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Incidence and Predictors of Acute Psychological Distress and Dissociation after Motor Vehicle Collision: a Cross-Sectional Study

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Abstract

Objective—The authors examined the incidence and predictors of peritraumatic distress and dissociation after one of the most common forms of civilian trauma exposure: motor vehicle collision (MVC).

Methods—In this study, patients presenting to the emergency department after MVC who were without serious injury and discharged to home after evaluation (n = 935) completed an emergency department interview evaluating sociodemographic, collision-related, and psychological characteristics.

Results—The incidence and predictors of distress (Peritraumatic Distress Inventory score ≥ 23) and dissociation (Michigan Critical Events Perception Scale score >3) were assessed. Distress was

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present in 355 of 935 patients (38%) and dissociation was present in 260 of 942 patients (28%). These outcomes showed only moderate correlation (r = 0.45), and had both shared and distinct predictors. Female gender, anxiety symptoms prior to MVC, and vehicle damage severity predicted both distress and dissociation. Higher socioeconomic status (higher education, higher income, full time employment) had a protective effect against distress but not dissociative symptoms. Better physical health and worse overall mental health were associated with increased risk of dissociation, but not distress. Distress but not dissociation was associated with lower patient confidence in recovery and a longer expected duration of recovery.

Conclusion—There are unique predictors of peritraumatic distress and dissociation. Further work is needed to better understand the neurobiology of peritraumatic distress and dissociation, and the influence of these peritraumatic outcomes on persistent psychological sequelae.

Keywords

Distress; Dissociation; Post-Traumatic Stress Disorder; Trauma; Motor Vehicle Collision

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Motor vehicle collisions (MVCs) are among the most common life-threatening experiences, resulting in 50 million injuries worldwide and almost four million US emergency department (ED) visits each year (Peden, 2004; Niska, Bhuiya, & Xu, 2010). More than 90% of patients presenting to US EDs following MVC do not have injuries requiring hospitalization and are discharged to home following evaluation (Platts-Mills, Hunold, Esserman, Sloane, & McLean, 2012). However, persistent psychological sequelae such as posttraumatic stress disorder (PTSD) are common in this population (Buitenhuis, 2006; Ehlers, Mayou, & Bryant, 1998; Nishi et al., 2010) and result in substantial morbidity and health status decline (Ehlers et al., 1998; Kuch, 1996; Mayou, 1993).

Understanding which patients are at risk for PTSD is an important priority. Three distinct categories of risk factors have been described: extant patient characteristics, stressor characteristics, and response characteristics (Green, 1994; Shalev, Peri, Canetti, & Schreiber, 1996). The extant patient characteristics include socio-demographics, mental health, and past experiences (McFarlane, 2008). Stressor characteristics include severity of harm or physical threat and other dimensions of the event (Green, 1990). Individual response characteristics include psychological sequelae immediately following the event, in particular distress and dissociation. Importantly, acute psychological response predicts PTSD independent of the severity of the traumatic stressor (Feinstein & Dolan, 1991; Lawyer et al., 2006; Perry, Difede, Musngi, Frances, & Jacobsberg, 1992). Although there is no currently known mechanism by which PTSD can be prevented in all individuals (Shalev, 2009), developing evidence suggests that a window exists shortly after the exposure during which therapeutic intervention may decrease the risk of PTSD development in susceptible patients (Bryant, 2003; Litz, 2008). Indeed, early interventions in rape victims and soldiers exposed to traumatic events have been shown to reduce prevalence of PTSD (Foa, Rothbaum, Riggs, & Murdock, 1991; Solomon & Benbenishty, 1986). A better understanding of immediate response characteristics may facilitate early identification and referral for treatment of those at high risk of PTSD.

Distress symptoms include perception of life threat; fear; feelings of helplessness, horror, guilt and shame; anger; loss of bowel and bladder control; shaking or trembling; and increased heart rate (Brunet et al., 2001; Jehel, Brunet, Paterniti, & Guelfi, 2005; Nishi et al., 2009). Higher levels of peritraumatic distress have been shown to correlate with increased likelihood of acute stress disorders in older patients (Bui et al., 2010), assault victims (Jehel, Paterniti, Brunet, Louville, & Guelfi, 2006), earthquake survivors and rescue workers (Nishi et al., 2012; Nishi & Matsuoka, 2013), sudden death survivors (Hargrave, Leathem, & Long, 2012), and in patients who have been involved in a severe MVC (Nishi et al., 2010); while the absence of peritraumatic distress strongly predicts absence of subsequent PTSD (Nishi et al., 2010). The association between peritraumatic distress and PTSD weakens as time between the traumatic event and the PTSD assessment increases (Thomas, Saumier, & Brunet, 2012), suggesting the involvement of other interim mediators.

Dissociative symptoms are characterized by alterations in the experience of time, place, and/or person during the course of the trauma exposure, characterized as derealization, numbing, detachment, reduced awareness of surroundings, and depersonalization (Marmar et al., 1994). It has been suggested that this alteration in perception may yield failures in memory processing and storage, thereby creating a subsequent sense of unreality surrounding recall of the traumatic event (Michaels, Michaels, Moon, et al., 1999). Dissociation in response to trauma is more common in patients reporting a prior history of exposure to combat (Branscomb, 1991), fires and other natural disasters (Cardena & Spiegel, 1993; Koopman, Classen, & Spiegel, 1994), child abuse (Chu, Frey, Ganzel, & Matthews, 1999), and interpersonal violence (Feeny, Zoellner, Fitzgibbons, & Foa, 2000), although whether this association results from increased reporting of prior trauma among those experiencing dissociation is unclear (Merckelbach & Muris, 2001). It has been proposed that dissociation is an adaptive mechanism to reduce the immediate psychological impact of a traumatic event (van der Kolk & van der Hart, 1989). Although dissociation may diminish the immediate psychological impact of trauma, observational data indicate that dissociative symptoms are associated with increased risk of PTSD development in victims of MVCs (Ehlers et al., 1998), emergency service workers (Marmar, Weiss, Metzler, & Delucchi, 1996), police officers (Martin, Marchand, Boyer, & Martin, 2009), Vietnam veterans (Bremner et al., 1992), and patients injured by other mechanisms (Michaels, Michaels, Moon, et al., 1999; Michaels, Michaels, Zimmerman, et al., 1999). A meta-analysis indicates that dissociation is the psychological response which most strongly predicts PTSD (Ozer, Best, Lipsey, & Weiss, 2003). Extant PTSD in turn predicts dissociative symptoms during subsequent traumatic events (Hetzel-Riggin & Wilber, 2010; Kaufman et al., 2002).

The relationship between peritraumatic dissociation and PTSD is, however, complex, and causality cannot be established based upon studies to date (Lensvelt-Mulders et al., 2008). Peritraumatic dissociation may not be predictive of PTSD when controlled for symptoms of persistent dissociative symptoms after the event (Briere, Scott, & Weathers, 2005; van der Velden & Wittmann, 2008). Additionally the relationship between peritraumatic dissociation and eventual development of PTSD may be partially mediated by avoidant coping (Pacella et al., 2011) and/or depression (Hodgson & Webster, 2011) in the subacute period following trauma, or may simply be reflective of underlying experiential avoidance as a predictor of

both dissociative symptoms and post-traumatic stress symptoms (Kumpula, Orcutt, Bardeen, & Varkovitzky, 2011).

There are several proposed relationships between peritraumatic distress and dissociation. Some authors have hypothesized that dissociation is a protective mechanism in which depersonalization and derealization occur to prevent the real-time experience of severe distress in response to trauma (Spiegel, Hunt, & Dondershine, 1988). Conversely, others have hypothesized that dissociation actually occurs as an epiphenomenon of high levels of distress (Bernat, Ronfeldt, Calhoun, & Arias, 1998; Friedman, 2000). It has been observed that dissociative symptoms often occur in the context of high levels of distress (Fikretoglu et al., 2006) and that dissociation may act as a mediator between the relationship between distress and PTSD development rather than being a distinct predictor (Otis, Marchand, & Courtois, 2012). Another possibility is that dissociation plays an important role in PTSD development in patients who are predisposed to dissociative reactions but not in others (Kihlstrom, Glisky, & Angiulo, 1994); dissociation is not necessary for PTSD to occur (Otis et al., 2012). Distress but not dissociation is associated with the development of PTSD in the elderly, further suggesting differences in underlying pathogenesis and relationship to PTSD between these two peritraumatic phenomena (Brunet et al., 2013). Little is known about the pathogenesis of these phenomena or what risk factors may predict distress and/or dissociation in response to trauma, and what the relationship between the two may entail. Prior investigation into risk factors for peritraumatic dissociation and acute distress symptoms has been minimally elucidative (Jaycox, Marshall, & Orlando, 2003). Understanding patient characteristics predictive of these acute responses may clarify their etiology and influence on PTSD development.

In this study we sought to characterize the incidence of distress and dissociation among a large cohort of patients presenting to the ED for care during the hours after MVC. We also assessed the strength of association between distress and dissociation in the early aftermath of MVC, compared sociodemographic, collision-related, and psychological characteristics that predict these outcomes, and evaluated the association between these outcomes and patients' expectations of recovery. Such information may improve understanding of the experience of individuals experiencing MVC, and provide further information regarding both the etiology of distress and dissociation as well as the association of these outcomes with patient expectations that may influence the recovery process (Castro, 2001; Ferrari, 2003).

Method

Patients were recruited between February 2009 and December 2010 from eight EDs located in four states (Michigan, Massachusetts, New York, and Florida). The study was approved by the institutional review boards of all participating hospitals. Each participant provided written informed consent.

A detailed description of study methods has been published. (Platts-Mills et al., 2011) In brief, patients age 18 to 65 who presented to the ED within 24 hours of MVC were screened for eligibility. Patients who required hospitalization, had fractures other than phalangeal

fractures, had more than 4 lacerations requiring sutures or a single laceration more than 20 cm in length, or had intracranial or vertebral injuries were excluded. Patients who were not alert and oriented were also excluded, as were pregnant patients, prisoners, patients unable to read and understand English, patients taking a β-blockers, or patients taking opioids above a total daily dose of 20 mg of oxycodone or equivalent. Enrollment was also limited to non-Hispanic whites (the most common ethnicity at study sites), because the study included the collection of genetic samples and ethnic heterogeneity increases the risk of population stratification bias. (Diatchenko et al., 2007)

A research assistant stationed in each of the study site EDs monitored the chief complaint and injury history of presenting patients. Potentially eligible patients were approached to determine eligibility and eligible patients were offered enrollment into the study. In order to assess patient competency to give informed consent, eligible patients were required to describe the essential elements of the study back to the research assistant. Following signing a local IRB-approved informed consent, study participants completed an ED interview using a web-based survey. Before enrolling patients in the ED, each research assistant completed a study training module followed by an interview with a standardized mock ED patient. Comparison of mock ED patient data across research assistants demonstrated high concordance (error rate 1.3%). Study participants were compensated for their time at the amount of $80.00 for completing the ED interview. After study participant discharge from the ED, a study site research assistant completed a web-based data extraction form which collected information from ED and hospital medical records.

Demographic information was assessed using standardized questionnaire items. Depressive symptoms during the week prior to the MVC were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D). (Radloff, 1977) Based on previous evidence, CES-D scores between 16 and 25 were defined as mild depressive symptoms and scores greater than or equal to 26 defined severe depressive symptoms. (Weissman, 1977; Zich, 1990) Trait anger and anxiety were assessed using the State-Trait Personality Inventory form Y (STPI-Y) anger and anxiety subscales. (Spielberger, 2000) Physical and mental health status during the 4 weeks prior to the MVC was assessed using the Mental Component Summary and Physical Component Summary scores of the Short-Form Health Survey version 2 (SF-12).(Ware, 1996) At-risk alcohol use was evaluated using the TWEAK alcohol screening instrument. TWEAK score has been shown to have high sensitivity (87%) and specificity (76%) for identifying individuals who meet ICD-10 criteria for alcohol dependence or harmful drinking. (Cherpitel, 1995) Marijuana use during the 3 months prior to the MVC was also assessed. Overall pain at the time of the ED interview and average overall pain during the month prior to the MVC were assessed using a 0 to 10 numeric rating scale. Severity of 21 individual somatic symptoms (e.g. fatigue, dizziness, blurry vision) in the month prior to MVC were assessed using a 0–10 numerical scale. These scores were compiled into an aggregate somatic symptom score were between 0 and 210. Research participant interview has been shown to be an accurate means of obtaining MVC history (Lee, 2011) and was used to assess collision characteristics.

Distress was assessed using the Peritraumatic Distress Inventory (PDI). This measure has high internal consistency (0.75–0.76) and test-retest reliability (0.74). (Brunet et al., 2001) A

PDI cut-off score of ≥23 was used to define marked distress symptoms ("distress"). (Nishi et al., 2010) Dissociation was defined by the Michigan Critical Events Perception Scale (MCEPS). (Michaels, Michaels, Moon, et al., 1999) This measure has high internal consistency (0.81) and strong correlation with the Peritraumatic Dissociative Experiences Questionnaire (r=0.5), a previously validated measure of dissociation. A MCEPS cut-off score of greater than 3.0 is indicative that the patient experienced dissociation. (Michaels, Michaels, Moon, et al., 1999) To assess confidence in recovery, participants were asked "How certain, or sure, are you that you will fully recover from this accident" on a 0–10, where 0 = "certain you will not recover" and 10 = "certain you will recover fully". Participants were also asked to estimate how many days they expected it would take for them to recover physically and how many days they expected it would take for them to recover emotionally from the accident.

To evaluate the strength of association between individual predictors and distress and dissociation outcomes, log binomial regression models (adjusted for study site) were used to generate relative risks with 95% confidence intervals. To select a set of variables that together best predicted distress and dissociation outcomes, multivariable lasso regression was performed using the "glmnet" package in R. (Tibshirani, 1996) Lasso is a form of penalized regression that performs variable selection while guarding against overfitting. All candidate predictors with $p<0.1$ in bivariate analyses were included as candidate predictors for developing lasso models. The tuning parameter for each model was chosen using cross-validation. The overall predictive utility of each model was evaluated using the area under the receiver-operator characteristic curve (AUROCC).

Since coefficient estimates from multivariable models are biased, they are not a reliable estimate of the effect size of an individual model variables.(Tibshirani, 1996) Therefore to evaluate the strength of association between individual model variables and study outcomes while adjusting for potential confounders (study site, gender, age, and education), log binomial regression modeling was used to generate relative risks with 95% confidence intervals for each variable with a nonzero lasso coefficient.

Results

A total of 949 individuals were evaluated in the ED in the early aftermath of MVC (mean time from MVC to ED presentation 2.2 +/− 2.8 hours). Most enrolled MVC survivors were women, had some education past high school, and worked full time (Table 1). Less than one third of participants were smokers and only about one in five reported mild or moderate depressive symptoms during the week prior to MVC. The great majority of patients were driving the vehicle at the time of the collision and over half of collisions resulted in severe vehicle damage.

Peritraumatic distress was experienced by 355/935 (38%) MVC survivors. Peritraumatic dissociation was less common, occurring in 260/942 (28%) MVC survivors. Raw scores for distress and dissociation were only moderately correlated (n = 930, Pearson correlation coefficient 0.45, $p < 0.001$). Among patients within the highest quartile of dissociative symptoms (MCEPS score ≥3.4), only 36% were distressed. Similarly, among individuals

within the highest quartile of distress symptoms (PDI symptoms score ≥27), only 51% dissociated.

Bivariate associations between sociodemographic and collision characteristics and distress and dissociation outcomes are shown in Figure 1A. Female sex and severity of vehicle damage were associated with both distress and dissociation. Those 50–65 years of age were less likely to experience either distress or dissociation than those aged 18–34. A history of marijuana use and higher vehicle speed at the time of the collision were associated with increased risk of distress (but not dissociation); levels of family income above twenty thousand dollars and rear end collision were protective against distress (but not dissociation). BMI within categories of 25–30 or >30 was protective against dissociation (versus BMI < 25), but was not protective against distress.

Bivariate associations between health status, psychological, and cognitive characteristics and distress and dissociation outcomes in the hours after MVC are shown in Figure 1B. Trait anxiety (highest versus lowest tertile) predicted both distress and dissociation and better mental health prior to MVC decreased risk of both outcomes. Increased depressive symptoms prior to MVC (≥6 versus <16), increased trait anger, past somatic symptom score (high versus lowest and middle versus lowest tertile), and participant feeling that collision was their fault were associated with increased risk of distress but not dissociation. Patients with better physical health were more likely to have dissociation, but not distress.

From the bivariate analyses shown in Figures 1A and 1B, a parsimonious set of predictors of distress and dissociation were identified using Lasso regression. Female sex, trait anxiety, severity of vehicle damage, and depressive symptoms prior to MVC together most efficiently predicted distress symptoms (Table 2, mean AUROCC=0.69). Female sex, trait anxiety, and severity of vehicle damage, and worse overall mental health prior to MVC were most predictive of dissociation (Table 2, mean AUROCC=0.57).

Table 3 displays associations between distress and dissociation after MVC and patient confidence in recovery and expected time to physical and emotional recovery. Distressed patients were 30% less likely to feel confident in achieving a full recovery than individuals who were not distressed, and were 40% less likely to estimate a time to emotional recovery of less than 30 days (Table 3). In contrast, the association between dissociation and patient expectations was weaker and did not reach statistical significance.

Discussion

We find that adverse psychological responses are common among patients treated in the ED after MVC and discharged to home. More than 1 in 3 individuals in our study experienced substantial distress, and more than 1 in 4 experienced dissociation. These outcomes were only moderately correlated (r = 0.45) and were less correlated than seen in a prior study (Fikretoglu et al., 2006). Among patients within the highest quartile of dissociative symptoms, only 36% were distressed. Similarly, among individuals within the highest quartile of distress symptoms, only 51% experienced dissociation. These results imply that distress and dissociation are separate entities and that, rather than dissociation being an

epiphenomenon of high levels of distress or protective against distress, distress and dissociation are distinct psychological processes. Although we do not directly examine the relationships between dissociation and long-term health or psychological outcomes, the absence of a relationship between dissociation and expectations for recovery in our sample does not support the hypothesis that dissociation indicates a more severe response or confers a negative prognosis (Holm, Carroll, Cassidy, Skillgate, & Ahlbom, 2008).

A previous study which sent mail questionnaires to police officers and civilian peers and asked about symptoms in response to past stressful life events (critical incidents) found a much stronger association between distress and dissociation symptoms (Fikretoglu et al., 2006). In that study 57% of police and 51% of civilians who reported dissociative symptoms in the highest quartile of respondents after a past critical incident also reported distress symptoms in the highest quartile. Differences in study results between that study and the present one could be due in part to differences in the populations, time elapsed since the traumatic event, and type of trauma exposure. An advantage of the present study is that distress and dissociation symptoms were assessed only hours after the MVC, reducing the likelihood of recall bias.

Consistent with weak correlation between distress and dissociation in our sample, predictors of these reactions also differed. In particular, higher socioeconomic status (higher education, higher income, full time employment) consistently had a significant protective effect against distress but not dissociative symptoms. Cigarette use was also associated with increased distress but not dissociation, but whether this relationship is a result of the direct effects of chronic nicotine exposure or confounding by socioeconomic status is unknown. Depressive and anxiety symptoms, and the feeling that the MVC was the participant's fault, were also more predictive of distress than dissociation. Other factors, such as reduced mental health prior to MVC, were more strongly predictive of dissociation. Interestingly, better physical health status had different effects on risk of distress and dissociation: better physical health was associated with greater risk of dissociation, but not associated with risk of distress. The distinct risk factors for distress and dissociation suggest that these phenomena are distinct clinical entities with distinct etiologies.

The relationship of several other study findings to previous literature are also worthy of comment. A prior investigation found that, as in our study, female gender was predictive of both dissociation and distress as characterized by "emotional reactions" (Lawyer et al., 2006). This is consistent with other reported findings (Brunet et al., 2001; Bryant & Harvey, 2003). Our results differ, however, in that our study identified greater age as being protective against both dissociation and distress, whereas in the study by Brunet et al. age greater than 55 predicted dissociative response. Our findings are consistent with two prior reports (Fullerton et al., 2000; Ursano et al., 1999) which found that education, income, and marital status were associated with distress/emotional response. Several exposure-related factors were found to be predictive of trauma response patterns in the studies by Fullerton et al. and Ursano et al.; fear of death/injury, friend of family member killed, location relative to the attack, and media exposure in the prior study as compared to vehicle damage, vehicle speed, location in vehicle, and collision type in ours. Other risk factors identified in these

analyses such as involvement in rescue efforts, race or ethnicity, loss of possessions, and fear of death were not investigated in our study.

Alcohol misuse has been reported as a possible risk factor for the development of PTSD (Blanchard et al., 1996). However at-risk drinking during the past 3 months was not associated with either distress or dissociation in the present study. Nicotine dependence is associated with increased risk of both PTSD (Koenen et al., 2005) and panic disorders (Isensee, Wittchen, Stein, Hofler, & Lieb, 2003), and cigarette smoking was associated with risk of peritraumatic distress in the present study. This association between tobacco use and distress has been described previously (Feldner, Babson, & Zvolensky, 2007), and could be due to the association between tobacco use and anxiety disorders (Morissette, Tull, Gulliver, Kamholz, & Zimering, 2007), self-medication among those with worse mental health, (Khantzian, 1997) or the association between smoking status and other sociodemographic markers (Laaksonen, Rahkonen, Karvonen, & Lahelma, 2005) that increase distress vulnerability. These same factors could also account for the association between frequency of marijuana use and peritraumatic distress (Bonn-Miller, Vujanovic, Feldner, Bernstein, & Zvolensky, 2007; Bremner, Southwick, Darnell, & Charney, 1996). Marijuana use has also been shown to cause dissociative symptoms in vulnerable individuals (Johnson, 1990).

Prior investigations have focused on traumatic exposures or stressors as risk factors for acute peritraumatic responses (Branscomb, 1991; Feeny et al., 2000; Lawyer et al., 2006). This is the first study to date to identify self-reported baseline psychological traits including depression, anxiety, anger, and poor overall mental health as predictors of peritraumatic distress and dissociation, as well as the first to relate peritraumatic responses to expectations of recovery. Recovery expectations are strong predictors of recovery and disability after MVC (Carroll, 2011; Holm et al., 2008), and may help shape cognitions and behaviors during the weeks after trauma (Carroll, 2011). Negative cognitions and altered behaviors during the weeks after MVC may be important mediators of the influence of distress on post-MVC outcomes. In our sample, distressed individuals were much less likely to be confident of full recovery and to believe that they would recover emotionally within one month of MVC. Point estimates suggest that dissociation has less influence on recovery expectations, and the associations between dissociation and recovery expectations did not reach statistical significance.

A number of study limitations should be considered when interpreting our study findings. First, our study was cross-sectional, therefore health characteristics and psychological traits prior to MVC were assessed retrospectively. The patient's emotional state at the time of the ED visit may have influences responses to questionnaires, particularly for psychological assessments of pre-trauma anxiety, anger, and depression. Assessment of these characteristics prior to induction of traumatic response is possible in experimental studies (e.g. CO_2 inhalation to incite distress and cold exposure or pharmacologic production of dissociation) but much more difficult in non-experimental studies. To try to reduce this influence, questions about current psychological symptoms were assessed completely prior to turning to questions regarding past psychological symptoms. The fact that our evaluations were performed only hours after MVC is also a strength of our study, as peritraumatic distress and dissociation symptoms were assessed in the peritraumatic period rather than

days or weeks after trauma exposure. This contemporaneous assessment may have provided us with a more accurate assessment of the peritraumatic psychological response. In addition, we did not adjust for multiple comparisons in our bivariate analyses, which increases the risk of false positive associations. However, many of the candidate predictor variables assessed were correlated, therefore adjusting for multiple tests would most likely result in a significant decrease in power with very little corresponding decrease in the risk of type I error. In addition, the need for such adjustment is a matter of considerable debate, particularly in the setting of studies such as this one in which candidate predictors were selected because of substantial pre-test association with study outcomes (Rothman, 1990; Savitz & Olshan, 1995). Another study limitation is that our study only assessed individuals experiencing one very common traumatic exposure, MVC. The incidence and association of distress and dissociation symptoms after other types of trauma is unknown. In addition, only patients discharged home from the ED after MVC were included. However, only about 10% of patients who seek ED evaluation after MVC are admitted to the hospital (Nishi et al., 2010) and evaluating a homogenous outcome (in which the degree of tissue injury is relatively constant) likely increased our ability to identify predictors of distress and dissociation separate from those related to tissue injury. Finally, because of genetic analyses performed as part of this project, enrollment was restricted to European Americans only. Non-European Americans may have different rates and predictors of distress and dissociation after MVC.

In summary, we found that distress and dissociation are common among individuals discharged home from the ED after MVC, with each outcome occurring in approximately one third of patients. These outcomes are only moderately correlated, and have both shared and distinct predictors including baseline psychological traits. Perhaps most notably in this regard, higher socioeconomic status had a consistent protective effect against distress but not dissociation. Similarly, better physical health was a risk factor for dissociation but not distress. Together these data suggest that distress and dissociation during the peritraumatic period are distinct phenomena with distinct biologic underpinnings. Further work is needed to understand the neurobiology of distress and dissociation and the relationship between these acute peritraumatic responses and persistent psychological sequelae. Such improved understanding may inform the development of early interventions to prevent long term psychological consequences of trauma exposure.

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Figure 1A.

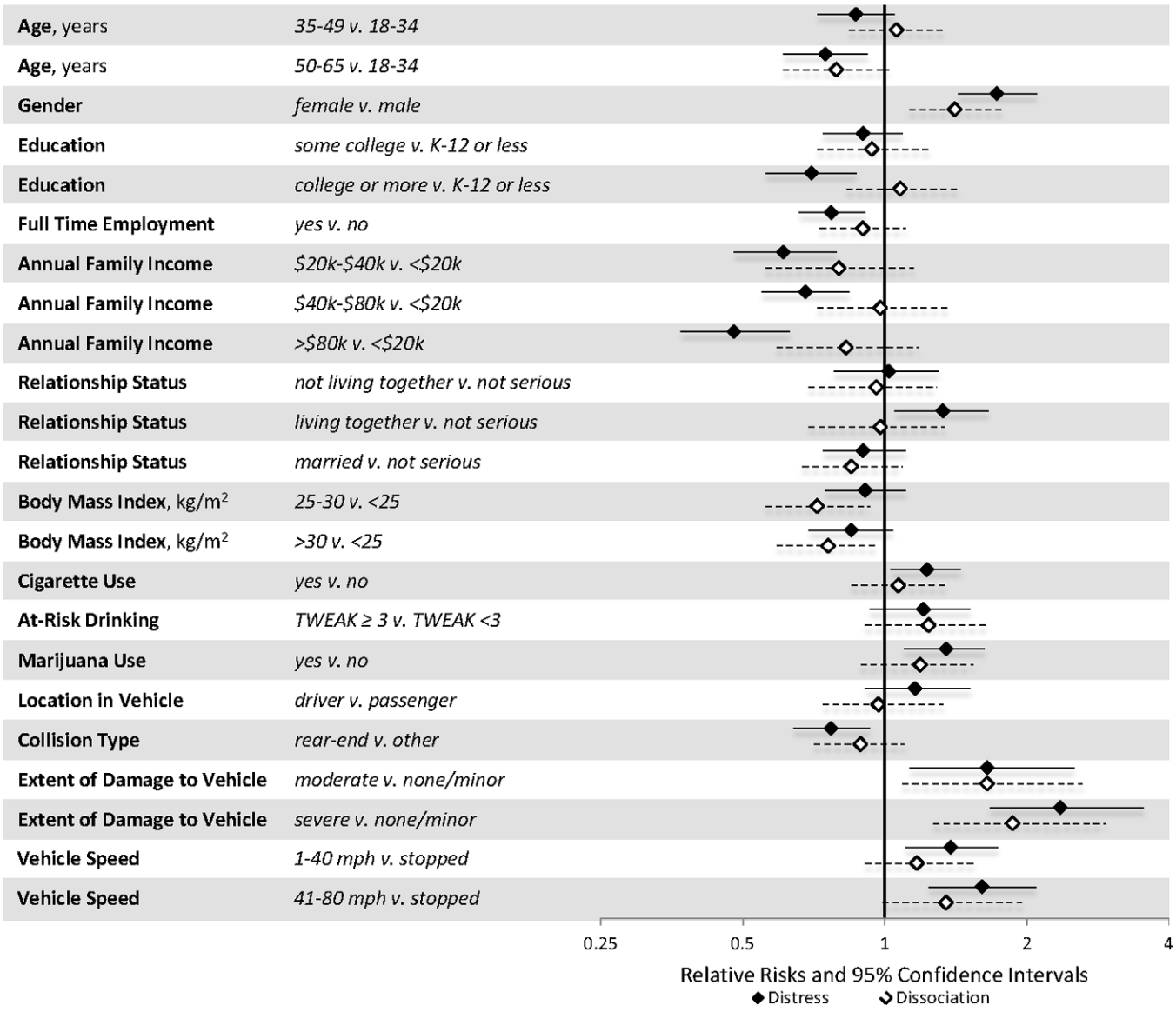

Figure 1B.

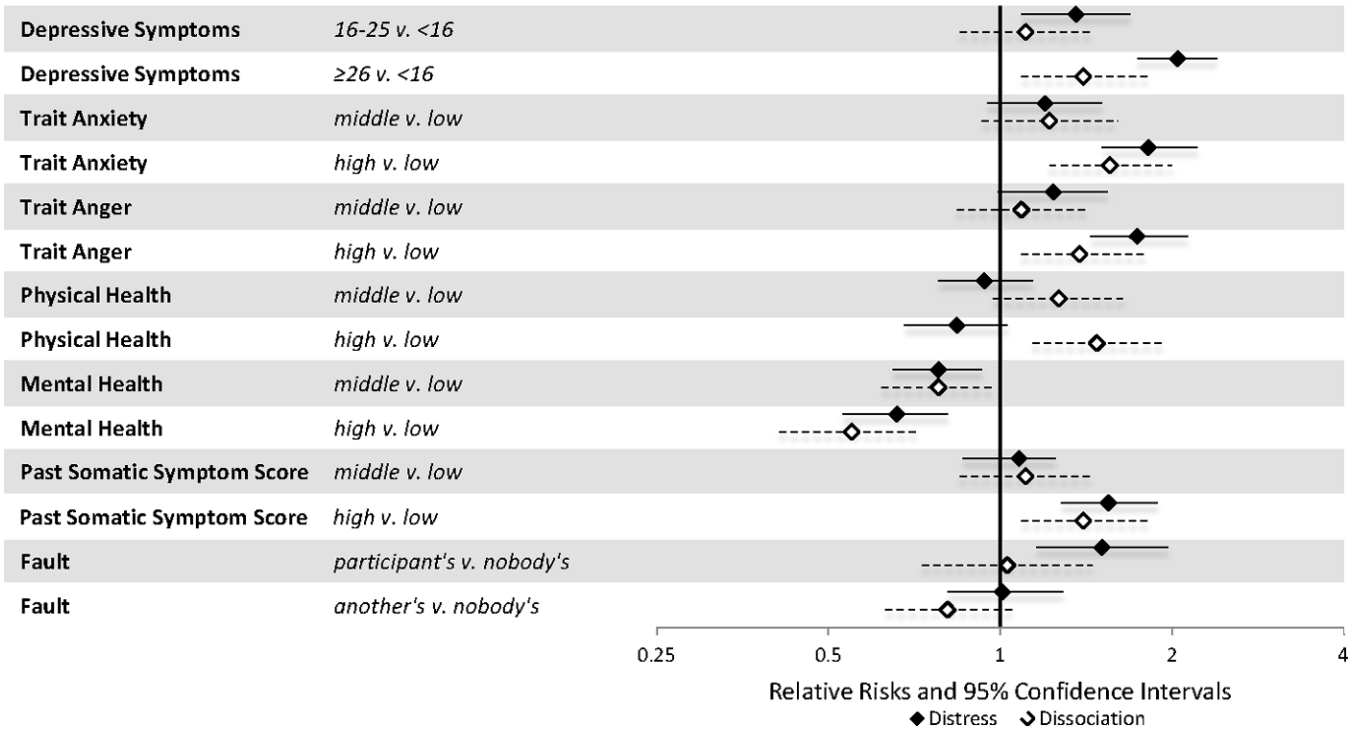

Figure 1.

Figure 1A. Association of Sociodemographic and Collision Characteristics with Distress and Dissociation

Figure 1B. Association of Health Status and Psychologic and Cognitive Characteristics with Distress and Dissociation

Table 1

Study participant characteristics (n = 949).

Predictor	Categories	N	%
Age	18–34	506	54.1
	35–49	251	26.8
	50–65	178	19.0
Gender	Male	377	39.7
	Female	572	60.3
Education	K-12 or less	227	24.0
	Some college	369	39.0
	College/more	351	37.1
Full Time Employment	No	396	41.7
	Yes	553	58.3
Income	<$20k	117	13.9
	$20k to $40k	176	20.9
	$40k to $80k	277	32.9
	>$80k	273	32.4
Relationship Status	Not serious	298	31.8
	Not living together	146	15.6
	Living together	121	12.9
	Married	371	39.6
BMI	<25	356	38.7
	25–30	287	31.2
	>30	277	30.1
Cigarette Use	No	691	73.0
	Yes	256	27.0
Depressive Symptoms Prior to MVC*	<16	755	79.7
	16–25	123	13.0
	>=26	69	7.3
Collision Type	Other	608	64.1
	Rear-end	341	35.9
Extent of Damage†	None-Minor	128	14.0
	Moderate	282	30.8
	Severe	507	55.3
Vehicle Speed	Stopped	257	27.3
	1–40mph	492	52.2
	41–80mph	194	20.6
Location in Vehicle	Passenger	137	14.4
	Driver	812	85.6
Fault	Nobody’s fault	164	17.3
	Subject’s fault	119	12.6
	Another’s fault	664	70.1

*As measured by CES-D Score

†Severe damage defined as car not being drivable

Table 2

Final Lasso regression models for distress and dissociation.

	Predictor	RR	95% CI	p
Distress (PDI≥23)	Female Gender	1.87	1.49–2.35	<0.001
	Trait Anxiety*	1.63	1.35–1.96	<0.001
	Vehicle Damage†	1.67	1.35–2.07	<0.001
	Depressive Symptoms in Month Prior to MVC‡	1.80	1.50–2.15	<0.001
Dissociation (MCEPS>3)	Female Gender	1.52	1.16–1.99	0.003
	Trait Anxiety*	1.44	1.13–1.83	0.004
	Vehicle Damage†	1.39	1.08–1.79	0.011
	Mental Health Score±	0.62	0.45–0.85	0.003

Each variable adjusted for study site, age, gender, and education status. Relative risks for individual variables identified by model.

*STPI-Y Anxiety subscale score in highest tertile (raw score 17–37) versus lowest tertile (raw score <13)

†Severe damage versus None-Minor damage

‡CES-D score in highest tertile (raw score 26–53) versus lowest tertile (raw score <16)

±SF-12 Mental Health Subscale Score in highest tertile (raw score 57.1–71.4) versus lowest tertile (raw score <47.8)

Table 3

Associations between distress and dissociation and patient confidence in recovery and expected time to physical and emotional recovery after MVC*

	Distress*			Dissociation†		
Expectation	**RR**	**95% CI**	**p**	**RR**	**95% CI**	**p**
Confident in Full Recovery	0.70	0.57–0.88	0.002	0.84	0.64–1.09	0.198
Expected Time to Physical Recovery <30 days	0.76	0.58–1.00	0.053	0.81	0.58–1.13	0.221
Expected Time to Emotional Recovery <30 days	0.62	0.49–0.79	<0.001	0.80	0.60–1.06	0.133

Each variable adjusted for age, education, pain severity, and study site

*As measured by PDI≥23

†As measured by MCEPS >3