

A Longitudinal Study of Posttraumatic Stress Symptoms and their Predictors in Rescue Workers after a Firework Factory Disaster

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ABSTRACT: Introduction: This is a follow up study on rescue workers participating in the primary rescue during and immediately after the explosion of a firework factory. We aimed to estimate the possible PTSD prevalence at five and 18 months post disaster, determining if the level of PTSD symptoms at 18 months could be predicted from factors measured at five months. **Methods:** we included measures of posttraumatic symptoms, social support, locus of control and demographic questions. **Results:** The possible PTSD prevalence rose from 1.6 % (n=465) at five months post disaster to 3.1% (n=130) at 18 months. A hierarchical linear regression predicted 59% of PTSD symptoms variance at 18 months post disaster. In the final regression, somatization explained the greatest part of the symptom variance (42%), followed by locus of control (29%) and major life events prior to and right after the disaster (23%). **Conclusion:** Rescue workers seemed to be relatively robust to traumatic exposure: The prevalence of possible PTSD in our study was even lower than previous studies, probably because of the less severe consequences of the disaster studied. Furthermore, we found that PTSD symptom level at 18 months post disaster was highly predicted by psychological factors, particularly by somatization. However, further investigations of traumatic responding are required in this population.

Key words: Posttraumatic stress, rescue workers, follow-up study, disaster, somatization

INTRODUCTION

The psychological reactions of rescue workers after disastrous events have been investigated in several studies. Most studies have found that compared to other trauma populations, rescue workers are relatively robust to the potential psychological consequences of being exposed to a disaster, as expressed by low rates of, for example posttraumatic stress disorder (PTSD) (Alexander & Wells, 1991; Duckworth, 1986; Erslund et al., 1989; Marmar et al., 1999; North et al., 2002). In an extensive review of the psychological consequences of disasters, Galea, Nandi, and Vlahov (2005) found PTSD prevalence rates ranging between 5 and 40% among rescue workers after human made disasters. This was a significantly lower range than that reported in direct survivors (25-75%), but higher than that reported in the normal population (1-11%) (Galea et al., 2005). However, as can be seen from the results of this review, prevalence rates vary greatly across studies. This variation may be attributable to differences in type of disaster, degree of destruction and losses, as well as methodological differences such as sampling procedures, varying measures etc. Furthermore, there is currently a paucity of knowledge related to which variables are associated with lower or higher rates of post-disaster symptomatology in rescue workers.

Alexander and Wells (1991) had the unique opportunity to compare pre- and post-disaster assessments of police officers involved in body-handling after an oil rig disaster. They also compared post-assessment data to assessments of a matched control group of police officers that were not involved in this work. The authors found no difference in symptomatology in the pre- and post-disaster assessments. Neither did they find any differences between the officers in question and the control group. These findings are taken by the authors to imply efficient coping mechanisms among the police officers in addition to

well-functioning organizational mechanisms thought to be present in the police service.

Marmar et al. (1999) studied two groups of rescue workers involved in a highway collapse after an earthquake and compared them with each other and with a control group with no experience of participating in disaster work. They found no differences between any of the groups in PTSD symptoms over time. North et al. (2002) studied fire fighters involved in rescue work after a major bombing in Oklahoma City and found a PTSD prevalence of 13% which was significantly lower than the prevalence found in a group of primary victims of the bombing (23%).

More recently, Perrin et al. (2007) found that among rescue workers contributing to the emergency during and after 9/11, there were significant differences between different occupational groups, with the lowest prevalence rates occurring for police (6.2%) and the highest for unaffiliated volunteers (21.2%). This suggests that prevalence rates were higher for occupational groups who were less prepared for work such as firefighting and search and rescue. Furthermore, they found that the level of PTSD symptoms generally increased with the number of days spent at the site.

In another study, Cukor et al. (2011) investigated the longitudinal course of PTSD among disaster workers deployed to the World Trade Center after 9/11. The authors of this study found a PTSD rate of 9.5% during the first year after 9/11, which reduced to 4.8% at four years post-disaster. This further reduced to 2.4% at six years post-disaster. The authors also found that trauma history, major depressive disorder, panic disorder, and occupational exposure at the first measurement predicted PTSD symptoms six years post-disaster.

In several studies of PTSD, across varying trauma populations, a range of different factors has proved to be of significance when trying to predict PTSD (Brewin et al., 2000; Ozer et al., 2003). Exposure to traumatic events before and after the focal traumatic experience seem

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to be somewhat related to the level of PTSD (Brewin et al., 2000). Earlier studies have found that previous traumatic experiences are related to a higher risk of developing PTSD after the focal traumatic experience (Breslau et al., 1999; Smith et al., 2008). Furthermore, peri-traumatic reactions, such as peri-traumatic dissociation, have been shown to be pertinent in relation to the development of posttraumatic symptomatology (Ozer et al., 2003). Moreover, high levels of negative affectivity have been shown to relate to high levels of PTSD (Fedoroff, Taylor, Asmundson et al., 2000). One of the factors most consistently found to predict PTSD is lack of social support after the trauma (Yap & Devilly, 2004). Also, the level of control a person feels to have over his or her life has been found to be of importance for the development of posttraumatic stress (Updegraff & Taylor, 2000). Finally, female gender is associated with an increased risk of PTSD (Ditlevsen & Elklit, 2010; Ditlevsen & Elklit, 2012). The latter study showed that accidents and disaster were associated with a larger gender difference than e.g. trauma types as serious illness and interpersonal violence.

A major disaster occurred in November 2004, when a firework factory, which was located within a residential area with 2000 inhabitants, exploded in the southern part of Denmark. The material consequences were comprehensive with 355 damaged houses; of which 87 were extensively damaged. One fireman but no residents were killed due to the evacuation of the area. The prevalence of PTSD among the residents was 13% three months after the explosion and this rate did not change during the following 12 months. A comparison group of residents from another suburb close by that due to geological conditions was not impacted, had PTSD prevalence at three months of 1%. A group of 800 rescue workers participated in the emergency work, consisting of approximately 350 firemen, 150 police officers, and 300 voluntary rescue workers. The rescue work included fire extension, evacuation of residents by police and ambulance drivers, cordoning off the area, and placement of residents in a school. In addition to this, several other rescue corps contributed at some point during the disaster. One rescue worker was killed and several others received injuries.

The current study was a follow-up study of trauma reactions in rescue workers at 18 months post disaster. All participants in the follow-up were also assessed at five months post-disaster. The aim of this follow-up was to estimate the prevalence of posttraumatic stress disorder at the two time points and to identify factors at the five months assessment that predict symptomatology at 18 months post disaster. We hypothesized that the prevalence of PTSD would be relatively low compared to other trauma samples. Also, we predicted that a range of pre-, peri-, and posttraumatic factors identified at the five months assessment would predict the level of PTSD at 18 months post disaster.

METHODS

Participants

At the first assessment, all identified rescue workers were asked to participate via communication with a contact person in their unit. Of 945 questionnaires, 465 were returned (response rate=49.2%). The first assessment was conducted at five months post disaster and included a statement of willingness to participate in a follow-up survey at 18 months post disaster. Two-thirds of the respondents indicated willingness to participate in the follow-up, and these respondents received the follow-up questionnaire one year later. One hundred and thirty respondents returned the follow-up questionnaire.

Measures

The respondents were assessed with a wide variety of measures.

We present only those of relevance for the current study herein. The first part of the questionnaire contained questions about demographics such as age, gender, and number of children, along with questions of major life events and traumatic experiences within the last six months. In addition, questionnaires queried about individuals' experiences of professional and personal importance during the disaster work including satisfaction with management, sense of cohesion in the group, closeness to the explosion, perceived life threat, and sensory perceptions that were later re-experienced.

Posttraumatic symptoms were assessed with the Harvard Trauma Questionnaire (HTQ) (Mollica, Caspi-Yavin, Bollini et al., 1992). The HTQ consists of 32 questions. The first 16 items relate to the three core clusters of PTSD in the DSM-IV: intrusion, avoidance, and arousal. The total HTQ score is based on the first 16 items. The Danish version of the HTQ has been found to be a reliable and valid measure (Bach, 2003). HTQ ratings according to the DSM-III-R diagnostic criteria of PTSD showed an 88% concordance with interview-based estimates of PTSD (Mollica et al., 1992). The answers are scored on a four-point Likert scale ("not at all" (1), "a little" (2), "quite a bit (3), "all the time" (4). Item scores above three indicate symptom presence. A PTSD diagnosis requires the presence of at least one re-experiencing symptom, three avoidance symptoms, and two arousal symptoms, as well as the A2 criteria and the functional impairment criteria. Subclinical PTSD was indicated when only symptom was missing for a full diagnosis. The HTQ-Part IV has been used extensively in Denmark (Bach, 2003).

Social support was measured by the Crisis Support Scale (CSS) (Joseph, Andrews, Williams et al., 1992), a 7-item measure of perceived social support. The answers are rated on a 7-point Likert-type scale. The CSS has been shown to have good reliability and validity in a large Danish sample (Elklit, Pedersen, & Jind, 2001).

Negative affectivity, somatization, and dissociation in relation to the traumatic event were measured through the Trauma Symptom Checklist (TSC) (Briere & Runtz, 1989). This measure consists of 26 items, each based on a 4-point Likert scale. The scale has been found to display good validity and reliability in a Danish sample (Krog & Duel, 2003).

Locus of control (Rotter, 1966) was measured on a 0-100 visual analogue scale (VAS) ranging from 'I have control over what happens to me' (1 mm) to 'I don't feel I have control over what happens to me' (100 mm).

RESULTS

Descriptive statistics of demographic background factors and psychological measures of Time 2 responders and non-responders are presented in Table 1. Univariate tests were performed to assess differences between the two groups in marital status, mental health, and perceived social support. Chi square was used for categorical variables and paired t-tests for continuous variables. The level for significance was set at $p < 0.05$. No significant differences between the two groups were present on any measurements with the exception of perceived life threat where Time 2 non-responders had a higher score.

Pearson's product-moment correlation was calculated for a range of demographic factors, pre-traumatic events, peri-traumatic factors, post-traumatic factors, and personality factors in relation to PTSD symptomatology in the form of HTQ-total scores. The correlations can be seen in Table 2.

Factors that correlated significantly with HTQ-total scores were entered into a hierarchical multiple regression analyses (see Table 3). We chose HTQ-total score as the dependent variable instead

Table 1.
Descriptive and Key Variables.

Characteristic	Time 2 Non-responders Time 1 data (n =335)	Time 2 Responders Time 1 data (n = 130)	Comparison of Time 2 Responders vs. Non-responders	<i>p</i>
Female gender	6.0% (n = 20)	10.1% (n = 13)	$\chi^2 2.30$	0.10
Age mean (SD)	39.1 (13.3)	40.7 (12.3)	<i>F</i> 1.43	0.23
Number of children means(SD)	1.5 (1.2)	1.6 (1.2)	$\chi^2 6.58$	0.09
Marital status (% married /cohabitating)	71.2%	80.0%	<i>F</i> 3.19	0.08
Experienced life threat mean(SD)	4.9 (2.2)	4.2 (2.3)	<i>F</i> 9.23	0.003
Locus of Control	13.5 (15.7)	12.1 (13.6)	<i>F</i> .73	0.39
TSC mean(SD)				
- Negative affectivity	11.5 (2.5)	11.3 (1.9)	<i>F</i> .33	0.56
- Somatization	14.1 (4.6)	13.9 (3.2)	<i>F</i> .19	0.67
- Dissociation	5.4 (1.0)	5.4 (1.0)	<i>F</i> .01	0.93
TSC Total	31.0 (7.5)	30.6 (5.2)	<i>F</i> .38	0.54
CSS mean(SD)	36.9(6.4)	30.6(5.2)	<i>F</i> .55	0.46
PTSD				
- HTQ total mean(SD)	38.1 (8.2)	39.5 (9.2)	<i>F</i> 2.45	0.12
- Full PTSD number (%)	5 (1.5)	2 (1.5)		
- Subclinical PTSD number (%)	30 (9.0)	7 (5.4)	$\chi^2 3.1$	0.40

Table 2.

Correlations of Possible Predictors (Measured Five Months Postdisaster) and HTQ Total (Measured 18 Months Postdisaster).

Correlations with HTQ total		
	Variable	Pearson's <i>r</i>
Demographics	Age	-0.01
	Gender (NB: Mann-Whitney U test <i>z</i> value)	-1.51
Pre-traumatic factors	Major life events	0.38**
	Number of traumatic events	-0.05
Peri-traumatic factors	Sense of cohesion in group	0.17
	Satisfaction with management	0.03
	Sensory perceptions	0.26**
	Perceived life threat	-0.03
	Closeness to explosion	0.22*
Post-traumatic factors	Perceived social support	-0.20*
Personality factors	Negative affectivity	0.62***
	Somatization	0.66***
	Dissociation	0.55***
	Locus of control	0.58***

Note: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.005$

of PTSD in order to exploit the full range of variance in PTSD-symptoms, instead of the dichotomous PTSD-measure. Variables were entered into the regression model in the following order: 1) Pre-traumatic factors, 2) peri-traumatic factors, 3) post-traumatic factors, and 4) personality factors. The first three were entered in a chronological fashion and personality factors were entered last to see if they had an impact above and beyond these. Note that the logical first step of the regression analysis, demographic factors, was omitted because of the non-significant correlations between these factors and HTQ-total.

The peri-traumatic factors lost significance when entered into the regression model in step three. Adding personality factors in the fourth step raised the explanatory value of the model significantly ($\Delta R^2 = 0.36$, $p < 0.001$). Of the three significant factors in the final

Table 3.

Hierarchical Multiple Regression Analyses Predicting Posttraumatic Stress Symptoms measured by HTQ Total

Predictor	ΔR^2	β
Step 1	0.15***	
Major life events		0.38**
Step 2	0.07	
Major life events		0.36*
Sensory perceptions		0.15
Closeness to explosion		0.18
Step 3	0.05*	
Major life events		0.38*
Sensory perceptions		0.14
Closeness to explosion		0.19
Perceived social support		-0.23*
Step 4	0.38****	
Major life events		0.23*
Sensory perceptions		0.04
Closeness to explosion		.16
Perceived social support		-.04
Negative affectivity		0.08
Somatization		0.42***
Dissociation		0.01
Locus of control		0.29**
Adjusted R^2	0.59****	
N	130	

Note: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.005$ **** $p < 0.001$

model, previous life changes explained 21.0 % of the variance, somatization explained 28.8 % of the variance, and locus of control explained 24.2 % of the variance. The model as whole explained 59% of the total HTQ variance.

DISCUSSION

The rescue workers in this study displayed a PTSD prevalence of 1.6% at 5 months post disaster that increased to 3.1% at 18 months post disaster. Three factors: Major life events, somatization, and external locus of control were significantly predicted PTSD symptom severity. This increase in PTSD rates is discordant with a number of other longitudinal disaster studies in rescue workers that found a general decrease over time (e.g. Cukor et al., 2011). However, other disaster studies, e.g. McFarlane (1989) after a bush

fire found a long-term persistence of PTSD symptoms in firefighters over a period of 2½ years.

The prevalence of PTSD among rescue workers identified in this study appears to be much lower than that reported in the above-mentioned studies. Indeed, as previously mentioned, a recent literature review found that PTSD prevalence ranged from 5-40% among rescue workers involved in human made disasters. However, the disasters included in the review and other studies referred to earlier, often had more severe consequences than the disaster in question here. For example, they often had more incidents of death and serious injury, and the perceived and actual life threat of the rescue workers was therefore probably higher than for the rescue workers involved in our study. Hence, it is not surprising that we have found lower rates of PTSD compared to most other studies. The increase from a very low level of PTSD could possibly be explained by the occurrence of other life stressors (e.g. illness, deaths in the family) that did not qualify as a potential traumatic event. This is in line with the McFarlane study (1989) where negative life events preceding the critical incident exposure were more significant in the persistent chronic stress group.

In comparison, residents in the area affected by the disaster had a PTSD-prevalence of 13.3% measured three months post-disaster (Elklit, 2007) – a prevalence that did not change during the next 12 months. This supports the findings of other studies, namely that rescue workers are relatively robust to the exposure to potentially traumatizing events. However, it is not possible to infer anything about the reasons for this apparent hardiness from the current study.

In our final model, personality factors played the largest role in predicting PTSD: whereas major changes in life situation prior to the disaster explained 20.1% of the PTSD-variance, somatization explained 28.4% of the total variance, while locus of control contributed to 24.3% of the explanatory value. All in all, our model predicted 59% of the total variance. Thus, the current study identified two important personality variables at the five months post-disaster measurement that showed high predictive value of PTSD-levels at the 18 months post disaster measurement. In a number of studies, somatization is associated with trauma exposure; e.g. Elklit & Christiansen (2009) studying the residents of the firework factory explosion found that early PTSD severity was a mediator for somatization until negative affectivity was controlled for. The latter factor and the feeling of incompetence explained 42% of the variance in later PTSD. Like in the present study, locus of control was found to be a significant predictor of PTSD symptoms in the Marmar et al. (1999) longitudinal study of rescue workers. Ultimately, these results show that, at least in this study, there is no simple dose-response relationship between the extent and circumstances of the trauma and the following psychological reaction in disaster workers. Contrary, factors of personality and reactions to the traumatic situation appear to play the most significant role in whether or not a traumatic reaction develops.

In the trauma literature, it is generally assumed that negative affectivity plays a central role in predicting PTSD (Brewin et al., 2000; Ozer et al., 2003). We also found a significant correlation between negative affectivity and level of PTSD symptoms; however, this association was ruled out by somatization in the regression model. It therefore seems that in this particular sample, a tendency towards somatization is a more significant predictor for PTSD than negative affectivity. This might be related to another fact in the literature whereby rescue personnel appear to have more problems with physical health compared to other populations (Sterud, Ekeberg, & Hem, 2006). Their tendency towards somatization might play a central role in their manifestation of physical problems. Unfortunately, it was not possible to look further into this relationship in the present study.

In addition to somatization, locus of control proved to be a strong predictive factor for PTSD in the follow-up assessment of this sample. In previous studies of different trauma populations (Kushner, Riggs, Foa et al., 1993; McKeever, McWhirter, & Huff, 2006), a high level of PTSD symptoms has co-occurred with a more external locus of control, which was also the case in our study. One might even hypothesize that an external locus of control might be even more predictive of PTSD in a sample of rescue workers than in other trauma groups, given that rescue workers in their professional life are expected to remain in control and not suppress feelings of helplessness.

It is somewhat surprising that social support does not contribute significantly to the prediction of PTSD level at 18 months post disaster. Surprising, given that earlier studies have consistently found that a lack of social support is highly predictive for the development of posttraumatic symptoms (Brewin et al., 2000; Ozer et al., 2003). From our study, it can be tentatively concluded that personality factors, in the form of somatization, are stronger predictors of PTSD than social support in this trauma sample.

This current study is not without limitations. Thus, these must be taken into consideration when interpreting the results. First, the generalizability of our results may be reduced due to the lack of a control group. Furthermore, our results are based on self-report, which may have biased some of the findings. However, we used only validated and highly reliable measures that have shown to be very valid in their assessments. We did not have any baseline data, and post-disaster levels of psychopathology may not reflect significant changes from the level pre-disaster. Hence, we can make no conclusions regarding causality. The participation rate, while within the expected range for a voluntary survey, yielded a select sample, in comparison to other studies that have integrated PTSD into broader health programming for disaster workers. Pertaining the high rate of attrition, however, comparisons made between the groups at five and 18 months revealed but only one difference. Other possible and relevant trauma sequelae in a predominant male sample as e. g. alcohol abuse were not part of the study. In general, in spite of these limitations, this study is useful in that it pinpoints the relative robustness of rescue workers, and outlines one important personality factor for the prediction of PTSD.

In conclusion, this study suggests that rescue workers represent a relatively robust sample when exposed to disastrous events although we found an increase over a period of one year. Also, it suggests that personality factors in the form of somatization and locus of control are of great importance in the prediction of PTSD. The relationship between somatization and level of PTSD in rescue workers calls for further investigation that utilizes larger samples, preferably with baseline data. Rescue workers should be monitored after a disaster for a longer period and those with a risk profile and with PTSD symptoms should be offered an effective early treatment.

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