Shorter communication

Posttraumatic stress disorder after motor vehicle accidents: 3-year follow-up of a prospective longitudinal study

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Abstract

The paper presents a 3-year follow-up of a prospective longitudinal study of posttraumatic stress disorder (PTSD) after motor vehicle accidents (J. Abnormal Psychol., 107 (1998) 508). Participants were 546 patients who had been assessed when attending an emergency clinic shortly after a motor vehicle accident, and at 3 months and 1 year afterwards. The prevalence of posttraumatic stress disorder PTSD at 3 years was 11%. Maintaining psychological factors, i.e. negative interpretation of intrusions, rumination, thought suppression and anger cognitions, were important in predicting the persistence of PTSD at 3 years, as were persistent health and financial problems after the accident. Other predictors were female sex, hospital admission for injuries, perceived threat and dissociation during the accident, and litigation. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Many people experience at least some of the symptoms of posttraumatic stress disorder (PTSD) in the immediate aftermath of traumatic events such as assault, natural disasters, or motor vehicle accidents. A sizeable proportion recover in the next few weeks or months, but in a significant subgroup the symptoms persist, often for years (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). It is largely the subgroup of people with persistent PTSD who seek treatment.

Despite the substantial rate of recovery from PTSD in the first year after trauma, PTSD research has to date largely focused on the question of which factors determine whether an individual will develop PTSD after a traumatic event. Variables such as aspects of trauma severity, the individ-

ual's emotional response during the trauma, sex, pre-trauma personality and history of psychiatric disorders have been linked to the onset of PTSD (for reviews see Blanchard & Hickling, 1997; Ehlers, Mayou, & Bryant, 1998). However, these variables only explain a small proportion of the variance of chronic PTSD.

Several authors have argued that *maintaining* factors need to be taken into account in addition to those explaining PTSD *onset* (Ehlers & Clark, 2000; Ehlers & Steil, 1995; Foa & Riggs, 1993; Foa & Rothbaum, 1998). This hypothesis is supported by a recent large-scale prospective study of consecutive patients who attended an accident and emergency clinic after a motor vehicle accident (MVA). The study demonstrated that the accuracy in predicting PTSD symptoms at 1 year could be substantially enhanced if psychological maintaining factors derived from theoretical considerations (Ehlers & Steil, 1995) were taken into account, i.e. negative interpretation of intrusive memories, rumination, thought suppression, and anger (Ehlers et al., 1998). The prognostic power of these variables compared favorably with that of variables shown to be related to PTSD severity after MVA in previous studies, i.e. trauma severity, pre-accident psychological and social variables, emotional response during the trauma, and litigation (Blanchard et al., 1996a,b).

Ehlers et al. (1998) also found, in line with previous findings (Blanchard et al., 1997; Mayou, Bryant, & Duthie, 1993; Mayou, Tyndel, & Bryant, 1997), that *persistent* health problems and financial problems resulting from the accident were more closely related to PTSD at 1 year than *initial* injury severity, again supporting the role of maintaining factors.

The present paper presents a 3-year follow-up of participants described by Ehlers et al. (1998). Our aims were to:

1. Determine the prevalence of PTSD at 3 years after a MVA.
2. Investigate the contribution of maintaining variables measured at 3 months and 1 year in predicting PTSD symptoms at 3 years.

2. Method

2.1. Participants

Patients (N=925) who had originally participated in the Ehlers et al. (1998) study, were sent a questionnaire 3 years after their MVA. About 59% (N=546) responded. Respondents did not differ from non-respondents in terms of their PTSD severity at 3 months or 1 year, or in terms of their scores on the predictor variables. There were some differences in sociodemographic variables: Participants tended to be older (means=36.0 vs. 30.2 years, t (892.09) =6.98, $p<0.001$). Patients with manual skilled (50%) and unskilled occupations (36%), and members of the armed forces (50%) were less likely to participate than those with professional, managerial/ technical, nonmanual skilled and partly skilled occupations (61% and above), χ^2 (6) =22.65, $p=0.001$, $N=768$ (Office of Population Censuses and Surveys, 1991). Patients who were living with friends (40%) had the lowest return rates, compared to rates of 55% and higher for those living alone, with relatives, parents or partners, χ^2 (4) =17.82, $p=0.001$, $N=914$.

2.2. Assessment of PTSD symptoms

Participants completed the Posttraumatic Stress Symptom Scale (PSS, Foa, Riggs, Dancu, & Rothbaum, 1993) at 3 month, 1 and 3 years after their MVA. The PSS asks participants to rate how much they were bothered by each of the PTSD symptoms specified in DSM-IV ranging from 0 'never' to 3 '5 times per week or more/ very severe/ nearly always'. The PSS yields a sum score measuring the overall severity of PTSD symptoms. In addition, the presence/absence of PTSD is determined by assessing whether a patient endorsed the minimum number of symptoms (with at least '1') required by DSM-IV (American Psychiatric Association, 1994). Several studies have supported the reliability and validity of the scale (Foa et al., 1993; Foa, Cashman, Jaycox, & Perry, 1997). The PSS used in the present study does not contain information on the disability criterion specified in DSM-IV. Disability was therefore assessed with two additional questions. Participants were asked to indicate the extent to which their symptoms interfered with (1) their (house)work and (2) their social activities. Disability was scored as being present if participants experienced interference in either of these areas.

2.3. Assessment of predictors of PTSD

On the basis of the results of previous studies on PTSD after MVA, 11 possible predictors of chronic PTSD were chosen (for a review and rationale, see Ehlers et al., 1998). In addition, the study investigated six variables that measured maintaining psychological factors as specified by Ehlers and Steil (1995).

2.3.1. Trauma severity

Injury severity. Two measures of injury severity after the accident were used. First, a research nurse reviewed patient charts in order to classify the type of injury on a scale from 0 (no injury), 1 (soft tissue injury only), and 2 (bone injury). This measure was suggested by the consultant orthopedic surgeon (Christopher Bulstrode) as a clinically useful distinction because the majority of participants had minor injuries, and other classification schemes such as the Abbreviated Injury Scale (American Association for Automotive Medicine, 1985) would not have given a clinically meaningful distinction for these less serious injuries. Second, it was recorded whether patients were admitted to hospital.

Persistent medical problems. At 3 months, 1 and 3 years, participants indicated how well they had recovered from their accident injuries on a scale from 0 (back to normal, fully recovered) to 2 (not back to normal, major problems).

Persistent financial problem. At 3 months, 1 and 3 years, participants indicated whether they had suffered persistent financial problems from the accident on a scale from 0 (none) to 2 (major problems).

2.3.2. Emotional response during trauma

Perceived threat was determined by asking patients at the initial assessment to rate how frightening the accident was on a scale from 1 (not frightening) to 4 (very frightening).

Dissociation. At initial assessment, participants were asked to indicate to what they extent they

felt numb and dazed, each on a scale from 0 (not at all) to 4 (extremely). The peritraumatic dissociation score is the mean of these two items.

2.3.3. Pre-accident psychological and social variables

Physical health and emotional problems prior to accident. At initial assessment, participants rated their health before the accident on a scale from 1 (excellent) to 5 (poor), and to what extent they had suffered from emotional problems such as anxiety, depression, or irritability in the 4 weeks prior to the accident, on a scale from 0 (not at all) to 4 (extremely).

2.3.4. Litigation

At 3 months, participants indicated whether they had claimed compensation or were planning to do so. At 1 and 3 years, they were asked whether their claim had been settled.

2.3.5. Psychological maintaining factors

Negative interpretations of intrusive memories. At 3 months, 1 and 3 years, participants rated how often they thought "I must be going out of my mind" and "I will never get over it" when having intrusive memories of the accident, each on a scale from 0 (never) to 4 (always). These interpretations are common examples of negative interpretations of intrusions found by Ehlers and Steil (1995). The negative interpretation score is the mean of these items.

Rumination and thought suppression. Two aspects of rumination were assessed, trait worry and rumination about intrusive recollections of the accidents. At initial assessments, participants rated their general tendency to worry ("I tend to worry a lot about things") on a scale from −3 (disagree very much) to 3 (agree very much). At 3 months, 1 and 3 years, they rated how often they dwelled on memories of the accident and how often they thought about "why did it happen to me" when memories occurred, each on a scale from 0 (never) to 4 (always). The rumination about memories of the accident score is the mean of these two items. At 3 months, 1 and 3 years, thought suppression was assessed by asking participants to rate how often they tried to push memories of the accident out of their mind when they occurred, on a scale from 0 (never) to 4 (always).

Anger. Two aspects of anger were assessed, initial anger reaction and anger related to intrusive memories. At initial assessment, participants were asked to indicate how angry they felt on a scale from 0 (not at all) to 4 (extremely). At 3 months, 1 and 3 years, they indicated how often they had anger-related thoughts ("Others have harmed me") when they had memories of the accident, on a scale from 0 (never) to 4 (always).

2.3.6. Statistical analysis

The relationship of predictor variables with PTSD diagnosis was tested using η coefficients (for injury severity, admission to hospital, unconsciousness, persistent health and financial problems, gender, and litigation) as recommended by Linton and Gallo (1975) or biserial correlations (for all other variables). Because symptom cut-offs for the DSM-IV classification of whether or not a patient fulfils criteria for PTSD are somewhat arbitrary and still under investigation, additional analyses were run predicting PTSD severity as measured by the sum score of the PSS. The vast majority of questionnaire measures was skewed to the left and leptokurtotic. For this reason, these variables were log-transformed for statistical analyses. Pearson correlations and step-

wise multiple regression analyses tested the relationship of the predictor variables and PTSD severity.

3. Results

3.1. Prevalence and course of PTSD symptoms

At 3 years, 11% the participants met DSM-IV criteria for PTSD. Participants meeting diagnostic criteria for PTSD at 1 year had a 47% chance of still suffering from PTSD at 3 years. The probability of persistent PTSD at 3 years was highest for those with the highest PSS severity scores at 1 year. For example, participants with a PSS score of 17 had a 53% chance of maintaining PTSD, and for those with scores of 20, 25 and 30, the chances were 56, 69 and 72%, respectively.

There were a number of cases of delayed onset of PTSD between 1 and 3 years: 5% of the participants who did not meet PTSD criteria at 1 year reported PTSD at 3 years (N=21 of 432). However, six of these patients had met criteria for PTSD at 3 months.

3.2. Predictors of PTSD at 3 years

The prospective and concurrent associations of the 17 predictor variables investigated in this study with PTSD diagnosis and severity at 3 years are shown in Table 1. Alpha-levels for correlations were set at $p \leq 0016$ because a maximum of 31 correlations were calculated for each of the PTSD measures (Bonferroni correction).

Trauma severity. Persistent medical and financial problems at the follow-up assessments showed moderate correlations with PTSD symptoms at 3 years. In addition, hospital admission showed a small correlation with PTSD severity.

Emotional response during trauma. Participants' ratings of how frightening the accident was and reports of peritraumatic dissociation at initial assessment predicted PTSD severity at 3 years.

Pre-accident psychological and social variables. Of these variables, only sex predicted PTSD at 3 years. Women had a larger risk than men of suffering from persistent PTSD: 16% vs. 7%, χ^2 (1) =11.55, p=0.001, N=543.

Litigation. Planned or initiated compensation claims at 3 months, and unsettled claims at 1 and 3 years were related to PTSD at 3 years.

Psychological maintaining variables. Participants who interpreted their intrusive memories of the accident in a negative way, who reported anger-related cognitions, and those who ruminated about their intrusive memories or tried to suppress them were more likely to suffer from PTSD symptoms at 3 years. Correlations with PTSD diagnosis and severity were moderately high.

3.3. Prediction of PTSD severity at 3 years: regression analyses

Stepwise multiple regression analyses tested the relative contribution of the different variables in predicting PTSD severity at 3 years from the initial and 1 year assessments. As shown in Table 2, a combination of rumination, negative interpretation of intrusions, thought suppression, anger

Table 1
Relationship between predictor variables and PTSD diagnosis and symptom severity at 3 years (note: underlined correlations are nonsignificant at $p \leq 0.0016$ (Bonferonni correction). PTSD = posttraumatic stress disorder. Log indicates that the variable was logarithmically transformed)

	PTSD diagnosis at 3 years	PTSD severity (log) at 3 years
Trauma severity		
Initial assessment		
Injury severity	<u>0.08</u>	<u>0.07</u>
Admission to hospital	<u>0.09</u>	0.15
Unconscious	<u>0.03</u>	<u>0.04</u>
3 months assessment		
Persistent medical problems	0.30	0.40
Financial problems	0.16	0.25
1 year assessment		
Persistent medical problems	0.34	0.45
Financial problems	0.30	0.37
3 year assessment		
Persistent medical problems	0.43	0.49
Financial problems	0.47	0.39
Emotional response		
Initial assessment		
Perceived threat (log)	<u>0.13</u>	0.17
Peritraumatic dissociation (log)	<u>0.13</u>	0.23
Pre-accident variables		
Initial assessment		
Female sex	0.15	0.16
Prior health problems	<u>0.11</u>	<u>0.12</u>
Prior emotional problems	<u>0.04</u>	<u>0.13</u>
Litigation		
Compensation claim at 3 months	0.19	0.32
Claim not settled at 1 year	0.24	0.32
Claim not settled at 3 years	0.28	0.29
Psychological maintaining factors		
Initial assessment		
Trait worry	<u>0.13</u>	<u>0.12</u>
Anger (log)	<u>0.07</u>	0.20
3 months assessment		
Interpretation of intrusions (log)	0.30	0.38
Anger cognitions (log)	0.18	0.30
Rumination (log)	0.24	0.37
Thought suppression (log)	0.24	0.26
1 year assessment		
Interpretation of intrusions (log)	0.40	0.46
Anger cognitions (log)	0.25	0.41

Table 1 (*continued*)

	PTSD diagnosis at 3 years	PTSD severity (log) at 3 years
Rumination (log)	0.36	0.48
Thought suppression (log)	0.19	0.35
3 year assessment		
Interpretation of intrusions (log)	0.59	0.56
Anger cognitions (log)	0.33	0.44
Rumination (log)	0.50	0.58
Thought suppression (log)	0.25	0.38

Table 2
Regression analyses

Variable	Assessment	β from final equation
1. Prediction of PTSD severity at 3 years from initial and 1-year measures		
Variables in regression function in order of step entered		
Rumination	1 year	0.14
Persistent health problems	1 year	0.21
Negative interpretation of intrusions	1 year	0.16
Female sex		0.10
Financial problems	1 year	0.12
Thought suppression	1 year	0.12
Anger cognitions	1 year	0.12
Dissociation	Initial	0.10
Adjusted R^2 =0.393		
2. Prediction of PTSD severity at 3 years from initial and 3-month measures		
Persistent health problems	3 months	0.25
Negative interpretation of intrusions	3 months	0.20
Litigation	3 months	0.17
Dissociation	Initial	0.11
Rumination	3 months	0.12
Female sex		0.08
Adjusted R^2 =0.301		

cognitions, persistent medical and financial problems at 1 year, peritraumatic dissociation and female gender, predicted 39% of the variance of PTSD severity 3 years after the accident, F $(8,447) = 37.22$, $p < 0.001$, $R = 0.636$, $R^2 = 0.404$, adjusted $R^2 = 0.393$. Table 2 also shows that a substantial proportion of the variance, 30%, could be predicted on the basis of the initial and 3-months assessments, F $(6,458) = 33.91$, $p < 0.001$, $R = 0.557$, $R^2 = 0.310$, adjusted $R^2 = 0.301$. The predictors that entered both equations were persistent medical problems, negative interpretations of intrusive memories, rumination, peritraumatic dissociation, and female sex.

A clinically important question is whether the predictor variables explain any variance of PTSD severity at 3 years beyond what can be predicted from PTSD severity early in the course of the

disorder. To investigate this question, PSS scores at 3 months were forced into the regression equation in the first step. They predicted 31% of the variance of PTSD severity at 3 years. In the next step, the predictors taken at initial assessment and at 3 months were submitted to a stepwise analysis. Persistent health problems, $\beta=0.18$, litigation, $\beta=0.13$, and negative interpretations of intrusions at 1 year, $\beta=0.11$, entered the regression function, and their combination with PSS scores at 1 year, $\beta=0.41$, explained 38% of the variance, $F (4,454) =70.37$, $p<0.001$, $R=0.619$, $R^2=0.383$, adjusted $R^2=0.377$.

4. Discussion

Three years after a MVA, 11% of the participants still suffered from PTSD. These data confirm previous findings that chronic PTSD is a common consequence of MVA and that it may persist for years (Mayou, Tyndel, & Bryant, 1997). The data also confirm previous findings that a minority of patients experience delayed onset of PTSD (Mayou et al., 1997).

On the other hand, about half of the patients who met the diagnostic criteria at 1 year had recovered by 3 years. This raises the question of what factors predict recovery vs. long-term chronicity. The results replicate and extend the results of the 1-year follow-up (Ehlers et al., 1998). Of the variables assessing trauma severity, persistent medical problems and financial problems correlated moderately with outcome at 3 years. This confirmed previous findings that persistent medical and financial problems are more important in predicting chronic PTSD than initial injury severity (Ehlers et al., 1998; Mayou et al., 1997). Persistent medical and financial problems are chronic stressors, which pose demands on the individual's coping abilities and may thus make it more difficult for them to overcome the psychological consequences of the trauma. It is also likely that they are continuing reminders of the trauma, which may make it more difficult for the patient to see the accident as something from the past.

The initial emotional response to the accident showed small but significant correlations with PTSD severity at 3 years, as did female sex. These findings are in line with other studies that have linked female sex (Kessler et al., 1995), perceived threat to life (March, 1993) and peritraumatic dissociation (Murray, Ehlers, & Mayou, 2001; Shalev, Peri, Canetti, & Schreiber, 1996) to PTSD after MVA and other trauma. It remains unknown why women have a greater chance of developing PTSD after trauma. The converging evidence that peritraumatic dissociation predicts chronic PTSD indicates the need for studies of the mechanisms underlying this relationship. Aspects of dissociation may be related to deficits in the way the trauma is laid down in autobiographical memory that lead to involuntary reexperiencing (Brewin, Dagleish, & Joseph, 1996; Ehlers & Clark, 2000; Foa & Hearst-Ikeda, 1996; van der Kolk and Fisler, 1995). In line with previous studies, litigation showed a positive relationship with persistence of PTSD symptoms (Blanchard et al., 1996a; Bryant & Harvey, 1995; Culpan & Taylor, 1973). The interrogations, delays, correspondence etc. involved in compensation claims may act as unpleasant reminders of the trauma which make it difficult for the patient to put the accident in the past and move on.

The 3-year follow-up confirmed the role of the maintaining psychological factors suggested by Ehlers and Steil (1995), negative interpretation of intrusive memories, rumination, thought suppression, and anger cognitions in predicting PTSD symptoms in the long-term. The 3-month, 1-year and 3-year assessments of these psychological predictors consistently showed moderate

correlations with PTSD severity at 3 years. How do these variables maintain PTSD symptoms? A common mechanism is that they maintain a sense of current threat (Ehlers & Clark, 2000). Negative interpretations of intrusions and anger cognitions directly lead to the perception of threat, accompanied by negative emotions and re-experiencing symptoms. They are likely to motivate the patient to engage in dysfunctional behaviors, such as avoidance, or dysfunctional cognitive strategies, such as suppression of intrusive memories, that maintain the disorder. Two of these dysfunctional cognitive strategies were assessed in the present study, rumination and thought suppression. Rumination probably prevents a change in negative appraisals of the trauma and its sequelae as well as a change in the nature of the trauma memory, and may, like thought suppression, also increase the frequency of reexperiencing symptoms directly.

A substantial proportion of the variance of PTSD severity at 3 years, 30%, could already been predicted from the assessment of the variables measured at 3 months (persistent health problems, negative interpretation of intrusive memories, rumination and litigation) after the accident, in combination with peritraumatic dissociation and female sex. If the 1-year assessment was taken into account, the accuracy of the prediction increased to 39% explained variance. This underlines the theoretical importance of the psychological maintaining factors in explaining persistent PTSD.

The maintaining variables may be also be useful in identifying patients who are in need of early intervention because they are at high risk of chronic PTSD symptoms. However, the question arises of whether these variables provide more predictive information than initial PTSD severity. As in previous studies, patients were more likely to stay symptomatic, the more severe their PTSD symptoms had been at 1 year. The results of the regression analysis showed, however, that negative interpretations of intrusive memories, persistent medical problems and litigation at 3 months predicted PTSD severity at 3 years over and above what could be predicted from PTSD severity at 3 year. While the additional variance explained was rather small (7%), the results nevertheless point to a role of these variables in selecting patients for intervention that are unlikely to recover on their own. The finding that the additional amount of variance explained was relatively small should not be interpreted as indicating that the theoretical importance of the variables is minor as it has been shown that variables such as the interpretation of PTSD symptoms and rumination in early stages after trauma predict PTSD symptoms at 3 months (Dunmore, Clark, & Ehlers, in press; Murray et al., 2001). By forcing PTSD symptoms at 3 months into the equation, the effects of these variables in explaining subsequent PTSD are underestimated as the common variance at 3 months is partialed out.

The present study has the advantage over many previous studies of PTSD following MVA in that a large sample of consecutive attenders to an accident and emergency clinic was assessed very shortly after the event, and followed up prospectively over 3 years. However, there are a number of methodological limitations. First, the response rate for the 3-year assessment was lower than desirable and patients of lower social classes tended to be less likely to participate than those of higher social classes. However, the comparison of responders and non-responders did not indicate any difference in previous PTSD severity or the predictors studied. The demographic variables were unrelated to PTSD (Ehlers et al., 1998). Most of the differences in sociodemographic characteristics are likely to reflect differences in the mobility of certain subgroups (e.g. younger people, people who share their house with friends, members of the armed forces) and thus are unlikely to have influenced the pattern of results.

A second possible limitation is that the predictors had to be assessed with very few or single

items to make the screening of a large consecutive sample of accident and emergency department attenders possible. This may have compromised the reliability of the assessment and underestimated some of the effects. For example, other studies conducted by our research using longer scales of established internal consistency to assess the constructs of interpretation of PTSD symptoms, rumination, and dissociation have found somewhat higher correlations with PTSD severity than the present study (Dunmore, Clark, & Ehlers, 1999; Murray et al., 2001) and thus cross-validate the present findings.

A third possible limitation is that PTSD was assessed with a standardized self-report instrument (PSS) rather than with a diagnostic interview. However, studies by Foa's group (Foa et al. 1993, 1997) have demonstrated that the PSS shows satisfactory to good agreement with the Structured Clinical Interview for DSM-IIIR (SCID, Spitzer, Williams, Gibbon, & First, 1990) and that it tends to estimate PTSD diagnosis conservatively.

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