Psychological Predictors of Chronic Posttraumatic Stress Disorder After Motor Vehicle Accidents

Anke Ehlers, Richard A. Mayou, and Bridget Bryant
University of Oxford

A prospective longitudinal study assessed 967 consecutive patients who attended an emergency clinic shortly after a motor vehicle accident, again at 3 months, and at 1 year. The prevalence of posttraumatic stress disorder (PTSD) was 23.1% at 3 months and 16.5% at 1 year. Chronic PTSD was related to some objective measures of trauma severity, perceived threat, and dissociation during the accident, to female gender, to previous emotional problems, and to litigation. Maintaining psychological factors, that is, negative interpretation of intrusions, rumination, thought suppression, and anger cognitions, enhanced the accuracy of the prediction. Negative interpretation of intrusions, persistent medical problems, and rumination at 3 months were the most important predictors of PTSD symptoms at 1 year. Rumination, anger cognitions, injury severity, and prior emotional problems identified cases of delayed onset.

Motor vehicle accidents (MVA) are common. Norris (1992) found that 23.4% of a sample of 1,000 participants from four North American cities had experienced an MVA at sometime during their lives and concluded that if both the frequency and the severity of traumatic events were considered, MVA may represent "perhaps the single most significant event" (p. 416) causing posttraumatic stress disorder (PTSD) in Western societies. The psychological sequelae of MVA have not yet been adequately studied (Di Gallo & Parry-Jones, 1996), and it is only recently that there has been systematic research to determine the prevalence of PTSD and to identify factors that predict onset and course after MVA. The present study was based on a large sample of consecutive attenders at an accident and emergency clinic who had been involved in all types of MVA with a wide range of injury severity. We aimed to study the prevalence and course of posttraumatic symptoms at 3 months and at 1 year after the accident and to identify variables that predict chronic PTSD.

A substantial proportion of individuals involved in MVA develop PTSD (see Kuch, Cox, & Evans, 1996; Taylor & Koch, 1995, for reviews). PTSD and associated psychopathology, such as travel anxiety and depression, represent a large clinically significant problem that may persist for years (Mayou, Bryant, & Duthie, 1993; Mayou, Simkin, & Threlfall, 1991; Mayou, Tyndel, & Bryant, 1997). Reported prevalences for PTSD have varied widely with figures between 1% (Malt, 1988) and 46% (Blanchard, Hickling, Taylor, Loos, & Gerardi, 1994). It is likely that this wide range is due to methodological differences, particularly in assessment and in recruitment procedures. For example, the study reporting the highest prevalence rates was based on participants who had either sought medical help for complications or who had replied to advertisements (39–46%; Blanchard, Hickling, Taylor, & Loos, 1995; Blanchard et al., 1994). In contrast, a study of consecutive attenders to an accident and emergency clinic reported considerably lower rates (11%; Mayou et al., 1993), and in their recent review, Kuch et al. (1996) concluded that a PTSD prevalence of about 10% is to be expected for the year after an MVA.

Predictors of PTSD After MVA

Very few published studies have addressed the question of which factors predict PTSD after MVA. Most have been based on small numbers of participants, and few have included assessments immediately after the accident. Most have used correlational rather than prospective designs and have focused particularly on trauma severity, preaccident psychological and social variables, emotional response during the trauma, and litigation.

Trauma Severity

Although there is evidence from research on other types of trauma suggesting that severity of exposure is an important risk factor for PTSD (e.g., March, 1993), the evidence from MVA is inconsistent. Several aspects of the severity of the physical consequences have been considered, although few studies have had access to initial medical assessments. Injury severity has been the most commonly studied indicator of accident severity. Several studies have reported a relationship with development of PTSD (e.g., Blanchard, Hickling, Mitnick, et al., 1995), but the majority have not (e.g., R. A. Bryant & Harvey, 1995; Mayou et al., 1993; reviewed by Taylor & Koch, 1995). Green
(1994) concluded in her review that a relationship between injury and posttraumatic stress is observed most clearly when only a subset of the participants are injured. There have been inconsistent findings about unconsciousness following an accident. Mayou et al. (1993) found that those who were recorded in medical notes to have been unconscious were much less likely to suffer from PTSD. In contrast Blanchard, Hickling, Taylor, et al. (1996) reported a small but positive correlation between those who later reported having been unconscious and PTSD symptoms. Another important aspect related to the severity of trauma is whether individuals suffer from persistent medical problems. Mayou et al. (1993, 1997) and Blanchard et al. (1997) found that persistence of PTSD was correlated with continuing physical problems. Mayou et al. (1993, 1997) also reported that chronic PTSD was related to persistent financial problems resulting from the accident.

**Preaccident Psychological and Social Variables**

Studies of different types of trauma suggest that women are at greater risk of developing PTSD after trauma than are men (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Norris, 1992). In line with this finding, Blanchard, Hickling, Taylor, et al. (1996) observed a small but significant correlation between female gender and PTSD following MVA. A history of psychiatric problems has been linked to PTSD risk in studies of Breslau, Davis, Andreski, and Petersen (1991) and Smith, North, McCool, and Shea (1990). Blanchard, Hickling, Taylor et al. (1996) found that the presence of any Axis I disorder (in particular anxiety and depressive disorders) prior to the accident was related to PTSD following the accident. Presence of a personality disorder or alcohol abuse at initial assessments were two of the predictors that entered a stepwise multiple regression function of PTSD severity at 1 year after an MVA (Blanchard, Hickling, Barton, et al., 1996).

**Emotional Response During Trauma**

The psychological aspect of trauma severity that has most consistently been shown to predict PTSD is perceived threat to life (March, 1993). For MVA, studies of Mayou’s group (Mayou et al., 1993, 1997) and Blanchard’s group (Blanchard, Hickling, Mitnick, et al., 1995; Blanchard, Hickling, Taylor, et al., 1996) supported this relationship. The latter reported that life threat and injury severity together accounted for 12.2% of the variance of PTSD symptom severity (Blanchard, Hickling, Mitnick, et al., 1995). A further important predictor of PTSD may be dissociation (Foa & Hearst-Ikeda, 1996; Spiegel, 1991). This term describes a range of psychological processes that involve a “disruption of the usually integrated feelings of consciousness, memory, identity, or perception of the environment” (p. 477; Diagnostic and Statistical Manual of Mental Disorders, 4th ed. DSM-IV; American Psychiatric Association, 1994). There is evidence from prospective longitudinal studies that dissociation during or immediately after the trauma (peritraumatic dissociation) predicts PTSD (Koopman, Classen, & Spiegel, 1994; Shalev, Peri, Canetti, & Schreiber, 1996).

**Litigation**

Historically, there has been great interest in the relationship of compensation claims and PTSD (Miller, 1961a, 1961b). The widespread belief that psychological symptoms following accidents are motivated by a desire for compensation has not received empirical support (Mendelson, 1995). In line with this conclusion, Mayou et al. (1997) did not find a relationship between compensation claims and persistent PTSD 5 years after an MVA, and B. Bryant, Mayou, and Lloyd-Bolstock (1997) reported no effect of settlement of compensation on recovery. On the other hand, other recent studies have found a correlation between litigation and PTSD symptoms (Blanchard, Hickling, Taylor, et al., 1996; R. A. Bryant & Harvey, 1995; Culpan & Taylor, 1973).

**Psychological Maintaining Factors in Chronic PTSD**

The variables described earlier explain only a modest proportion of the variance of PTSD symptoms following MVA. In a cross-sectional analysis, Blanchard, Hickling, Taylor, et al. (1996) found that eight predictors explained 38.1% of the variance of PTSD symptoms. This suggests that there may be further psychological variables that would increase the accuracy of prediction. Ehlers and Steil (1995) have argued that most previous studies of PTSD have focused on variables that explain the onset of PTSD symptoms rather than their maintenance and that the inclusion of psychological maintaining factors would increase the accuracy with which chronic PTSD could be predicted. The present study therefore included a number of possible maintaining factors derived from theoretical considerations.

**Negative Interpretations of Intrusive Recollections**

Ehlers and Steil (1995) observed that people differ widely in the meaning they assign to the occurrence and context of intrusive recollections of traumatic events. Whereas many individuals see them as a normal part of recovery from an upsetting event, others interpret them in a more negative way, for example, as an indication that they are going mad. Ehlers and Steil proposed that such negative interpretations are important in explaining the maintenance of intrusive recollections and PTSD in general because they determine (a) how distressing the intrusions are and (b) the extent to which the patient engages in strategies to control the intrusions that then prevent change in meaning of the trauma and posttraumatic intrusions. They provided evidence for these hypotheses in two correlational studies of MVA victims (Steil & Ehlers, 1998). Further indirect evidence has come from a prospective study of a representative sample of MVA patients that found that intrusive recollections that were described as horrific at initial assessment predicted PTSD at 1 year and at 5 years after the accident (Mayou et al., 1993, 1997).

**Thought Suppression and Rumination**

Ehlers and Steil (1995) suggested that strategies used by traumatized individuals to control intrusive recollections may maintain PTSD. Research on the effects of thought suppression (e.g., Trinder & Salkovskis, 1994; Wegner, 1989) suggests that
efforts to suppress memories of the traumatic event may increase their frequency. The role of worry in maintaining generalized anxiety has recently received empirical support (Davey & Tallis, 1994), and it is to be expected that rumination on aspects of the traumatic event and its sequelae (e.g., how things could have been different if only . . . , or rumination about the "why me" question) also plays a role in maintaining PTSD. Steil and Ehlers (1998) have shown that rumination and suppression of intrusive recollections correlated with PTSD severity in MVA survivors.

Anger

Anger is very common in victims of trauma. Prospective longitudinal studies of victims of physical or sexual assault found that feelings of anger predict chronic PTSD (Riggs, Dancu, Gershuny, Greenberg, & Foa, 1992). There is also evidence that the preoccupation with anger impedes treatment outcome in exposure therapy (Foa, Riggs, Massie, & Yarczower, 1995; Vaughan & Tarrier, 1992). It is uncertain but likely that these findings can be generalized to other trauma such as MVA.

Goals

The goals of the present study were as follows:

1. Assess the prevalence and course of PTSD symptoms at 3-month and 1-year follow-ups in consecutive patients presenting to an accident and emergency clinic after an MVA. The study circumvented the problem of selection bias by studying a large series of consecutive attenders at a trauma center serving a large urban and rural area for all types of MVA. DSM-IV (American Psychiatric Association, 1994) criteria were used to diagnose PTSD because they represent the most widely accepted basis for diagnosis.

2. Investigate the role of variables identified in previous research as predictors of PTSD, namely trauma severity, preaccident psychological and social variables, emotional response during trauma, and litigation. The prospective design enabled examination of the relative contribution of these variables in predicting chronic PTSD at 3 months and at 1 year after an MVA.

3. Demonstrate that the accuracy of the predictions can be enhanced if psychological maintaining variables as proposed by Ehlers and Steil (1995) are also taken into account. The study therefore included assessments of negative interpretations of traumatic memories, thought suppression and rumination, and anger.

Method

Participants

We recruited consecutive patients who attended the Accident and Emergency Department of the John Radcliffe Hospital, Oxford, United Kingdom, after a motor vehicle accident and gave them an initial questionnaire while they were still in the hospital. The hospital is the single trauma center for a population of about 500,000. A total of 1,441 patients were given the questionnaire, and 1,181 (82%) completed it. Of these participants, 20% completed the questionnaire on the same day, 50% within 3 days, and 75% within 8 days of the accident. A total of 122 attenders were excluded from the study. The most common reasons for exclusion were as follows: patient left the hospital before seeing a physician (30%), multiple injuries requiring intensive care (26%, most commonly head injuries; patients who had been unconscious for more than 15 min were excluded), overseas visitors with language problems (26%), death in the hospital (10%), and illiteracy or mental handicap (6%).

Patients completed further questionnaires at 3 months and at 1 year after the accident. In the present article, we report data on the 967 patients (67.1% of the recruited patients) who filled in the questionnaires at initial assessments and at 3 months (N = 888), at initial assessments and at 1 year (N = 781), or at all three time points after the accident. Fifty-four percent of the participants were men. Their ages ranged from 17 to 89 years (M = 33.4 years, SD = 13.1 years). Of the participants, 20% had no injuries, 60% had soft tissue injuries, and 20% had bone injuries. Twenty-six percent were admitted to the hospital. Seventy-seven percent of the participants reported not having been unconscious, 11% reported unresponsiveness, and 12% were uncertain about it. Thirty-one percent had been injured in an MVA in the past, and 6% experienced another MVA during the 1-year follow-up. Table 1 shows further demographic and accident characteristics of the sample.

Assessment of PTSD Symptoms

Participants completed the Posttraumatic Stress Symptom Scale (PSS; Foa, Riggs, Dancu, & Rothbaum, 1993) at the 3-month and 1-year assessments. The PSS asks participants to rate how much they were bothered by each of the PTSD symptoms specified in the 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 or absence of PTSD is determined by assessing whether a patient endorsed the minimum number of symptoms (with at least a score of 1) required by the DSM-IV criteria. Fox et al. (1993) demonstrated that the self-report questionnaire has good reliability and concurrent validity with other PTSD measures, such as the Impact of Event Scale (Horowitz, Wilner, & Alvarez, 1979). The questionnaire also showed good agreement with the Structured Clinical Interview for DSM-IIR (SCID; Spitzer, Williams, Gibbon, & First, 1990) and was somewhat more conservative in diagnosing PTSD than was the SCID. The PSS is an earlier version of the Posttraumatic Stress Diagnostic Scale that has satisfactory agreement with the SCID (x = .65, agreement = 82%, sensitivity = .89, specificity = .75; Fox, Cashman, Jaycox, & Perry, 1997). The PSS used in the present study does not contain information on the disability criterion specified in the DSM-IV. Disability was therefore assessed with two additional questions. Participants were asked to indicate the extent to which their symptoms interfered with (a) their work or housework and (b) their social activities. Disability was scored as being present if participants experienced interference in either of these areas. The 1-year assessment also included a separate rating of how distressing participants found their intrusive recollections.

Assessment of Predictors of PTSD

On the basis of the results of previous studies, we chose 11 possible predictors of chronic PTSD for the present investigation. In addition, we investigated six variables that measured maintaining factors as specified by Ehlers and Steil (1995).

Trauma Severity

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

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

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

Emotional Response During Trauma

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

Dissociation. At initial assessment, participants were asked to indicate to what extent they felt numb and dazed, each on a scale ranging from 0 (not at all) to 4 (extremely). The dissociation score was the mean of these two items.

Preaccident Psychological and Social Variables

At initial assessment, participants rated their health before the accident on a scale ranging from 1 (excellent) to 5 (poor). They also rated 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 ranging from 0 (not at all) to 4 (extremely).

Litigation

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

Psychological Maintaining Factors

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

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

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

Statistical Analysis

The relationship of predictor variables with PTSD diagnosis and delayed onset of PTSD was tested by using eta coefficients (for injury severity, admission to the hospital, unconsciousness, persistent health and financial problems, gender, and litigation) as recommended by Linton and Gallo (1975) or by biserial correlations (for all other variables). Because symptom cutoffs for the DSM-IV classification of whether a patient fulfills criteria for PTSD are somewhat arbitrary and still under investigation, we ran additional analyses 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 stepwise multiple regression analyses tested the relationship of the predictor variables and PTSD severity. Discriminant analysis was used to investigate which of the predictor variables contributed to the identification of participants with delayed onset. If not mentioned otherwise, the significance level was .05.

Results

Dropout Analyses

Study participants and individuals who were assessed initially but failed to provide information on PTSD at the follow-up
asymptotics were compared on demographic and accident characteristics and on psychological predictors assessed at baseline. There was no indication that dropouts and participants differed on any of the psychological variables (perceived threat during the accident, health or emotional problems prior to the accident, peritraumatic dissociation, anger, and trait worry, \( ps > .26 \)).

There were differences on some accident and demographic characteristics. Women were more likely than men to participate in the follow-up (71% vs. 64%), \( \chi^2(1, N = 1,441) = 7.72, p = .005 \). Participants were older than dropouts (\( M_s = 33.4 \) vs. 29.5 years), \( t(1,050.86) = 5.72, p < .001 \). Participants who were admitted to the hospital were more likely to participate than nonadmitted patients (81% vs. 63%), \( \chi^2(1, N = 1,441) = 36.18, p < .0001 \). Patients with bone injuries were more likely to participate than those without injuries or with soft tissue injuries (80% vs. 66% and 64%), \( \chi^2(2, N = 1,440) = 22.09, p < .0001 \). Patients who were living alone (82%) or with their partner (86%) had a higher return rate than those living with parents (76%), other relatives (74%), or friends (75%), \( \chi^2(4, N = 1,145) = 17.22, p = .002 \). Patients with manual skilled occupations (66%) and partly skilled occupations (57%) and members of the armed forces (44%) were less likely to participate than those with professional, managerial or technical, nonmanual skilled occupations, and unskilled occupations (70% and above), \( \chi^2(6, N = 1,126) = 35.77, p < .0001 \) (Office of Population Censuses and Surveys, 1991). Unemployed patients had the lowest follow-up rates (66%), and retired patients had the highest (94%), with the other groups ranging between 78% and 87%, \( \chi^2(7, N = 1,150) = 16.92, p = .02 \). Note that some of these variables are interrelated. For example, the effect of living situation does not remain significant if age is controlled, and patients with bone injuries were more likely to be admitted than those without or those with soft tissue injuries. There were no relationships between participation and vehicle type, drug status, previous MVA injury, or unconsciousness during accident.

**Prevalence of PTSD Symptoms**

**DSM–IV Diagnosis**

Table 2 shows the proportion of participants meeting criteria for the DSM–IV symptom clusters and disability. At 3 months, 23.1% of the sample met DSM–IV criteria for PTSD, and at 1 year, 16.5% met criteria. Approximately half of the participants met the reexperiencing, hyperarousal, and disability criteria at both time points. Whether a participant was classified as suffering from PTSD largely depended on the avoidance and numbing symptom cluster.

**Course of the Disorder**

Participants meeting diagnostic criteria for PTSD at 3 months had a 50.3% chance of still suffering from PTSD at 1 year. The probability of persistent PTSD at 1 year was highest for those with the highest PSS severity scores at 3 months. For example, participants with a PSS score of 17 had a 61.4% chance of maintaining PTSD, and for those with scores of 20, 25, and 30, the chances were 70.7%, 82.4% and 86.7%, respectively.

There were a number of cases of delayed onset of PTSD between 3 and 12 months: 6.2% of the participants who did not meet PTSD criteria at 3 months reported PTSD at 1 year (\( N = 34 \) of 549). Among those participants who did not meet criteria at 3 months, those who met criteria for the reexperiencing and arousal clusters had a higher chance of meeting criteria for PTSD at 1 year than participants who did not meet these criteria (11.6% vs. 3.3%), \( \chi^2(1, N = 549) = 14.51, p = .0001 \). If they met the disability criterion in addition to the reexperiencing and hyperarousal criterion, their chances of having PTSD at 1 year increased to 15.9%.

**Sensitivity and Specificity of PTSD Symptoms**

Table 3 presents the frequency, sensitivity, and specificity of the PTSD symptoms listed in the DSM–IV at 3 months and at 1 year, together with the prospective sensitivity and specificity of symptoms assessed at 3 months in predicting PTSD status at 1 year. The most specific symptoms were bad dreams, physiological responses to reminders, situational avoidance, and the symptoms of the numbing cluster, but these symptoms were of low to moderate sensitivity (47–78%). The most sensitive symptoms were those of the hyperarousal cluster, intrusive recollections, distress when confronted with reminders, and cognitive avoidance. These symptoms showed moderate specificity (67–83%), with the exception of unacceptably low specificity for hypervigilance and exaggerated startle.
of symptoms emerged. Of the cases, 94.2% were classified correctly (8.8% of the delayed onset cases, 0.2% false positives).

Predictors of PTSD at 3 Months and 1 Year

There were no relationships of PTSD with the following accident or demographic characteristics: vehicle type, previous MVA injury, subsequent MVA, whether participants had been drivers or passengers, age, social class, employment status, or living situation. The concurrent and prospective associations of the 17 predictor variables investigated in this study with PTSD diagnosis and severity are shown in Table 4. Alpha levels for correlations were set at \( p = .002 \) because a maximum of 24 correlations were calculated for each of the PTSD measures.

Trauma Severity

Injury severity. Injury severity was not significantly related to PTSD diagnosis or severity at either time point. Whether or not a patient was admitted to the hospital showed small but significant correlations to both PTSD diagnosis and PTSD severity. Of the admitted patients, 32.2% suffered from PTSD at 3 months and 24% at 1 year, compared with 19.7% and 13.5%, respectively, in the nonadmitted group.

Unconsciousness. Participants' reports of unconsciousness were related to PTSD diagnosis and severity at 3 months. Of those who reported that they had been unconscious, 28.6% suffered from PTSD; of those who were not sure, 35.8%; and of those who were not unconscious, 20.5%. At 1 year, the associations with PTSD ceased to be significant.

Persistent medical problems. At both follow-up assessments, those participants who suffered from continuing medical problems had a higher chance of a diagnosis of PTSD and of greater PTSD severity. Of the participants who reported major problems resulting from the injuries at 3 months, 55.2% met criteria for PTSD; and of those still suffering from major medical problems at 1 year, 74% met PTSD criteria.

Persistent financial problems. At both follow-up assessments, those participants who reported financial problems as a result of the accident had a higher chance of having PTSD and had greater PTSD severity. Of the participants who reported major financial problems at 3 months and at 1 year, 46.5% and 56%, respectively, met criteria for PTSD.

Emotional Response During Trauma

Participants' ratings of how frightening the accident was and reports of peritraumatic dissociation correlated with PTSD diagnosis and severity at both assessments.

Preaccident Psychological and Social Variables

Gender. Women had a greater risk than men of suffering from PTSD at 3 months (28.9% vs. 18.2%), \( \chi^2(1, N = 888) = 14.19, p = .0002 \). At 1 year, there was no significant relationship of gender with PTSD diagnosis. Gender showed small associations with PTSD severity at both assessments. Women had less severe injuries (12.8% of women vs. 26.9% of men had bone fractures), \( \chi^2(2, N = 966) = 34.37, p < .0001 \), and were less likely to be admitted to the hospital, \( \chi^2(1, N = 967.) = 9.11, p = .003 \), but gave higher ratings of how frightening the accident was than did men, \( t(916) = 6.72, p < .001 \). However, partial correlations of gender with PSS severity at 3 months remained significant when controlling for perceived threat (3 months, \( pr = .15, p < .001 \); 1 year, \( pr = .08, p < .05 \), n.s.).

Health and emotional problems prior to accident. Partici-
Table 4

Relationship Between Predictor Variables and PTSD Diagnosis and Symptom Severity

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>PTSD diagnosis</th>
<th>PTSD severity (log)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 months</td>
<td>1 year</td>
</tr>
<tr>
<td>Trauma severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury severity</td>
<td>.06</td>
<td>.06</td>
</tr>
<tr>
<td>Admission to hospital</td>
<td></td>
<td>.13</td>
</tr>
<tr>
<td>Unconscious</td>
<td>.12</td>
<td>.08</td>
</tr>
<tr>
<td>3-month assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent medical problems</td>
<td>.31</td>
<td>.31</td>
</tr>
<tr>
<td>Financial problems</td>
<td>.26</td>
<td>.25</td>
</tr>
<tr>
<td>1-year assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent medical problems</td>
<td>—</td>
<td>.47</td>
</tr>
<tr>
<td>Financial problems</td>
<td>—</td>
<td>.37</td>
</tr>
<tr>
<td>Emotional response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived threat (log)</td>
<td>.17</td>
<td>.15</td>
</tr>
<tr>
<td>Peritraumatic dissociation (log)</td>
<td>.26</td>
<td>.18</td>
</tr>
<tr>
<td>Preaccident variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.13</td>
<td>.06</td>
</tr>
<tr>
<td>Prior health problems</td>
<td>.09</td>
<td>.10</td>
</tr>
<tr>
<td>Prior emotional problems</td>
<td>.19</td>
<td>.14</td>
</tr>
<tr>
<td>Litigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compensation claim at 3 months</td>
<td>.18</td>
<td>.23</td>
</tr>
<tr>
<td>Claim settled at 1 year</td>
<td>—</td>
<td>.23</td>
</tr>
<tr>
<td>Psychological maintaining factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trait worry</td>
<td>.12</td>
<td>.08</td>
</tr>
<tr>
<td>Anger (log)</td>
<td>.18</td>
<td>.15</td>
</tr>
<tr>
<td>3-month assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpretation of intrusions (log)</td>
<td>.51</td>
<td>.40</td>
</tr>
<tr>
<td>Anger cognitions (log)</td>
<td>.28</td>
<td>.32</td>
</tr>
<tr>
<td>Rumination (log)</td>
<td>.67</td>
<td>.40</td>
</tr>
<tr>
<td>Thought suppression (log)</td>
<td>.33</td>
<td>.24</td>
</tr>
<tr>
<td>1-year assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpretation of intrusions (log)</td>
<td>—</td>
<td>.55</td>
</tr>
<tr>
<td>Anger cognitions (log)</td>
<td>—</td>
<td>.42</td>
</tr>
<tr>
<td>Rumination (log)</td>
<td>—</td>
<td>.52</td>
</tr>
<tr>
<td>Thought suppression (log)</td>
<td>—</td>
<td>.29</td>
</tr>
</tbody>
</table>

Note: Underlined correlations are nonsignificant at $p \leq .002$ (Bonferroni correction). Dashes indicate that the correlation was not calculated because the relationship with PTSD was not concurrent or prospective. Log indicates that the variable was logarithmically transformed. PTSD = posttraumatic stress disorder.

Participants who reported that they had emotional problems prior to the accident had a higher chance of chronic PTSD and greater PTSD severity than those who did not have emotional problems. There were no significant associations between previous health problems and PTSD diagnosis and severity.

**Litigation**

Planned or initiated compensation claims at 3 months were related to PTSD at 3 months and at 1 year. Among the participants who were not involved in compensation claims or who were unsure, 16.4% had PTSD at 3 months and 8.1% at 1 year, compared with 31.3% at 3 months and 24.6% at 1 year of those who were planning to start or had already started compensation proceedings. At 1 year, PTSD was related to current status of compensation claims. Of those participants whose claims had not been settled, 28.9% had PTSD, compared with 10.4% of those whose claims had been settled, who had dropped their claims, or who had not filed a claim.

**Psychological Maintaining Variables**

**Negative interpretations of intrusive recollections.** Participants who assigned negative meanings to their intrusive recollections were more likely to suffer from PTSD symptoms at 3 months and at 1 year. Correlations with PTSD diagnosis and severity were moderately high.

**Rumination and thought suppression.** Rumination about intrusive recollections and suppression of recollections of the accident at 3 months and at 1 year correlated with PTSD diagnosis and severity at both time points. Participants' general tendency to worry measured at initial assessment showed lower correlations that were significant for PTSD diagnosis at 3 months and for PTSD severity at both time points.
Table 5
Results of Regression Analyses

<table>
<thead>
<tr>
<th>Variable</th>
<th>PTSD severity at 3 months</th>
<th>PTSD severity at 1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assessment</td>
<td>$\beta$</td>
</tr>
<tr>
<td>Persistent health problems</td>
<td>3 months</td>
<td>.27</td>
</tr>
<tr>
<td>Peritraumatic dissociation</td>
<td>Initial</td>
<td>.18</td>
</tr>
<tr>
<td>Financial problems</td>
<td>3 months</td>
<td>.19</td>
</tr>
<tr>
<td>Gender</td>
<td>.15</td>
<td>.15</td>
</tr>
<tr>
<td>Perceived threat</td>
<td>Initial</td>
<td>.17</td>
</tr>
<tr>
<td>Prior emotional problems</td>
<td>Initial</td>
<td>.17</td>
</tr>
<tr>
<td>Litigation</td>
<td>3 months</td>
<td>.07</td>
</tr>
</tbody>
</table>

1. Stepwise analyses, 11 predictor variables from previous studies

2. Stepwise analyses, all 17 predictor variables including maintaining factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>PTSD severity at 3 months</th>
<th>PTSD severity at 1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assessment</td>
<td>$\beta$</td>
</tr>
<tr>
<td>Rumination</td>
<td>3 months</td>
<td>.25</td>
</tr>
<tr>
<td>Persistent health problems</td>
<td>3 months</td>
<td>.20</td>
</tr>
<tr>
<td>Negative interpretation of intrusion</td>
<td>3 months</td>
<td>.20</td>
</tr>
<tr>
<td>Thought suppression</td>
<td>3 months</td>
<td>.13</td>
</tr>
<tr>
<td>Peritraumatic dissociation</td>
<td>Initial</td>
<td>.11</td>
</tr>
<tr>
<td>Financial problems</td>
<td>3 months</td>
<td>.12</td>
</tr>
<tr>
<td>Prior emotional problems</td>
<td>Initial</td>
<td>.11</td>
</tr>
<tr>
<td>Gender</td>
<td>.10</td>
<td>.09</td>
</tr>
<tr>
<td>Anger cognitions</td>
<td>3 months</td>
<td>.08</td>
</tr>
</tbody>
</table>

Note. Variables in regression functions are in order of steps entered. For Stepwise Analyses 1, adjusted $R^2 = .353$ at 3 months; adjusted $R^2 = .261$ at 1 year. For Stepwise Analyses 2, adjusted $R^2 = .530$ at 3 months; adjusted $R^2 = .376$ at 1 year. PTSD = posttraumatic stress disorder.

Anger. Participants who reported anger at initial assessment were more likely to suffer from PTSD symptoms at 3 months and at 1 year. Anger-related cognitions at 3 months and at 1 year were also related to PTSD diagnosis and severity at both time points.

For each of the proposed psychological maintaining factors, partial correlations with the PTSD severity at 3 months and at 1 year were calculated, partialling out injury severity (type of injury and hospital admission) and perceived threat during the accident. These analyses showed that neither objective nor subjective trauma severity accounted for the relationship between these predictors and PTSD.

Prediction of PTSD: Regression Analyses

PTSD at 1 Year

Stepwise multiple regression analyses tested the relative contribution of the different variables in predicting PTSD severity at 1 year. The first analysis tested which combination of the 11 variables derived from previous studies (stressor variables, emotional response during trauma, preaccident psychological and social variables, and litigation) predicted PTSD severity. As shown in Table 5, persistent health and financial problems at 3 months, peritraumatic dissociation and perceived threat during the accident, female gender, emotional problems prior to the accident, and litigation predicted 26.1% of the variance of PTSD severity 1 year after the accident. The other predictor variables (injury severity, admission to the hospital, unconsciousness, and previous health problems) did not add to the prediction.

Second, the variables measuring psychological maintaining factors were included together with the above variables to test whether they increased the accuracy of the predictions. Table 5 shows that this was the case. The most important predictors were rumination, persistent health problems, and negative interpretations of intrusions at 3 months. In addition, thought suppression, anger cognitions, and financial problems at 3 months, and peritraumatic dissociation, prior emotional problems, and litigation entered the regression function. These variables predicted 37.6% of the variance. The remaining 8 variables did not enter the regression function (injury severity, admission to hospital, unconsciousness, gender, prior health problems, perceived threat during accident, trait worry, and initial anger).

Because regression analyses capitalize on sampling error, the results were cross-validated. One hundred regression analyses were performed on random samples of approximately half of the participants to test how well the regression function replicated. Three predictors entered the regression function in all or nearly all of the 100 samples: negative interpretations of intrusive recollections (100% of the 100 subsamples, mean step when entered 2.0), persistent health problems (99%, 2.5), and rumination (93%, 2.6). Four other predictors entered the regression function in more than half of the subsamples: prior emotional problems (66%, 5.6), persistent financial problems (63%, 4.8), thought suppression (59%, 4.8), and anger cognitions (57%, 4.1). Three other predictors entered the regression function in a significant proportion of subsamples: peritraumatic dissociation (43%, 5.2), litigation (38%, 4.9), and gender (24%, 6.1). The remaining 7 predictors entered the regression function in no more than 5 subsamples and were thus considered nonsignificant: prior health problems (5%, 7.0), unconsciousness (5%, 7.4), perceived threat (4%, 6.3), trait worry (4%, 7.0), initial anger (4%, 6.5), injury severity (1%, 4), admission...
to the hospital (0%). Thus, the regression function for the whole sample shown in Table 5 replicated well and the cross-validation suggested only one additional variable that explains additional variance in some subsamples, female gender.

A clinically interesting question is whether the predictor variables explain any variance of PTSD severity at 1 year beyond what can be predicted from PTSD severity at 3 months. To investigate this question, we forced PSS scores at 3 months into the regression equation in the first step. They predicted 51.6% of the variance of PTSD severity at 1 year. In the next step, the 17 predictors were submitted to a stepwise analysis. Anger cognitions, persistent health problems, and negative interpretations of intrusion (all $\beta$s = .08) entered the regression function, and their combination with PSS scores at 3 months ($\beta$ = .62) explained 53.2% of the variance.

**PTSD at 3 Months**

Further regression analyses tested which combination of variables predicts PTSD severity at 3 month after the accident. When only variables taken at initial assessment were used (prospective analysis), 23.4% of the variance could be explained by the combination of peritraumatic dissociation ($\beta$ = .20), perceived threat ($\beta$ = .16), prior emotional problems ($\beta$ = .16), admission to the hospital ($\beta$ = .17), initial anger ($\beta$ = .16), and female gender ($\beta$ = .16). Injury severity, unconsciousness, prior health problems, and trait worry did not significantly improve the prediction. Table 5 summarizes the results of further analyses predicting PTSD at 3 months from initial and concurrent assessments. The 11 predictor variables derived from previous studies explained 35.3% of the variance, and the accuracy of the prediction was enhanced to 53% if the psychological maintaining factors were included. The variables that entered the regression functions were nearly identical to those predicting PTSD at 1 year.

**Delayed Onset**

Table 4 presents the associations of the predictor variables with delayed onset of PTSD between 3 months and 1 year after the accident. Injury severity, persistent medical problems, financial problems, anger cognitions, and rumination at 3 months and at 1 year, and negative interpretation of intrusions and thought suppression at 1 year were significantly associated with delayed onset. A discriminant analysis was conducted to test which combination of the 17 variables measured at initial or 3-month assessments classified cases of delayed onset. Injury severity, Wilks's lambda = .97; rumination, Wilks's lambda = .95; anger cognitions, Wilks's lambda = .94; and prior emotional problems, Wilks's lambda = .93 (all $p$s < .001), entered the discrimination function, $\chi^2 (4, N = 484) = 36.55, p < .0001$, accounting for 93.4% correct classifications. The accuracy of the prediction could not be enhanced by including PTSD severity at 3 months as a predictor.


Because negative interpretations of intrusions were among the most powerful predictors of chronic PTSD, we performed two further sets of analyses on participants who reported intrusions at the 1-year assessment ($N = 234$) to test Ehlers and Steil's (1995) hypotheses. The first prediction was that negative interpretations determine the distress caused by the intrusions. The correlation between these variables was $r = .63$ ($p < .001$). It was higher than the correlation between frequency of intrusions and distress ($r = .39, p < .001$). The partial correlation between interpretations and distress when controlling for intrusion frequency was .55 ($p < .001$).

The second prediction was that negative interpretations of intrusions motivate the individual to engage in psychological strategies intended to control the intrusions but which prevent change in the negative meaning of the trauma. High correlations (all $p$s < .001) were found with the severity of avoidance symptoms as measured by the PSS ($r = .52$), thought suppression ($r = .38$), and rumination ($r = .62$). These correlations were significantly higher than the correlations of intrusions frequency with these measures ($rs = .31, .24$, and .37, respectively). Partial correlations of negative interpretations with these measures when controlling for intrusion frequency were not much smaller than the zero-order correlations and were all highly significant.

**Discussion**

The study confirmed that PTSD is a common consequence of MVA and that it poses a significant clinical problem. More than 50% of the sample met *DSM-IV* criteria for intrusive reexperiencing, hyperarousal, or distress caused by the symptoms. The high prevalence of posttraumatic symptoms is especially noteworthy in that a high proportion of the participants either did not sustain any injury or suffered only soft tissue injury and that only 26% were admitted to the hospital. The analysis of the components of the *DSM-IV* criteria presented in Table 2 shows that the avoidance symptom cluster is largely responsible for determining whether a patient is classified as suffering from PTSD. This is in agreement with observations from other studies (e.g., Norris, 1992). It may be that the avoidance criterion is too strict given that about half of our sample met criteria for the reliving and hyperarousal cluster and that the disability scores showed that a substantial proportion of those who did not meet the avoidance criterion reported disability. These patients may require treatment, and it may not be sensible to assign them nonpatient status just because they do not meet an arbitrary score for avoidance and numbing criteria. The finding that those participants who met reliving and hyperarousal criteria at 3 months were more likely to meet all criteria for PTSD at 1 year than those who did not supports this argument. Blanchard, Hickling, Barton, et al. (1996) have come to similar conclusions from their analyses of subthreshold PTSD (see also Buckley, Blanchard, & Hickling, 1996).

The prevalence estimates for PTSD calculated in the present study take an intermediate position in the range reported in previous samples. They have the advantage that they are based on a large number of consecutive attenders with all types of MVA and nearly the whole range of injury severity. They are directly comparable with other epidemiological studies (Kessler et al., 1995) because they are based on *DSM-IV* criteria. A possible limitation is that PTSD was assessed with a standard-
ized self-report instrument rather than with a diagnostic interview. However, it is unlikely that the self-report version of the PSS used in this study overestimated the proportion of participants meeting DSM-IV criteria because it tends to be more conservative in diagnosing PTSD than are interviews (Foa et al., 1993).

The dropout analysis suggested a somewhat higher percentage of women and of patients with more severe injuries (higher proportion of bone injuries and admitted patients) among the participants, compared with the initial sample. Adjusting for these variables, the true estimate for the 3-month prevalence of PTSD in MVA patients who present to the Accident and Emergency Services is approximately 20%. The other variables that distinguished between participants and dropouts, such as age, vehicle type, driver status, and social and employment status, were not related to PTSD in the remaining sample and are therefore unlikely to have led to distortions in prevalence rates. Finally, we were unable to assess some attenders for a range of reasons, and it is unclear whether these are linked to PTSD. Systematic biases are, however, unlikely.

It is important to note that there was no indication of differences between participants and dropouts in the psychological predictor variables. It is therefore highly unlikely that selection effects affected the relationship between predictor variables and PTSD reported in this article.

**Prediction of Chronic PTSD**

Among the variables characterizing the severity of the stressor, persistent health problems and financial problems due to the accident emerged as the major predictors of chronic PTSD and delayed onset of PTSD. The pattern of results from the present study, from Mayou et al.'s (1993, 1997) previous studies, and from Blanchard et al.'s study (1997) suggests that the persistent physical consequences are more important in the long-term than original injury severity. The mechanisms by which chronic PTSD is related to persistent medical or financial problems are unclear. They may represent chronic stressors that exceed the patients' coping resources and may thus make it more difficult for patients to overcome the trauma. It is also likely that they are continuing reminders of the trauma that may make it more difficult for the patient to see the accident as something from the past. However, it is also conceivable that patients with PTSD find it more difficult to cope with physical impairments and financial restrictions and thus rate these problems more severely than would patients without PTSD. This is unlikely to explain the elaboration in the present study because medical and financial problems not only correlated with PTSD at concurrent assessments but also predicted PTSD at 1 year prospectively.

In this study, we replicated previous findings that the emotional response during trauma predicts PTSD, with the advantage that ratings were obtained soon after the accident. Perceived threat during the accident was among the consistent predictors of chronic PTSD when the variables identified in previous studies were considered on their own, and its influence was not explained by objective stressor measures such as injury severity (see also Blanchard, Hickling, Taylor, et al., 1996; Mayou et al., 1993). These findings support the emphasis in the DSM-IV on the subjective experience during trauma. However, the regression analyses also indicated that perceived threat does not explain any variance beyond that explicable by the maintaining psychological factors, such as negative interpretation of symptoms and rumination. Thus, in explaining chronic PTSD, maintaining psychological factors may be more important than the initial response.

Peritraumatic dissociation was among the strongest predictors of chronic PTSD when the variables identified in previous studies were considered on their own and remained a significant predictor when the maintaining factors were included in the analyses. These results agree with those of Shalev et al. (1996), although in our sample other important predictors besides dissociation were identified. The role of dissociation is further supported by the logistic regression analysis showing that emotional numbing symptoms assessed at 3 months predicted PTSD at 1 year. 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 the way the trauma is laid down in memory (Ehlers & Clark, in press; Foa & Hearst-Ikeda, 1996; van der Kolk & Fisler, 1995). Recent cognitive models of PTSD propose a role of strong implicit memories, as compared with explicit memories of the trauma in PTSD, and in particular, in explaining the reexperiencing symptoms (Brown, Dalgleish, & Joseph, 1996; Ehlers & Clark, in press; van der Kolk & Fisler, 1995). Consistent with these models, flashbacks and physiological responses to reminders assessed at 3 months predicted PTSD at 1 year in the present study.

The 3-month data supported earlier reports (Blanchard, Hickling, Taylor, et al., 1996; Kessler et al., 1995; Norris, 1992) that women are more likely than men to develop PTSD after MVA. Women found the accident more frightening, although they sustained less severe injuries. However, partial correlations and regression analyses showed that perceived threat did not mediate the gender effect. It remains unclear what causes a gender difference that has similarities to those which are also common in other anxiety disorders such as phobias.

Reports of emotional problems prior to the trauma were related to chronic PTSD symptoms and to delayed onset of PTSD. These results are consistent with results from Blanchard's group (Blanchard, Hickling, Barton, et al., 1996; Blanchard, Hickling, Taylor, et al., 1996). In the present study, we used a simple rating scale to assess previous psychopathology. It is possible that the relationship between previous emotional problems and chronic PTSD would have been even stronger if a formal assessment of the DSM-IV diagnoses had been used. However, it is also conceivable that this analysis would have shown smaller correlations because the present rating scale may have shared some common method variance with the PSS (e.g., willingness to endorse psychological symptoms). In a smaller sample, Blanchard's group did not find that 7 patients with delayed onset of PTSD differed in Axis I and Axis II disorders from 38 MVA survivors who did not develop PTSD (Buckley et al., 1996).

In the present study, we replicated the relationship between PTSD and compensation claims reported by Blanchard, Hickling, Taylor, et al. (1996), R. A. Bryant and Harvey (1995), and Culpin and Taylor (1973). The exact nature of the relationship between litigation and PTSD remains unclear. The prospective
results from the present study suggest that litigation may be involved in maintaining PTSD symptoms. The interrogations, delays, correspondence, and so forth, involved in compensation claims may act as unpleasant reminders of the trauma that make it difficult for the patient to put the accident in the past and move on. The few early settlements achieved in the first year may be considered inadequate and may lead to a sense that justice has not been done.

**Maintaining Psychological Factors**

In the present study, we aimed to demonstrate that a number of psychological variables that were derived from theoretical considerations predict the maintenance of PTSD symptoms. The correlations shown in Table 4 and the regression analyses support the role of negative interpretations of intrusions, rumination and thought suppression, and anger cognitions. These maintaining psychological variables, together with persistent health problems and financial problems, were the major predictors of PTSD at 1 year. When the maintaining variables were included, the proportion of the variance explained by PTSD severity at 3 months. This underlines their importance as a maintaining factor. The present study confirmed the predictions of Ehlers and Steil (1995) in that negative interpretations of intrusive memories explained a large proportion of the variance of the distress caused by the intrusions that was not explained by their frequency. Furthermore, negative interpretations explained a large proportion of the variance of strategies that are intended to control the intrusions but maintain them. These conclusions replicate and extend Steil and Ehlers's (1998) findings in cross-sectional studies of MVA victims.

**Conclusions**

The findings from this large representative sample of MVA victims add to the understanding of the prevalence and course of PTSD and of predictive factors. They also have wider implications for understanding reactions to trauma in general and for further research on underlying psychological processes.

The results of the study also bear practical clinical implications. First, the predictor variables identified in the study can be used to identify patients at risk of chronic PTSD. Second, the great influence of negative interpretations of intrusions and rumination makes it likely that cognitive interventions targeting these maintaining factors will be effective in treating chronic PTSD.

**References**


References


