1)	255 (56.8)
Non-western, No. (%)	29 (2.9)	194 (43.2)

Table 1. Demographic characteristics of participants

*Numbers do not add up because not all the respondents answered these questions, % are valid.

Changes in health experience

Table 2 shows the changes in health experience of involved and not involved rescue workers between the time of the medical investigation (baseline) and 12 weeks later (follow-up). All rescue workers were more sensitive to somatic sensations (SAS), more anxious about their health (HA) and less reassured (RQ) 12 weeks after the examination than at baseline. In addition, they reported more symptoms of fatigue (CIS) and psychopathology (GHQ) than at baseline. All effect-sizes were small or

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negligible, except for somatic sensitivity which showed a medium effect-size. There were no significant interaction effects between group and time, which shows that the change in health experience did not differ between involved and non-involved rescue workers. The only difference between the two groups of rescue workers, i.e., those who were involved and those who were not, was that the former group showed more post-traumatic stress symptoms at baseline and follow-up (F(1)=6.3, p<.05).

	Involved	l (<i>n</i> =123)	Not involv	ed (<i>n</i> =370)	<i>F</i> (1, 491) time	<i>F</i> (1, 491) group x time	d time
	baseline	follow-up	baseline	follow-up			
	M(SD)	M(SD)	M(SD)	M(SD)			
GHQ	0.7 (1.5)	1.1 (2.4)	0.9 (1.9)	1.0 (2.1)	5.1*	1.9	.09
IES	1.2 (3.3)	1.3 (3.7)	0.4 (2.7)	0.7 (3.2)	1.2	0.1	.07
CIS	39.9 (15.7)	45.0 (19.0)	42.2 (20.9)	46.5 (22.3)	33.7***	0.2	.22
EQ-5D	0.93 (0.1)	0.93 (0.1)	0.92 (0.1)	0.94 (0.1)	3.8	2.9	.20
HA	5.3 (5.1)	6.4 (6.7)	5.3 (5.3)	6.3 (5.9)	16.1***	0.0	.19
RQ	5.9 (4.4)	7.3 (5.1)	6.6 (4.9)	7.3 (5.4)	18.3***	2.2	.17
SAS	6.4 (3.7)	8.7 (4.0)	6.8 (4.0)	8.6 (3.8)	111.1***	2.3	.47

Table 2. Changes in health experience of rescue workers between time of examination (baseline) and 12 weeks later (follow-up)

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.

Twelve weeks after the first investigation residents also showed more signs of health anxiety and somatic sensitivity and less reassurance by physicians than at baseline (Table 3). However, they did not report an increase in subjective health complaints. On the contrary, self-reported quality of life somewhat improved. The effect-sizes were again small or negligible and there were no significant interaction effects between group and time, meaning that the change in health experience did not differ between residents varyingly involved in the disaster. The groups differed from each other regarding post-traumatic stress symptoms (F(2)=4.6, p<.05), fatigue (F(2)=3.9, p<.05), reassurance (F(2)=3.3, p<.05) and somatic sensitivity (F(2)=4.2,

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p<.05), however. Residents who lived within the disaster area reported more concerns and complaints at baseline and at 12 weeks compared to residents who lived more remote from the disaster area.

Table 3. Changes in health experience of residents between time of examination (baseline) and 12 weeks later (follow-up)

	Most involv	ved (n=111)	Intermedia	ate (n=85)	Least invol	ved (n=78)	F(1, 271)	<i>F</i> (2, 271)	d	
							time	group x time	time	
	baseline	follow-up	baseline	follow-up	baseline	follow-up				
	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)				
GHQ	2.9(3.7)	3.0(3.9)	2.3(3.3)	2.5(3.4)	1.8(3.3)	2.6(3.4)	3.1	1.3	.01	
IES	12.7(17.9)	14.7(18.9)	9.2(13.4)	7.9(12.1)	7.5(15.1)	8.0(13.9)	0.4	2.2	.04	
CIS	69.4(30.1)	68.0(30.3)	59.4(27.3)	60.4(27.9)	56.8(28.2)	59.6(29.0)	0.4	1.0	.02	
EQ-5D	0.75(0.3)	0.76(0.3)	0.77(0.2)	0.83(0.2)	0.82(0.2)	0.84(0.2)	6.1*	1.0	.14	
HA	10.7(8.7)	12.6(9.5)	8.5(8.2)	10.8(8.5)	8.9(8.2)	10.5(8.6)	25.2***	* 0.3	.22	
RQ	10.8(7.0)	11.7(7.1)	8.8(7.0)	10.2(7.5)	8.3(6.7)	9.2(7.5)	11.1**	0.4	.14	
SAS	12.5(6.1)	14.8(6.4)	10.8(5.6)	12.2(5.7)	11.0(5.9)	13.1(6.0)	38.4***	⊧ 0.8	.32	

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; RO = Reassurance Questionnaire: SAS = Somatosensory Amplification Scale.

Prediction of increased self-awareness of health problems

A principal component analysis (PCA) on the residualized gain scores on the SAS, HA subscale and RQ in rescue workers clearly yielded a one-factor solution (eigenvalue 1.6) accounting for 54.1% of the variance. Factor loadings were high (respectively 0.53, 0.84 and 0.80). A PCA in residents yielded similar results: a one-factor solution (eigenvalue 1.8) accounting for 58.9% of the variance with high factor loadings (respectively 0.72, 0.80 and 0.78).

Of the investigated predictive demographic and clinical risk factors (age, gender, ethnicity, education, trauma exposure, GHQ, IES, CIS, and EQ-5D), in rescue workers, besides gender (t(1)=2.3, p<.05), also the measurements for severity of fatigue and psychopathology were predictive of changes in the self-awareness of mental

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health problems (see Table 4). In residents, besides ethnicity (t(1)=-2.6, p<.01) and education (F(2,234)=10.0, p<.001), all of the scores for mental and physical health were predictive of changes in self-awareness of health status. These results clearly indicate that participants with higher levels of psychological and physical symptoms are more prone to increased self-awareness of their current health status. The same holds true for male rescue workers and residents of a non-western ethnicity and a lower level of education.

	Composite factor sc	Composite factor score for change		
	Rescue workers	Residents		
GHQ	.13*	.17**		
IES	.05	.15*		
CIS	.24***	.22***		
EQ-5D	11	16*		

Table 4. Prediction of increased self-awareness of health problems

Pearson correlation coefficients. *p<.05; **p<.01; ***p<.001. GHQ = General Health Questionnaire; IES = Impact of Event Scale; CIS = Checklist Individual Strength; EQ-5D = EuroQol-5 Dimensions

Evaluation of medical investigation

The subjective evaluation of the medical investigation by residents and rescue workers can be found in Table 5. Most of the participants did not indicate that the medical investigation had any impact on their psychological or physical condition and more participants judged participation to have had a positive instead of negative impact on their health. Of note is that only about 0.2 to 1.6% of the residents and rescue workers indicated that the investigation had had a very negative impact on their mental and/ or physical well-being.

Table 5. Impact of participating in investigation on psychological and physical condition

	Rescue workers		Residents	
Impact,	Psychological	Physical	Psychological	Physical
No.(%)	condition	condition	condition	condition
Very negative	3(0.3)	4(0.4)	7(1.6)	1(0.2)
Negative	11(1.1)	9(0.9)	34(7.6)	25(5.5)
No influence	864(85.4)	873(86.3)	276(61.3)	310(68.4)
Positive	108(10.7)	98(9.7)	105(23.3)	87(19.2)
Very positive	26(2.6)	28(2.8)	28(6.2)	30(6.6)

Relation between involvement of residents and self-reported exposure to trauma To assess whether the division of the residents in three groups according to their place of domicile concurred with self-reported trauma exposure, we compared the groups on the traumatic events they had experienced at the time of the disaster. Results are shown in Table 6. Twice as many residents from the disaster area reported having experienced at least one traumatic event when compared to the least involved group of residents. The intermediately involved group mostly reported percentages that lay in between the two other groups.

Table 6. Number and percentage of residents reporting traumatic events by degree of involvement

Traumatic event, No. (%)	Most involved (n=195)	Intermediate (n=129)	Least involved (n=123)	χ²(2)
Present in struck apartments	116 (60.7)	62 (50.0)	42 (34.4)	20.6***
Seen dead/injured	66 (37.5)	19 (19.6)	21 (25.6)	10.5**
Been in danger of life	34 (17.8)	9 (7.0)	6 (4.9)	15.7***
Became injured	5 (2.6)	1 (0.8)	0 (0.0)	4.2
Apartment damaged	39 (20.3)	2 (1.6)	0 (0.0)	49.5***
Partner/children in danger of life	34 (17.7)	7 (5.5)	4 (3.3)	21.4***
Partner/children injured	5 (2.6)	0 (0.0)	0 (0.0)	6.6*
Partner/children died	2 (1.0)	0 (0.0)	0 (0.0)	2.7
Other family members died	4 (2.1)	2 (1.6)	0 (0.0)	2.5
At least one of these events	157 (80.5)	72 (55.8)	49 (39.8)	56.2***

*p<.05; **p<.01; ***p<.001.

Stability and validity

We investigated whether the present results were affected by time effects or selection-bias. The stability of the measurements was studied by comparing scores obtained in different time periods. Participants were included over a period of approximately 15 months and the order of appointments for the medical investigation was not systematically predetermined. Measurements at baseline were divided over four equal time periods for the rescue workers and two equal time periods for the residents (because the epidemiological study among residents was cancelled after these two periods). During the first time period of the baseline measurements the rescue workers as well as the residents scored lower on sensitivity to somatic sensations than during other episodes. No other indications for systematic trends over time were found, neither in residents nor in rescue workers. It is therefore unlikely that the present study results are due to systematic trends over time (e.g. a systematic worsening of symptoms and health concerns over time).

269 rescue workers (21%) and 384 residents (46%) participated in the epidemiological study itself, but not in our study on its effects. Because the GHQ, IES, and CIS were also administered in the medical investigation we were able to compare participants and non-participants on these measures. Non-participating residents

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reported higher levels of physical and psychological complaints than participating residents at the time of the medical investigation (baseline); specifically, they showed more signs of fatigue (CIS), psychopathology (GHQ-12) and post-traumatic stress (IES) (p<.01, effect-sizes were small to medium). No differences between participating and non-participating rescue workers were present on these measures. Residents and rescue workers that did not participate were more often of a non-west-ern ethnicity than participants in our study (p<.01). In addition, there was no selective drop-out of participants. The only difference between those that took part in the last measurement (follow-up) and those that did not was that dropouts (residents and rescue workers) showed more post-traumatic symptoms at the time of the medical investigation than completers (p<.05, effect-sizes were small).

Discussion

The main aim of this study was to evaluate the effects of participating in an epidemiological investigation on concerns about health and subjective complaints among rescue workers and residents. Both groups reported less reassurance, and increased health anxiety and somatic sensitivity 12 weeks after participating in a traumafocused epidemiological research study. Rescue workers also reported elevated levels of psychopathology and fatigue whereas residents indicated an improved quality of life. Although the reported significant changes have a small to medium effect size and denote deteriorations of only modest clinical importance, the effects are remarkably consistent and clearly suggest that participation in an epidemiological investigation may have unobtrusive and pervasive effects. Irrespective of the degree of involvement in the disaster, residents as well as rescue workers showed more concerns about their health at the follow-up at 12 weeks than at the time of the examination. However, only a very small minority of the participants indicated that participating in the research study has had a very negative effect on their psychological or physical well-being. Hence, after participation in the epidemiological investigation, even among rescue workers who were in no way involved in the disaster, more signs of health anxiety, somatic sensitivity, and feelings of being less reassured by medical information of a physician were reported.

These results replicate and extend previous study results in participants of health surveys in general [e.g. 12, 14, 15, 22, 31] and of trauma-related surveys in particular [20]. Although only a very small minority of participants indicated very strong negative reactions, a more unobtrusive effect of participating in health surveys may be the enhanced awareness of current health problems. Although this possibility has been suggested by several authors as a putative mechanism accounting for a worsened self-assessed health status and service use following participation in a health

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survey [22] no studies up till now had empirically investigated this possible risk mechanism. On the basis of our study results it may be concluded that a health survey intensifies the attention for somatic sensations, enhances worries about health and even reduces the confidence of participants in medical information provided by physicians. These results are in accordance with the cognitive-behavioral model of health anxiety [24]. This model predicts that directing attention to bodily sensations and providing reassurance to patients preoccupied with their health, will result in a higher need of reassurance, stronger illness beliefs and higher levels of health anxiety.

Interestingly, this effect of participating in a trauma-focused epidemiological study was found to be independent of (degree of) trauma exposure. This is in contrast to the results of previous studies in which trauma exposure was positively associated with adverse reactions to study participation [e.g. 8, 34]. One explanation for this non-differential impact could be that the investigation in the present study had a rather pronounced medical focus and that the assessment of trauma exposure was only part of the total investigation. A more extensive assessment of trauma exposure and trauma-related consequences could have resulted in more distinct psychological effects particular in those subjects exposed to trauma.

An additional explanation for the lack of a non-differential impact can also be accounted for by the time-lag of more than eight years between the disaster and the start of the epidemiological study. Some authors have convincingly argued that exposure to the disaster's long-term aftermath may have more detrimental health consequences than the exposure to the disaster itself [3, 11, 32, 36]. This may be especially true for 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 [10]. The long and turbulent aftermath of the Bijlmermeer aviation disaster may have diminished the effect of trauma exposure on possible health effects of participating in an epidemiological study. However, other risk factors for negative reactions to health survey study participation were replicated in the present study. In concordance with the results of previous studies [12, 14, 31] it seems that in particular participants with higher levels of psychological and physical symptoms may become more aware of their current health status.

To our knowledge our study is unique in investigating the effects of participating in an epidemiological investigation after a disaster on such a large scale. Also, we were able to investigate two large groups of rescue workers as well as residents living in the disaster area, and to compare subgroups according to their degree of involvement in the disaster. Another strong point of the present study is its prospective design.

Some limitations of the present study should also be mentioned. In the absence

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of a control group of individuals not participating in a health survey or participating in a survey in which no personally relevant information is assessed, all observed effects could reflect time trends and regression to the mean. We analyzed the possible influence of time trends by dividing baseline measurements in equal time periods and found no evidence for systematic changes in scores for anxiety about health or subjective complaints as a result of passage of time however. Given the elevated scores for complaints and concerns at follow-up regression to the mean is also an unlikely alternative explanation of the present findings. As Norris et al. [21] showed in a review study among 160 samples of disaster victims, the general rule was for samples to improve as time passed and symptoms predominantly declined, even with two to 15 years between the two measurements. This makes it likely that our study results may be attributed to participation in the medical investigation.

Secondly, the validity of measurements of trauma exposure after so many years may be questioned, since empirical evidence showed that retrospective reporting of exposure to trauma may be influenced by the current physical and mental state of a person [18]. People suffering from serious psychological complaints unjustly tend to report more exposure to trauma, leading to an inflated association between exposure and outcome. In order to circumvent recall bias we therefore used the place of domicile of the residents as a more objective measure of their involvement. Of note is that this more objective measure concurred with self-reports of exposure to trauma. The group of residents who were most involved in the disaster not only reported more trauma exposure but also reported higher levels of post-traumatic stress symptoms, fatigue and somatic sensitivity and less reassurance compared to the two groups of residents with lower degrees of involvement [cp. 5]. These results suggest that our findings regarding changes in health experience in residents involved in varying degrees in the disaster are not critically affected by the operationalization of involvement in the disaster.

Finally, it is possible that factors such as social desirability or litigation issues may have influenced the answers. However, although these factors can result in over- or underreporting of health complaints, they are unlikely to influence changes in health problems during a 12 week time period 8 to 10 years after a disaster. Moreover, participants in the present study were invited to participate by the researchers and did not take part on their own initiative. Hence, they were probably more driven by compassion with the people involved in the disaster than by their own needs.

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Conclusion

To conclude, the results of our study suggest that participation in an epidemiological study of the long term sequelae of exposure to a disaster does not lead to very strong negative reactions in most of the participants, but can result in an increased awareness of somatic sensations and enhanced health worries, especially in participants with higher levels of psychological and physical symptoms. Future and better controlled studies are needed to investigate the temporal stability of these inadvertent and unobtrusive negative consequences.

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