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

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Chapter 5

Factors predictive of changes in perception of current health problems following a trauma-focused study

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Abstract

Background The aim of the present study is to assess which risk factors are related to changes in perception of current health problems after participation in a trauma-focused study among rescue workers and residents in varying degrees involved in an aviation disaster.

Methods There were measurements during the data collection of an epidemiological study or a medical examination (baseline), 12 weeks after the first investigation (short-term follow-up) and six weeks after communication of the findings of the epidemiological study among rescue workers (long-term follow-up). 3514 participants completed the baseline measurements. Standardized instruments on health anxiety, somatic sensitivity and reassurability by a physician constituted the measurement for perception of current health problems. Linear regression analyses were conducted to predict the change score in perception of current health problems on both follow-up measurements on the basis of demographic, trauma-related and study variables and physical and psychological health symptoms at baseline.

Results The multivariate prediction of the short- and long-term follow-up change scores indicated that higher levels of perception of health problems at both measurements were reported more by residents than by rescue workers, participants with a lower education, participants with a non-western background, participants with higher levels of fatigue at baseline, and participants who did not consult the physician to discuss the results of their medical investigation. Post-traumatic stress symptoms were only predictive of short-term change scores.

Conclusion Several demographic and study characteristics and clinical variables are predictive of an enhanced perception of current health problems after participation in a trauma-focused study. Exploring ways of adapting trauma-related scientific studies and medical investigations to the needs of specific vulnerable groups seems warranted.

Introduction

In recent years there has been growing attention for the emotional reactions of participants in trauma-focused studies. The risk of such research causing distress and having a negative impact on the mental state of participants has been assessed in several studies (e.g. Runeson & Beskow, 1991; Newman *et al.* 1999; Boscarino *et al.* 2004). The prevalence of distress in trauma-focused studies is generally higher than in studies which focus on the participant's psychiatric state (Jorm *et al.* 2007). However, little indication was found for any longer-term harm to participants.

In their review article on participant distress in psychiatric research Jorm *et al.*

(2007) also report on the characteristics of participants that are most likely to become distressed. Generally, they are more likely to have mental disorders or symptoms, or have risk factors such as traumatic experiences. Post-traumatic stress symptoms were associated with distress in several studies (e.g. Walker *et al.* 1997; Parslow *et al.* 2000; Galea *et al.* 2005), as well as several socio-demographic variables such as age, gender and education.

In most of the studies on participant distress the prevalence is assessed with one or a few questions asked at the end of an interview or survey study investigating other issues. The only standardized instrument used is (part of) the Reactions to Research Participation Questionnaire (Newman *et al.* 2001). We have no knowledge of any studies in this area using specific standardised instruments to assess the reaction of the participants to the content of the examination they are undergoing. Only a few studies used a pre-post design to assess longer-term effects (e.g. Parslow *et al.* 2000; Halek *et al.* 2005), let alone that a control group was included (see Celio *et al.* 2003 for a notable exception).

On October 4th 1992, a transport plane crashed into the Bijlmermeer district of the city of Amsterdam, the Netherlands, after attempting to return to Schiphol airport shortly after take-off. The death count totalled 43 (including the plane's crew), and 266 apartments were destroyed of buildings that were populated predominantly by immigrants and refugees, many of whom might have been illegal (Knipscheer *et al.* 2000). Discussions about the health consequences in surviving residents and rescue workers ensued, fuelled by speculations about the possible radioactive cargo of the airplane. In their article about toxic fear, Boin *et al.* (2001) described how the Bijlmermeer air disaster developed into a public health crisis. The governmental reaction of crisis termination, combined with a collective underestimation of the possible effects of 'toxic fear' resulted in heightened public concern. In addition, extensive media coverage of unresolved issues, such as the disappearance of the depleted uranium used as balance weight in the aircraft, created fertile grounds for further rumours (Vasterman *et al.* 2005). Instigated by a parliamentary inquiry, political pressure led more than eight years later to the Medical Investigation Bijlmermeer Aviation Disaster (Dutch acronym: MOVB). The main intention of this investigation was to reassure the participants about their health and to provide information about the consequences of the disaster in general. The MOVB consisted of two main studies: an epidemiological investigation to assess the relationship between health complaints and exposure to the disaster and an individual medical examination for all individuals who considered themselves to be suffering from the consequences of the disaster. On top of these studies an examination of the effects of participation was carried out, specifically assessing a hoped-for decrease in health complaints and worries. The MOVB provided a unique opportunity to study these effects with appropriate, health-related measures.

We reported already on the short- and long-term effects of participating in this investigation. The short-term effects of participating in the medical examination showed that residents and rescue workers showed more health anxiety and somatic sensitivity after 12 weeks, with those that attended the consultation with the physician reporting less health anxiety than those not attending (Verschuur *et al.* 2008b). Short-term effects in the epidemiological investigation yielded similar results, also showing less reassurance at 12 weeks, irrespective of exposure to the disaster. This increased perception of health problems was predicted by higher levels of psychological and physical symptoms at baseline (Verschuur *et al.* 2008a). The long-term effects of both studies were assessed 6 weeks after communication of the results of the epidemiological study among rescue workers to all participants. Elevated levels of psychopathology and fatigue, increased anxiety and somatic sensitivity were reported by all participants, fuelled by the (unjustified) conviction that their health complaints were caused by toxic exposure (Verschuur *et al.* 2007). Overall, we found no long lasting reassuring effects, and concluded that such examinations may even have counterproductive effects by sensitizing participants for health complaints.

Since we found a worsening of health concerns in the short- and long-term, among residents as well as rescue workers, both in the medical examination and epidemiological study, the aim of the present study was to predict which risk factors are most likely to cause changes in perception of current health problems across participants and settings. Because of the medical focus of both the epidemiological investigation and individual medical examination it was hypothesized that a possible negative impact would become apparent in an enhanced perception of health problems in particular. For this reason specific standardized measures for health anxiety, somatic sensitivity and reassurability by a physician were used to obtain a relevant measure for participants' distress within the context of the present study. On the basis of previous studies (for a review see, Jorm *et al.* 2007), it was hypothesized that several socio-demographic variables (e.g. age, gender, education and ethnicity), being exposed to the disaster and clinical factors (especially post-traumatic stress symptoms) are associated with short- and long-term aggregated scores of participants' perception of current health problems.

Methods

Procedure

The full project consisted of several parts, which were described in detail elsewhere (Medical Investigation Bijlmermeer Aviation Disaster Website, 2002; Slottje *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. All participants were invited to participate on the basis of clearly defined criteria in order to compare representative groups of exposed and non-exposed participants. The medical investigation in this part of the study took around two and a half hours and consisted of filling in questionnaires (assisted by medical assistants and if necessary by professional interpreters), 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.

All rescue workers and residents involved in the disaster were also offered the possibility to undergo a medical examination. Participants in this part of the study were not invited, but took part on their own initiative. Here, the procedure consisted of an individual medical examination and subsequently 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 (assisted by medical assistants and if necessary by professional interpreters), an examination of lung function, collection of blood and urine samples and medical history taking and physical examination by a medical doctor. At the consultation six weeks later 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, in the present study 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.

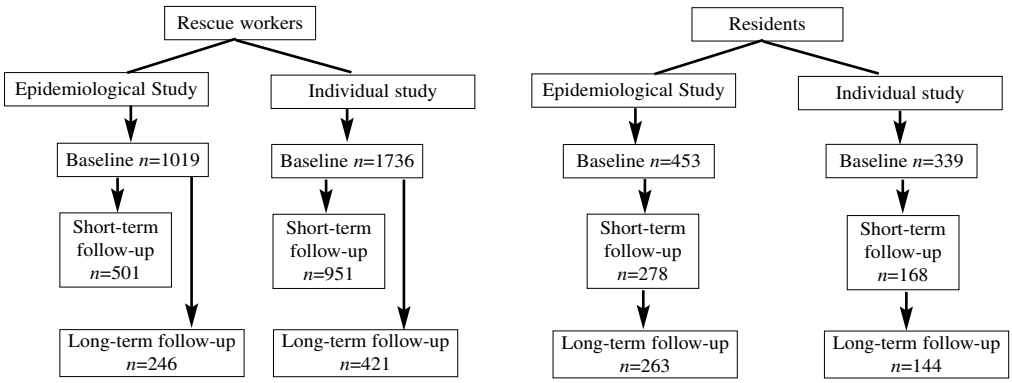
Here we report on the prediction of changes in health concerns in rescue workers and residents who participated in the epidemiological study or the individual medical examination. There were measurements at three time points: one during the data collection of the epidemiological study or the medical examination (baseline), one 12 weeks after the first examination (short-term follow-up) and one six weeks after communication of the findings of the epidemiological study among rescue workers (long-term follow-up). All participants irrespective of taking part in the epidemiological study or in the individual examination, or being rescue workers or residents, were informed of these findings. Data collection took place eight years after the disaster at a general hospital in Amsterdam (baseline) and by mail (both follow-ups). The long-term 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 of the present study was approved by the Medical Ethics Committee of the Leiden University Medical Center and all participants gave written informed consent.

Participants

In this study, 3514 rescue workers and residents completed the baseline measurements. Of these, 1883 participants took part in the short-term follow-up measurements. Of the potential participants in the epidemiological study, 501 (80%) of the randomly selected rescue workers and 278 (62%) of the residents responded to the short-term follow-up. Among participants in the individual examination, 951 (81%) of the randomly selected rescue workers and 168 (59%) of the residents responded. Long-term follow-up measurements were collected among 1068 rescue workers and residents. Here, response-(percentages) were 246 (63%) of rescue workers and 263 (59%) of residents in the epidemiological study, and 421 (71%) of rescue workers and 144 (52%) of residents in the individual examination respectively. Figure 1 shows a flow chart of the numbers of participants over the three measurements.

Figure 1. Flow chart of participants over time



All residents who completed the baseline assessment were also invited to complete the follow-up assessments. However, 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 assessments. Despite a substantial loss to both follow-up measurements, there was no selective drop-out of participants apparent. The results of the baseline comparisons between those that took part in the follow-up measurements and those that did not, were described elsewhere (Verschuur *et al.* 2007; Verschuur *et al.* 2008a; Verschuur *et al.* 2008b).

A description of the participants is shown in Table 1. At both follow-up measurements participants were predominantly male, and most participants were of a western ethnicity. Non-western participants were mainly of Surinamese, Netherlands Antilles, and Ghanaian background. More than 60% of the participants were either professionally involved in the disaster as rescue workers, or lived as residents in one of the three struck apartment buildings. About one-third of the participants did receive individual feedback on the results of their medical investigation in a consultation with the physician.

Table 1. Demographic characteristics of participants

Characteristics	Short-term Follow-up (*n*=1883)	Long-term Follow-up (*n*=1068)
Age in years: mean (SD)	44.6 (9.0)	44.6 (9.6)
Gender [a]: *n* (%)		
Men	1532 (81.4)	780 (73.0)
Women	350 (18.6)	288 (27.0)
Education [a]: *n* (%)		
Primary	539 (30.2)	295 (29.4)
Secondary	811 (45.5)	437 (43.6)
Higher	433 (24.3)	270 (26.9)
Ethnicity [a]: *n* (%)		
Western	1672 (89.4)	884 (83.5)
Non-western	199 (10.6)	175 (16.5)
Involved in disaster [a]: *n* (%)		
Yes	1216 (64.9)	646 (60.7)
No	658 (35.1)	419 (39.3)
Consultation with physician: *n* (%)		
Yes	584 (31.0)	367 (34.4)
No	1299 (69.0)	701 (65.6)

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

Outcome measures

With regard to health concerns the following questionnaires were filled in. The Dutch version of the Somatosensory Amplification Scale (SAS) (Barsky *et al.* 1990; Speckens *et al.* 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 *et al.* (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 information by a physician the Reassurance Questionnaire (RQ) (Speckens *et al.* 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 short Dutch version of the General Health Questionnaire (GHQ-12) (Goldberg, 1972; Koeter & Ormel, 1991) 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-12 in the present study was 0.89. Post-traumatic stress symptoms related to the Bijlmermeer air disaster were investigated with the Dutch version of the Impact of Event Scale (Horowitz *et al.* 1979; Brom & Kleber, 1985). 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).

Demographic and trauma-related characteristics of participants that were considered possible risk factors for enhanced perception of health problems included age, gender, educational level, western/non-western ethnicity, and whether or not they were involved in the disaster (for a review see, Jorm *et al.* 2007). We also added the study variable whether or not they consulted the physician 6 weeks after the medical investigation, because earlier we found that those that attended the consultation with the physician reported less health anxiety than those not attending (Verschuur *et al.* 2008b).

Statistical analysis

Because it was hypothesized that changes in perception 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 princi-

pal 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 perception of current health problems was calculated. The univariate prediction of this change score by demographic and clinical variables was investigated with linear regression analyses, corrected for differences between rescue workers and residents and between participants of the epidemiological study and the individual examination. To assess the unique contribution of each variable over and above these two variables, semipartial correlation coefficients will be reported. The same procedure was executed for the long-term follow-up scores, which were collected 6 weeks after communication of the results of the epidemiological study among rescue workers.

Hierarchical linear regression analyses were conducted to predict the change score in perception of current health problems on both follow-up measurements on the basis of the demographic variables and the clinical variables at baseline. First, the dummy variables that differentiated between rescue workers and residents and between participants of the epidemiological study and the individual examination were forced into the regression equation. In the next steps the demographic variables (age, gender, education, ethnicity and involvement in disaster) and the clinical variables (CIS, GHQ-12, IES, and EQ-5D) were stepwise entered into the equation (Probability of F-to-enter < .05, probability of F-to-remove > .10). In the final step whether or not the participants had a consultation with the MOVB physician was added. This was done to sort out the unique contribution of the variables in each step over and above the variance explained by the differences between participants (rescue worker or resident, epidemiological study or individual examination). In this way we could trace the most important predictors for change scores at both follow-up measurements.

Results

Univariate prediction of changes in perception of health problems

A principal component analysis (PCA) on the residualized gain scores on the SAS, HA subscale and RQ at the short-term follow-up clearly yielded a one-factor solution (eigenvalue 1.75) accounting for 58.4% of the variance. Factor loadings were high (respectively 0.70, 0.82 and 0.77). A PCA at the long-term follow-up residualized gain scores yielded similar results: a one-factor solution (eigenvalue 1.81) accounting for 60.2% of the variance with high factor loadings (respectively 0.73, 0.83 and 0.77).

Of the investigated predictive demographic and clinical risk factors (age, gender, education, ethnicity, involvement in disaster and consultation with physician, CIS, GHQ-12, IES, and EQ-5D), besides education, ethnicity, and consultation with the physician also all clinical measures were predictive of changes in the perception of health problems at the short-term follow-up (see Table 2). At the long-term follow-up, except for age and involvement in the disaster, all of the demographic and clinical risk factors were predictive of changes in perception of health status. These results clearly indicate that participants with higher levels of psychological and physical symptoms at baseline are more prone to increased perception of their current health status. The same holds for rescue workers and residents of a non-western ethnicity and a lower level of education, particularly when they did not go to the consultation with the physician. Also, at the long-term follow-up women seemed to be more aware of health problems than men.

Table 2. Univariate prediction of changes in perception of health problems controlling for participants (rescue workers vs residents) and setting (epidemiological study vs individual examination)

	Short-term Follow-up (*n*=1529)		Long-term Follow-up (*n*=941)	
Risk factors	*sr*	β	*sr*	β
Age	.038	.038	-.038	-.038
Gender	-.019	-.023	.087	.100**
Education	-.144	-.144***	-.141	-.142***
Ethnicity	.127	.152***	.210	.244***
Involved in disaster	-.004	-.005	-.054	-.063
Consultation with physician	-.181	-.215***	-.105	-.149**
CIS	.173	.188***	.097	.109**
GHQ-12	.134	.142***	.062	.066*
IES	.182	.216***	.119	.141***
EQ-5D	-.167	-.185***	-.101	-.111**

*p<.05; **p<.01; ***p<.001. *sr* = semi-partial correlation coefficient; β = standardized B; CIS = Checklist Individual Strength; GHQ-12 = General Health Questionnaire; IES = Impact of Event Scale; EQ-5D = EuroQol-5 Dimensions.

Multivariate prediction of changes in perception of health problems

In order to analyse the multivariate prediction of changes in perception of health problems on the basis of demographic and clinical variables at baseline, two hierarchical linear regression analyses were conducted, on both follow-up measurements. In Table 3 the results are shown of the multivariate prediction of the short-term follow-up change score. The variables that differentiated rescue workers from residents and participants of the epidemiological study from participants in the individual examination accounted for 10% of the variance in the short-term follow-up score (F (2,1406) = 77.35, $p < .001$) with the difference between rescue workers and residents as the only significant predictor. In the final model, of the demographic variables only education and ethnicity were significant predictors, and of the clinical variables the scores at baseline on fatigue (CIS) and post-traumatic stress symptoms (IES). In the final step whether or not the participants had a consultation with the MOVB physician explained a small although significant additional amount of 3% of the variance independent of and in addition to the other variables in the equation (F change (1,1401) = 55.14, $p < .001$). Of note is that the difference between the participants of the epidemiological study and the individual examination, although significant in steps 4 and 5, was no longer an independent predictor in the final model. These results indicate that especially residents with a lower education, non-western background, higher levels of fatigue and post-traumatic symptoms at baseline, who did not consult the MOVB physician report higher levels of perception of health problems three months after the investigation.

Table 3. Multivariate prediction of short-term changes in perception of health problems

	Short-term Follow-up			
Model	β	p-value	Total R^2	ΔR^2
Step 1			.099	.099
Rescue workers/Residents	-.305	.000		
Epidemiological/Individual	-.025	.362		
Step 2			.120	.021
Rescue workers/Residents	-.304	.000		
Epidemiological/Individual	-.033	.211		
Education	-.146	.000		
Step 3			.130	.010
Rescue workers/Residents	-.237	.000		
Epidemiological/Individual	-.042	.117		
Education	-.135	.000		
Ethnicity	.118	.000		
Step 4			.150	.020
Rescue workers/Residents	-.182	.000		
Epidemiological/Individual	-.075	.005		
Education	-.123	.000		
Ethnicity	.106	.000		
CIS	.155	.000		
Step 5			.158	.008
Rescue workers/Residents	-.144	.000		
Epidemiological/Individual	-.095	.001		
Education	-.114	.000		
Ethnicity	.080	.009		
CIS	.123	.000		
IES	.117	.000		
Step 6			.190	.032
Rescue workers/Residents	-.129	.000		
Epidemiological/Individual	.013	.669		
Education	-.109	.000		
Ethnicity	.086	.004		
CIS	.125	.000		
IES	.118	.000		
Consultation with physician	-.211	.000		

CIS = Checklist Individual Strength; IES = Impact of Event Scale.

Table 4 shows the results of the multivariate prediction of the long-term follow-up change score. Again, the variables that differentiated rescue workers from residents and participants of the epidemiological study from participants in the individual examination accounted for well over 10% of the variance in the long-term follow-up score (F (2,847) = 48.99, $p < .001$), the difference between rescue workers and residents being the only significant predictor. In the final model, of the demographic variables ethnicity turned out to be a more important predictor than education, and of the clinical variables only the score at baseline on fatigue (CIS) was a significant predictor. Even on the long-term follow-up, whether or not the participants had a consultation with the MOVB physician six weeks after the first investigation, explained a small although significant additional amount of 1% of the variance independent of and in addition to the other variables in the equation (F change (1,843) = 7.62, $p < .01$). The difference between the participants of the epidemiological study and the individual examination was not an independent predictor in any step. So, particularly residents of a non-western background and a lower level of education, with higher levels of fatigue at baseline, who did not consult the MOVB physician, report higher levels of perception of health problems even more than one year after the investigation.

Table 4. Multivariate prediction of long-term changes in perception of health problems

	Long-term Follow-up			
Model	β	p-value	TotalR^2	ΔR^2
Step 1			.104	.104
Rescue workers/Residents	-.321	.000		
Epidemiological/Individual	-.002	.954		
Step 2			.146	.042
Rescue workers/Residents	-.200	.000		
Epidemiological/Individual	-.017	.601		
Ethnicity	.237	.000		
Step 3			.161	.015
Rescue workers/Residents	-.210	.000		
Epidemiological/Individual	-.019	.569		
Ethnicity	.216	.000		
Education	-.124	.000		
Step 4			.166	.005
Rescue workers/Residents	-.175	.000		
Epidemiological/Individual	-.040	.239		
Ethnicity	.213	.000		
Education	-.112	.001		
CIS	.081	.023		
Step 5			.173	.007
Rescue workers/Residents	-.152	.000		
Epidemiological/Individual	.037	.401		
Ethnicity	.219	.000		
Education	-.108	.001		
CIS	.082	.022		
Consultation with physician	-.122	.006		

CIS = Checklist Individual Strength.

Discussion

The aim of the present study was to assess which risk factors are related to changes in perception of current health problems when participating in a research study on health complaints after trauma exposure. We used standardized instruments on health anxiety, somatic sensitivity and reassurability by a physician to record perception of current health problems. It was hypothesized that several socio-demographic, trauma-related and clinical factors are associated with short- and long-term composite change scores.

Risk factors for an enhanced perception of health problems at short and long-term follow-up proved to be very consistent. Residents more than rescue workers, participants with a lower education, participants from a non-western background, participants with higher levels of fatigue at baseline, and participants who did not consult the MOVB physician showed more participants' distress. Post-traumatic stress symptoms were only predictive of short-term change scores. This convergence between the results of the short- and long-term prediction is remarkable, especially considering the fact that rescue workers were randomized to take part in either the short- or the long-term follow-up assessment. It is also noteworthy that the difference between the epidemiological study and the individual medical examination was not a significant predictor in the final model of the short- or long-term change scores. However, the most important element in this difference seems to be the consultation with the MOVB physician, which turned out to be an independent predictor in the short- and long-term prediction models.

First, we would like to compare our results with what is known about *demographic* characteristics of participants associated with study-distress. Martin *et al.* (1999) in a study of experiences of childhood sexual abuse also reported that a negative evaluation of participation in the study was associated with less education. Conversely, Jacomb *et al.* (1999) found a higher level of education to be a significant predictor of participants' distress. Only one study mentioned an association with ethnicity: veterans with PTSD that spontaneously reported emotional upset were more likely to be American Indian or Native Alaskan (Halek *et al.* 2005). Although in the present study women at the long-term follow-up seemed to be more aware of health problems than men in the univariate analyses, this effect was no longer present in the multivariate analyses. However, a gender difference in participants' distress has been reported in several previous studies, e.g. Jacomb *et al.* (1999), Galea *et al.* (2005) and Halek *et al.* (2005). We did not find a significant association between age and changes in perception of health problems. Previous studies also did not find consistent age effects, with younger age, middle age and older age participants all reporting more distress after participation in trauma-focused studies (Jorm *et al.* 2007).

In addition, a novel finding of the present study was the opportunity to directly compare differences in participants' distress between residents and rescue workers, showing a more pronounced perception of health problems in residents compared to rescue workers. The lower levels of perception of health problems of rescue workers could be explained by the 'healthy worker effect'. For example, in the individual medical examination a total of 63% of the residents and 26% of the rescue workers showed at baseline scores above the clinical cut-off value on the General Health Questionnaire, compared to approximately 27% in the normal population (Verschuur *et al*. 2008b). Also, the rescue workers were predominantly (≥87%) male, whereas among residents the sexes were more or less equally represented. 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 could have influenced our results. On the other hand, it is also possible that the difference between residents and rescue workers is not due to a difference in pre-disaster factors, but is more related to post-trauma factors. Residents that stayed in the area where the disaster took place probably were much longer confronted with the aftermath of the disaster than rescue workers.

Besides demographic variables, *trauma-related* variables were found to be predictive of participants' distress in several previous studies (Jorm *et al.* 2007). In contrast to these studies, we did not find that whether or not being involved in the disaster did predict the change scores at the short-term or long-term follow-up. Of note is that previous studies were either population studies in which e.g. childhood (sexual) abuse was predictive of participants' distress (Walker *et al.* 1997; Jacomb *et al.* 1999; Newman *et al.* 1999), or patient studies where the number of traumatic experiences predicted more upset than expected (Johnson & Benight, 2003; Halek *et al.* 2005). Only one study by Galea *et al.* (2005) specifically reported that being directly affected by the event studied (9/11) predicted emotional upset by survey questions 6 to 9 months after trauma exposure.

Moreover, we investigated two *study* characteristics as predictors of participants' distress. Participating in the epidemiological study vs. individual examination was not predictive of outcome, but changes in perception of current health problems were less apparent in those participants that consulted the physician, at the short term and even at the long-term follow-up. The possibility to consult a physician was only open for participants in the individual examination and used by approximately one-third of the participants. This result indicates that being given the opportunity to discuss the results of the medical examination must have had a positive effect. Of note is that in the present study medical assistants and physicians were specifically trained in discussing health worries and anxieties and giving personalized feedback in this particular group of people involved in the disaster. Dowrick *et al.* (2004)

showed that effective normalisation of unexplained symptoms includes an explanation with a tangible mechanism, grounded in patients' concerns, often linking physical and psychological factors. Without such an explanation, participants in our study tended to show more perception of health problems at the short- and long-term follow-up.

Previous studies also reported that *clinical* variables are predictive of participants' distress, in particular post-traumatic stress symptoms (e.g. Walker *et al.* 1997; Carlson *et al.* 2003; Johnson & Benight, 2003). Although in the present study all clinical variables (including level of psychopathology as assessed with the GHQ (cp. Henderson & Jorm, 1990) and post-traumatic stress symptoms as measured with the IES) were predictive of an enhanced perception of health problems, only an elevated level of fatigue (CIS) at baseline was a unique and significant predictor of participants' distress at short- and long-term follow-up. Medically unexplained symptoms after exposure to war or related events such as fatigue could exacerbate when the focus of medical care and diagnostics is on identifying objective clinical findings (Clauw *et al.* 2003). Perhaps the exhaustive diagnostic testing that took place in the Medical Investigation Bijlmermeer Aviation Disaster inadvertently gave the participants with higher levels of somatic symptoms such as fatigue the impression that the likelihood of a serious undiagnosed disease was high and as such led to a higher perception of current health problems.

The present study has some limitations. In addition to the last point, the findings of this study may not generalise to other studies on participants' distress, because of the circumstances which led more than eight years after the disaster to this investigation. As was mentioned in the introduction, there were persistent rumours concerning possible toxic contamination of the area and the instigation of the MOVB, after several other studies had been executed (e.g. Carlier & Gersons, 1997; Donker *et al.* 2002), may have contributed to the conviction that the government was trying to cover up that there was really something wrong. Especially in toxicological disasters risk perception and health anxiety are important putative mediators between trauma exposure and long-standing health problems (Havenaar *et al.* 2003). A second limitation of the present study is that we did not assess the prevalence of positive reactions but primarily focused on measuring changes in health complaints and worries. According to Jorm *et al.* (2007) participants can experience distress, and at the same time see their participation as a positive experience. Finally, since our study was designed on top of both the epidemiological and individual medical investigations to exclusively examine the effects of participation, it was not possible to introduce a control group of non-participants in those investigations. We did however compare the results of participants and non-participants in our study of the effects of participation (Verschuur *et al.* 2008a; Verschuur *et al.* 2008b). Overall, non-participants reported higher levels of physical and psychological complaints than par-

ticipants at baseline (e.g. post-traumatic stress symptoms). So, at the most our study results underestimate the effect of participation at baseline.

Several strengths of this study should also be mentioned. To our knowledge, this is the first study to use specific standardized instruments to assess relevant aspects of participants' distress in the context of a study on the health effects of trauma exposure. Also, we were able to predict longer-term effects of participation on two different moments in time. Almost 20% of variance in changes of perception of current health problems on both follow-ups could be explained by demographic and clinical variables at baseline. Ultimately, although we did not use a control group of non-participants, whether or not participants made use of the consultation with the physician turned out to be a small but independent predictor of participants' perception of current health problems.

We conclude that several demographic and study characteristics and clinical variables are predictive of an enhanced perception of current health problems after participation in a trauma-focused investigation. Exploring ways of adapting trauma-related scientific studies and medical investigations to the needs of specific vulnerable groups in order to prevent inadvertent negative reactions seems warranted.

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