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Gender Differences in PTSD Symptoms: An Exploration of Peritraumatic Mechanisms

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Abstract

Females are at higher risk than males for developing posttraumatic stress disorder symptoms (PTSS) following exposure to trauma, which may stem from gender differences in initial physiological and psychological responses to trauma. The present study aimed to examine a number of peri- and initial post-traumatic reactions to motor vehicle accidents (MVAs) to determine the extent to which they contributed to gender differences in PTSS. 356 adult MVA survivors (211 males and 145 females) reported on peritraumatic dissociation, perception of life threat and initial PTSS. In addition, heart rate and urinary cortisol levels were collected in-hospital. 6 weeks and 6 months later, PTSS were assessed via clinical interviews. Results suggested that initial PTSS and peritraumatic dissociation were marginally significant mediators at 6-week follow-up and significant mediators at 6-month follow-up, providing partial support for the hypothesis that initial responses to trauma may account for observed gender differences in PTSS development.

Keywords

posttraumatic stress disorder; posttraumatic stress symptoms; gender differences; peritraumatic dissociation

Epidemiological studies have revealed gender-specific risk for posttraumatic stress disorder (PTSD) development, such that females are approximately twice as likely as males to develop PTSD following exposure to a traumatic event (Breslau et al., 1998; Kessler et al., 1995). A meta-analysis by Tolin and Foa (2006) found that females were at greater risk for developing PTSD despite reporting exposure to fewer traumatic events than males. Further, results revealed that differential exposure to specific types of trauma (i.e. sexual assault) only partially accounted for gender differences in PTSD rates. Meta-analytic reviews of

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PTSD risk factors initially suggested that post-traumatic factors accounted for the highest percentage of variance in subsequent PTSD (Brewin, Andrews & Valentine, 2000), although a more recent meta-analysis found that peritraumatic risk factors were the strongest predictors of PTSD (Ozer, Best, Lipsey & Weiss, 2003). A number of individual and trauma-related characteristics have been hypothesized to contribute to gender differences in PTSD including sex differences in psychophysiology and differences in appraisal of threat, dissociation, coping style and social support (see review by Olff, Langeland, Draijer & Gersons, 2007). The current investigation examined the extent to which initial reactions to a trauma mediated the relationship between gender and subsequent acute and chronic PTSD symptoms (PTSS). Specifically, we examined the extent to which gender differences in perceived injury severity, peritraumatic dissociation, initial PTSS and initial physiological responses accounted for the relationship between gender and PTSS 6 weeks and 6 months following a serious motor vehicle accident (MVA).

Research examining the relationship between injury severity and PTSS has produced mixed findings, perhaps due to differences between studies in whether injury severity was assessed objectively or subjectively. Research examining the relationship between objective measures of injury severity and PTSD have produced mixed results, with some reporting positive relationships (e.g. Blanchard et al., 1995; Briere & Elliot, 2000), some reporting negative relationships (e.g. Delahanty, Raimonde, Spoonster & Cullado, 2003; Dougall, Ursano, Posluszny & Fullerton, 2001), and some reporting no relationship (e.g. Bryant & Harvey, 1995; Ehlers, Mayou & Bryant, 1998). However, trauma victims' subjective perceptions of life threat have consistently been related to PTSS development, such that greater perceived threat predicts greater PTSD risk (Bernat, Ronfeldt, Calhoun & Arias, 1998; Blanchard et al., 1995; Dunmore, Clark & Ehlers, 1999; Ehlers et al., 1998; Kilpatrick et al., 1989), with effect sizes ranging from small to medium (Ozer et al., 2003). Overall, these empirical findings suggest that PTSD vulnerability may be affected more by cognitive appraisal than by actual physical injury.

Cognitive models of trauma response focus on the role of appraisal in evaluating the threat of a traumatic event and the ability to cope with that threat (Ehlers & Clark, 2000). According to these models, when a trauma survivor appraises an event as catastrophic, they continue to feel threatened even after the event has passed. This persistent feeling of danger likely worsens PTSS because the victim is unable to return to an adaptive stress response (Ehlers & Clark, 2000). In general, negative cognitive appraisals of a traumatic event are associated with increased risk for posttraumatic disorders (Dunmore et al., 1999; Ehlers et al., 1998; Nixon & Bryant, 2005). Studies specifically comparing gender differences in initial perceptions of fear, helplessness and horror revealed that women were more likely than men to view comparable events as threatening (see Norris, Foster & Weisshaar, 2002). In studies of earthquake survivors (Karanci et al., 1999) and terrorist attack survivors (Solomon et al., 2005), results revealed that women reported a greater sense of threat from the trauma than men, and that perceived threat predicted psychological distress in women, but not in men. These results suggest that gender differences in initial appraisal of a trauma may serve as a mechanism for gender differences in rates of PTSS.

Peritraumatic dissociation may also impact symptom development and appears to differ by gender. Peritraumatic dissociation consists of distorted perceptions of time, person and place, which may include disbelief that the event is really happening, feeling disconnected from one's own body, or feeling that time has slowed down or accelerated (Marmar, Weiss & Metzler, 1997). Peritraumatic dissociation is posited to lead to inadequate consolidation of the traumatic memory. As a result, a trauma victim may be unable to adequately process trauma-related cognitions and emotions, and therefore fail to engage in an adaptive stress response (Koopman, Classen & Spiegel, 1994). The association between peritraumatic

dissociation and PTSD is well documented, such that trauma victims who report more dissociation are at greater risk for developing PTSD (Ehlers et al., 1998; Koopman et al., 1994; Shalev et al., 1998; Ursano et al., 1999; see meta-analysis by Ozer et al., 2003). Further, females appear to engage in more peritraumatic dissociation than males (Bryant & Harvey, 2003; Ehlers et al., 1998; Grieger, Fullerton & Ursano, 2003; Lawyer et al., 2006; see Punamaki, Komproe, Qouta, Elmasri & de Jong, 2005 for an exception), suggesting that peritraumatic dissociation may serve to mediate the relationship between gender and PTSS.

While a diagnosis of PTSD requires symptoms to be present for at least one month, PTSS are common soon after a traumatic event. Acute intrusive, avoidant and hyperarousal symptoms have been reported in the days and weeks following a traumatic event, and have been shown to predict development of later PTSD in a variety of trauma populations (Bryant & Harvey, 1996; Cardeña & Spiegel, 1993; Feinstein & Dolan, 1991; North, Smith & Spitznagel, 1994; Richmond & Kauder, 2000; Rothbaum, Foa, Riggs, Murdock & Walsh, 1992). Richmond and Kauder (2000) found that in-hospital intrusive and avoidance symptoms significantly predicted the development of PTSS three months after a MVA. Birmes and colleagues (2005) reported that both peritraumatic dissociation and acute PTSS accounted for significant and unique variance in subsequent PTSD. Some acute PTSS clusters may predict subsequent PTSD better than others; Schell and colleagues (2004) found that hyperarousal symptoms soon after trauma predicted the development of other PTSS clusters and were associated with lower symptom improvement over time.

In general, studies of acute PTSS typically have not focused on gender differences. However, when gender effects were reported, women have consistently reported more acute PTSS than men (Bryant & Harvey, 2003; Elkilt, 2002; Fullerton et al., 2001). These findings underscore the importance of considering acute PTSS and peritraumatic dissociation as possible mechanisms of gender-specific risk for PTSD. Overall, research has demonstrated that males and females differ in their reports of perceived life threat, peritraumatic dissociation and initial PTSS, and that these factors are all consistent predictors of posttraumatic distress. However, it remains to be seen whether gender differences in incidence rates of PTSD can be partly explained by gender differences in initial responding to a traumatic event.

Psychobiological responses to trauma may also play a role in explaining gender differences in PTSD. Much of the work on the biology of PTSD has focused on the body's two primary stress pathways: the sympathetic-adrenal-medullary (SAM) pathway and the hypothalamic-pituitary-adrenal (HPA) axis (for a review, see Yehuda, 2002). In general, the majority of studies have found that HR assessed in-hospital following traumatic injury is positively associated with development of PTSS in both adults (Bryant, Harvey, Guthrie, & Moulds, 2000; Shalev et al., 1998; Zatzick et al., 2005) and children (Kassam-Adams, Garcia-España, Fein & Koplin-Winston, 2005; Nugent, Christopher & Delahanty, 2006), although some have found negative or no relationships between early HR and subsequent PTSS (Blanchard, Hickling, Galovski, & Veasey, 2002; Buckley et al., 2004). Research investigating HPA activity and the release of cortisol has generally found that low levels of cortisol in the acute aftermath of trauma are associated with increased risk for the development of PTSS in adult trauma survivors (for a review, see Delahanty & Nugent, 2006).

Despite the broad theoretical and empirical literature on the biology of PTSD, very few studies have examined potential gender differences in psychobiological responses to trauma. To our knowledge, data have not been presented on gender differences in the association between acute HR after trauma exposure and development of PTSD in adults. Similarly, research has not examined gender differences in acute HPA responses to trauma in adults.

Rasmusson and colleagues (2003) reviewed studies of cortisol and chronic PTSD, and observed that studies including male and postmenopausal female participants were more likely to find low levels of cortisol associated with PTSD while studies of premenopausal females were more likely to find high levels of cortisol associated with PTSD. Further, a recent meta-analysis (Meewisse Reitsma, de Vries, Gersons & Olff, 2007) of cortisol levels in chronic PTSD concluded that females with PTSD have lower basal cortisol levels than female controls, but found that this relationship was not significant in males, leading the authors to hypothesize that women's higher sensitivity to HPA axis alterations may help explain their increased risk for development of PTSD. These results suggest potential gender differences in HPA functioning in chronic PTSD, but the extent to which gender differences in acute cortisol response to trauma may account for gender differences in PTSS is unclear.

Although equivocal, existing research suggests the possibility that gender-based differences in psychobiological responses soon after trauma may serve as a mechanism for gender-based differences in subsequent PTSS. The purpose of the present study was to examine gender differences in perceived life threat, peritraumatic dissociation, initial PTSS, and acute HR and cortisol levels. These factors were tested as mechanisms through which gender differences in PTSS developed following a MVA. We hypothesized that female gender would be associated with more severe PTSS both 6 weeks and 6 months post MVA and that this would be at least partially accounted for by greater perception of life threat, more peritraumatic dissociation and higher initial PTSS in women. As prior research was mixed with respect to gender differences in biological responses to trauma, our hypotheses regarding gender differences in acute HR and cortisol levels were considered exploratory.

1. Methods

1.1 Participants

Three hundred fifty-six non-amnesic MVA victims (211 males and 145 females) were recruited following admission to a hospital trauma unit. The age of participants ranged from 18-87 ($M=38.68$, $SD=16.16$) and average household income was \$20,000-30,000 per year. The majority of the sample (89%) was Caucasian, consistent with the demographics of the Northeast Ohio area. At the 6-week follow-up, 251 participants (139 males and 112 females) were retained, and 196 (103 males and 93 females) were retained for the 6-month follow-up. Comparison of those who remained in the study with those who did not revealed that males were more likely than females to drop out at the 6-week ($p<.05$) and 6-month follow-ups ($p<.01$). In addition, subjects who were retained for the 6-week follow-up reported fewer initial avoidance symptoms ($p<.05$) than those who were not retained. Subjects who were retained for the 6-month follow-up reported fewer initial avoidance ($p<.01$), hyperarousal ($p<.05$) and total initial PTSS ($p<.05$) and fewer peritraumatic dissociative experiences ($p<.05$) than participants who were not retained. Further, within gender attrition analyses revealed differential attrition patterns for males and females, such that males retained at the 6-month follow up differed significantly on initial PTSS and peritraumatic dissociation from males who dropped, but this relationship was not significant in females. As this has the potential to influence our findings regarding gender differences, we addressed differential attrition between genders via last observation carried forward analyses (see analysis section). No other differences in demographic or study variables were found between participants who remained in the study and those who dropped.

1.2 Procedure

The present procedures were approved by the Institutional Review Boards of Kent State University, Summa Health System and Akron General Hospital. Participants were approached a median of 26 hours after admission to the hospital by a research nurse who

administered the Mini-Mental Status Exam (Folstein, Folstein & McHugh, 1975) to determine the patient's ability to give informed consent. Eligible patients were then approached by a researcher who described the study, obtained informed consent, and collected demographic information. In addition, participants completed self-report measures in-hospital including the Impact of Event Scale – Revised (IES-R; Weiss & Marmar, 1997), Peritraumatic Dissociative Experiences Questionnaire (PDEQ; Marmar, Weiss & Metzler, 1997) and a question relating to perceived life threat. Injury severity scores (ISS; Baker, O'Neill, Haddon & Long, 1974) and HR data were recorded from medical charts. Trauma patients admitted to the hospital were catheterized upon arrival to collect urine for a variety of tests. Urine samples were collected for ten hours, and following participant's consent, were assayed to assess urinary cortisol levels. Less than 10% of participants were not catheterized, and were asked to urinate into polypropylene containers during the collection period. Sample volumes did not differ significantly between catheterized and non-catheterized patients. At the 6-week and 6-month follow-ups, master's level graduate students administered the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) and the Structured Clinical Interview for DSM-IV (SCID; First, Gibbon, Spitzer & Williams, 1996) in participants' homes to evaluate PTSS and concurrent depression diagnoses respectively. Interviews were audiotaped, and a random 10% of tapes were coded by an independent interviewer. The inter-rater reliability calculations for these 10% were acceptable for both the CAPS ($r=.98$ for 6-weeks post-MVA and $r=.97$ for 6-months post-MVA) and SCID ($kappa=1.0$ for 6-weeks post-MVA and $kappa=.83$ for 6-months post-MVA).

1.3 Measures

The injury severity score (ISS; Baker et al., 1974) is frequently used to evaluate extent of injury, to determine treatment and recovery considerations, and to assess risk for mortality. The ISS is derived by recording the extent of injury to 6 regions of the body on a scale from 0 to 6, with higher numbers representing more serious injury. The ISS is computed by calculating the sum of the squares of the three regions with the highest ratings. The ISS was computed by medical personnel and recorded from patients' charts. Subjective perception of life threat during the accident was assessed by asking participants the question "To what extent did you fear for your own life during the accident?" on a scale of 1 (*not at all*) to 7 (*a lot*).

The Peritraumatic Dissociative Experiences Questionnaire (PDEQ; Marmar et al., 1997) was used to assess dissociative experiences (e.g., "What was happening seemed unreal to me, like I was in a dream or watching a movie or play") during and immediately following the accident. Each item was rated on a scale from 1 (*not at all true*) to 5 (*extremely true*) and summed to create a total dissociative experiences score (possible range of 10-50). The PDEQ is widely used and had research has supported its reliability and validity (see Marmar et al., 1997). Reliability was acceptable for the present sample (Cronbach's $\alpha=.77$).

The Impact of Event Scale-Revised (IES-R; Weiss & Marmar, 1997) is a 22-item self-report questionnaire designed to assess intrusive, avoidant and hyperarousal symptoms following a traumatic event. Participants were asked to rate how true various statements were on a scale from 0 (*not at all*) to 4 (*extremely*). Responses were averaged for each subscale, and the subscale means were summed to create a total score. Cronbach's alphas reflected acceptable reliability for the present sample (intrusion subscale=.83, avoidance subscale=.76, hyperarousal subscale=.78, total scale=.90). Additional research has supported the reliability and validity of the IES-R in a variety of samples (Creamer, Bell & Failla, 2003; Weiss & Marmar, 1997) including MVA victims (Beck et al., 2008).

HR (recorded as beats per minute) was obtained from participants' medical charts. Because HR can be affected by environmental or emotional factors (e.g. pain, needle prick), single HR assessments may be misleading. To address this concern, two HR assessments recorded during Emergency Medical Services (EMS) transport were averaged to create a mean EMS HR score, and four HR measures assessed over the first 20min after arrival to the emergency room (ER) were averaged to create a mean ER HR score for each individual. As some EMS records indicated only the presence of a pulse rather than specific HR, 20 participants with incomplete data were excluded from these analyses. Cortisol assays were conducted on 10-hour urine samples using fluorescent polarization immunoassay (FPIA; Abbot TDx Diagnostics), and cortisol levels were calculated as $\mu\text{g/dL}$.

The Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) is a structured clinical interview that measures the frequency and intensity of PTSD symptoms. Participants were instructed to report symptoms experienced in the last month as a consequence of the MVA. This measure provides both a continuous symptom score and a diagnosis. The CAPS is the gold standard in the assessment of PTSD, and has demonstrated good reliability and validity (Blake et al., 1995; Weathers, Ruscio & Keane, 1999; Weathers, Keane & Davidson, 2001). Cronbach's alpha for the present sample was .91 at 6 weeks and .92 at 6 months.

Diagnosis of major depression was determined with the Structured Clinical Interview for DSM-IV (SCID; First et al., 1996). The major depression module evaluates ten depressive symptoms and impairments in functioning, and rules out depression due to organic disease or recent bereavement. A diagnosis of major depression was applied if more than five symptoms were endorsed that could not be accounted for by health or bereavement reasons.

1.4 Data analyses

Due to nonnormal distribution, natural log transformation was applied to urinary cortisol data, which successfully normalized the distribution of this variable. To ensure that all participants who were retained could be included in the present analyses, missing data points were imputed using an expectation-maximization (EM) imputation algorithm in EQS 6.1 (Bentler, 2004) prior to all analyses. One way analyses of variance (ANOVAs) were conducted to examine gender differences in perceived life threat, peritraumatic dissociation, initial PTSS, in-hospital HR, cortisol, demographic variables, and 6-week and 6-month PTSS. Bivariate correlations were used to evaluate associations among the continuous variables of interest.

Based on these correlations, mediation models were conducted to evaluate the role of peritraumatic factors as possible mechanisms for gender differences in PTSS. Mediation analyses were conducted using hierarchical linear regression following the guidelines of Baron and Kenny (1986) with significance determined by the Sobel test. In order to address concerns that differential attrition of males versus females at the 6-month follow-up may influence the results, these same mediation models were tested after carrying forward CAPS scores for those individuals with CAPS data at the 6-week follow-up, but who had not been retained at the 6-month follow-up. This allows for the examination of a sample without differential attrition by including reasonable estimates for the 55 individuals who dropped from the study between follow-ups.

2. Results

At the 6-week follow up, 10.36% (6 males and 20 females) met full diagnostic criteria for PTSD and 12.35% (7 males and 24 females) met diagnostic criteria for major depression. At 6 months, 7.14% (2 males and 12 females) met full criteria for PTSD and 12.24 % (9 males

and 15 females) were clinically depressed. Given the relatively low rates of diagnostic PTSD levels, the following analyses were conducted on continuous PTSS scores.

2.1 One Way ANOVAs

One way ANOVAs were used to examine gender differences in the variables of interest. Means, standard deviations and results of one way ANOVAs are displayed in Table 1. Results suggested that females reported significantly more PTSS than males at both 6 weeks and 6 months post-MVA. In addition, females reported greater levels of initial PTSS, peritraumatic dissociation and perceived life threat. Males reported higher income. No gender differences existed in current age or injury severity score. In addition, males and females did not differ in in-hospital cortisol or HR levels; therefore these variables were excluded from further analysis.

2.2 Bivariate Correlations

Pearson product moment coefficients were used to evaluate associations between continuous demographic variables, acute responses to trauma, and PTSS 6 weeks and 6 months post-MVA. Correlations are displayed in Table 2. Results revealed that initial PTSS and peritraumatic dissociation were positively correlated with PTSS at 6 weeks and 6 months post-MVA. Perception of life threat was positively associated with PTSS at the 6-month follow up only, and therefore a mediation model for perceived life threat was tested for that time point only. Income was negatively associated with PTSS at both follow-ups, and age was negatively associated with PTSS at the 6-week follow-up only. Because of the significant associations between income, gender and PTSS, mediation models were repeated with income included as a control variable.

2.3 Mediation Analyses

Mediation analyses were conducted using hierarchical linear regression to test initial PTSS, peritraumatic dissociation and perceived life threat as mediators of the relationship between gender and 6-week and 6-month PTSS. A hierarchical linear regression was conducted for each mediator and PTSS outcome, resulting in five models. Specifically, two hierarchical regressions were conducted for each mediation analysis. First, the relationship between gender and the mediator was tested by entering gender as the IV and the mediator as the DV. In the second regression model, gender was entered in step 1, and the mediator in step 2, with 6-week or 6-month PTSS entered as the DV. When analyses included income as a control variable, income was entered in step 1, gender in step 2, and the mediator in step 3. Due to symptom overlap between PTSD and depression, it is unclear whether depression should be controlled in PTSD models. To address this concern, analyses were conducted both with and without participants with a diagnosis of major depression. Excluding depressed participants did not impact the results of any mediation models.

Regressions examining initial PTSS as a mediator between gender and later (6-week and 6-month) PTSS revealed a marginal association between gender and initial PTSS in the 6-week model ($\beta=.11$, $p=.08$) and a significant association in the 6-month model ($\beta=.15$, $p<.05$). Positive associations were also found between gender and later PTSS (6 week model $\beta=.25$, $p<.001$; 6 month model $\beta=.31$, $p<.001$). In addition, initial PTSS significantly predicted development of later symptoms after controlling for gender (6 week model $\beta=.44$, $p<.001$; 6 month model $\beta=.42$, $p<.001$). The standardized regression coefficient for gender was reduced from .25 to .20 when initial PTSS were added to the 6-week model and from .31 to .25 in the 6-month model. Gender continued to significantly predict later PTSS after initial PTSS were added to the model, suggesting partial mediation. The Sobel test confirmed marginal significance of the 6-week mediation ($z=1.72$, $p=.09$) and significance of the 6-month mediation ($z=1.97$, $p=.05$). These results are displayed in Figure 1. Initial

symptom clusters (intrusive, avoidant and hyperarousal symptoms) were also examined separately to determine whether certain symptom clusters were responsible for the gender differences in later PTSS. Results of symptom cluster analyses mirrored those of the total symptom analyses.

Next, peritraumatic dissociation was examined as a possible mediator in the relationship between gender and PTSS development using similar analyses. Results suggested that females reported more peritraumatic dissociation (6-week model $\beta=.13$, $p<.05$; 6-month model $\beta=.19$, $p<.05$) and more PTSS (6-week model $\beta=.25$, $p<.001$; 6-month model $\beta=.31$, $p<.001$) than males. After controlling for gender, peritraumatic dissociation continued to contribute significantly to the variance in PTSS (6-week model $\beta=.29$, $p<.001$; 6-month model $\beta=.34$, $p<.001$) and produced a reduction in beta of gender (6-week model β from .25 to .21; six-month model β from .31 to .25). Results of the Sobel test confirmed marginal significance for the six-week model ($z=1.89$; $p=.06$) and significant mediation for the six-month model ($z=2.41$; $p<.05$). These results are displayed in Figure 2.

Finally, the regression model with perceived life threat as a mediator demonstrated that female gender was significantly associated with higher perception of life threat ($\beta=.16$, $p<.05$) and more PTSS at 6-month follow-up ($\beta=.31$, $p<.001$). After perceived life threat was added to the model, it was not significantly associated with 6-month PTSS. In addition, including perceived life threat in the model yielded only a small reduction in the beta of gender (from .31 to .30), suggesting that perceived life threat was not a mediator of the relationship between gender and later PTSS.

In order to examine the possibility that differential attrition at the 6-month follow-up may have inflated the results of the 6-month mediation models, identical models were tested which included the original sample retained at the 6-month follow-up as well as the 6-week CAPS scores for the 55 individuals who had dropped after the 6-week time point. Results of these analyses revealed almost identical findings to those presented in the retained sample, with both initial PTSS and peritraumatic dissociation found to be significant ($p<.05$) mediators of the relationship between gender and 6-month PTSS. These findings help address concerns about differential attrition at the 6-month follow-up, and further validate the meaningful relationships expressed in these mediation models. Results displayed in Figures 1-4 represent the original data, without last observation carried forward.

Including income as a control variable in the peritraumatic dissociation mediation models had very little impact on the overall results. After controlling for income, peritraumatic dissociation continued to significantly mediate the relationship between gender and PTSS at 6 months post-trauma and was marginally significant at 6 weeks post-trauma.

The inclusion of income as a control variable had a more substantial impact on the models examining initial PTSS as a mediator. After controlling for income, Sobel tests revealed a change in the significance of both models, with the 6-week model becoming nonsignificant ($p=.11$), and the 6-month model becoming marginally significant ($p=.06$).

3. Discussion

The aim of the present study was to examine peritraumatic and acute-phase factors hypothesized to contribute to gender differences in PTSS following a MVA. Specifically, it was predicted that females would report greater perceived threat, more peritraumatic dissociation, and more initial PTSS than males. It was also hypothesized that PTSS 6-weeks and 6-months post-MVA would be positively associated with perceived threat, peritraumatic dissociation and initial PTSS, providing further support to the existing literature (e.g. Ozer et

al., 2003). Finally, the primary purpose of the present analyses was to test previously hypothesized mechanisms for gender differences in PTSS (e.g. Olff et al., 2007).

Results supported the expected gender differences in acute responses and later PTSS. In addition, peritraumatic dissociation and initial PTSS were positively associated with PTSS at both 6-week and 6-month follow-ups. Perceived life threat; however, was associated with PTSS at 6 months post-MVA only. Based on bivariate analyses, five mediation models were tested to assess the extent to which each acute response accounted for the relationship between gender and either 6-week or 6-month PTSS. Results of these analyses suggested that both initial PTSS and peritraumatic dissociation served as partial mediators of the relationship between gender and PTSS at both 6 weeks and 6 months post-MVA, although only marginally in the 6-week models. Perceived life threat was not a significant mediator of the relationship between gender and PTSS at either time point. Because income was significantly correlated with both gender and PTSS, additional analyses were conducted including income as a control variable. Inclusion of income resulted in relatively minor changes to the peritraumatic dissociation models, but resulted in a reduction of significance to the initial PTSS models. While it is plausible to conclude that income alone would have a meaningful impact on the development of PTSS (e.g. as a result of fewer financial and coping resources), it may also simply represent a proxy for the relationship between gender and PTSS, such that much of the variance is actually a result of gender differences represented in the income variable.

These results provide partial support for our hypotheses. Initial PTSS and peritraumatic dissociation both partially accounted for gender differences in PTSS. Interestingly, these relationships appeared stronger in chronic (6-month follow-up) versus acute PTSS (6-week follow-up). This may be explained simply by the natural course of PTSS over time, or may suggest a greater impact of peritraumatic responses on later PTSS in females. Attrition analyses must also be considered here, as they suggested significant differences in both initial PTSS and peritraumatic dissociation between individuals who were and were not retained for the 6-month follow-up. In addition, more males than females dropped out at each follow-up. However, individuals with higher initial PTSS and peritraumatic dissociation were more likely to drop out; therefore, if differential attrition affected the present analyses, it is possible that without attrition, the results would have been stronger.

Overall, the present study has provided initial support for the hypothesis that differences in peritraumatic responding to a trauma serve as partial mechanisms through which females are more likely to develop PTSS. The present findings suggest that subjective emotional or cognitive responses may best explain gender differences in PTSS development, as the objective measures of this study (injury severity, cortisol, and heart rate) did not reveal any meaningful gender differences. Further examination of these subjective variables will help clarify and confirm these relationships. It is interesting to note that gender differences in response to trauma were apparent in the immediate aftermath of a trauma and persisted over time, rather than appearing gradually over time. It may be that similar factors underlie gender-specific risk for both acute and chronic PTSD and dissociative symptoms.

Psychobiological factors have also been implicated in increased vulnerability to PTSS, although little is known about gender differences in acute physiological responses to trauma. The present study conducted exploratory analyses to determine whether there were gender differences in initial HR and cortisol levels, which are the two most consistent acute biological predictors of PTSS. Results revealed no significant differences between males and females in early HR (EMS or ER) or 10-hour urinary cortisol levels, suggesting that differences in acute physiological responding to trauma were not likely to account for gender differences in later PTSS.

Future investigation of gender differences in PTSD should focus on prospective designs in a variety of samples. There are many other factors to consider that may play a role in gender-specific risk for PTSD. Pre-trauma characteristics should be considered, including prior trauma history, age at current and prior traumatization and history of family and individual psychopathology. In addition to the acute factors evaluated in the present study, other peritraumatic factors such as cognitive appraisals of self, event and symptoms should be examined along with biological mechanisms which may contribute to symptom maintenance and additional life stressors. Examination of adjustment, coping and social support during longer-term adjustment to a trauma may also help improve our understanding of gender differences in PTSD risk and maintenance.

The present study suffered from two primary limitations. The sample consisted solely of MVA victims, and therefore our findings may not generalize to other traumatized populations. In addition, as is often the case with accident victims, PTSD symptom severity was relatively low. However, inclusion of a more symptomatic sample of trauma victims may have increased the strength of the observed relationships in the present study. Research in samples with a wider range of symptoms and higher rates of diagnostic levels of PTSD may produce different results regarding gender differences in PTSD. Despite these limitations, the present study provides a step toward systematically examining possible explanatory mechanisms of gender differences in PTSD. Investigation of a wider range of biological, cognitive and psychosocial factors in a variety of trauma populations will further our understanding of the underlying cause of female vulnerability to PTSD.

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Figure 1.

Results of mediation models examining gender, initial symptoms and development of PTSD symptoms six weeks and six months post-MVA.

Note: PTSS=posttraumatic stress symptoms, * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 2. Results of mediation models examining gender, peritraumatic dissociation and development of PTSD symptoms six weeks and six months post-MVA.
 Note: PTSS=posttraumatic stress symptoms, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 1

Means, standard deviations and results of one way ANOVAs examining gender differences in peritraumatic responses, demographic variables and PTSD symptoms

	Total sample [M(SD)]	Males [M(SD)]	Females [M(SD)]	F	Cohen's d
<u>In-hospital (n=356)</u>					
Initial PTSD symptoms	3.61(2.35)	3.40(2.25)	9.62(3.91)	4.07*	.24
Peritraumatic dissociation	23.86(7.85)	23.08(7.78)	25.0(7.83)	5.15*	.21
Perceived life threat	3.61(2.37)	3.28(2.29)	4.09(2.42)	10.38***	.32
Injury severity	7.23(5.49)	7.21(5.07)	7.27(6.07)	.01	.03
Income	2.86(2.07)	3.22(2.08)	2.35(1.93)	16.03***	.43
Age	38.68(16.16)	37.90(15.62)	39.82(16.91)	1.22	.12
Mean EMS HR	92.57(15.78)	92.09(15.59)	93.31(16.10)	.47	.12
Mean ER HR	90.70(14.03)	89.77(13.89)	92.09(14.18)	2.33	.17
Cortisol	2.78(1.03)	2.74(1.01)	2.85(1.86)	.76	.08
<u>Six-week follow-up (n=251)</u>					
PTSD symptoms	25.80(20.76)	21.13(15.86)	31.64(24.46)	16.83***	.52
<u>Six-month follow-up (n=196)</u>					
PTSD symptoms	20.49(19.01)	14.95(14.44)	26.87(21.48)	10.95***	.66

Note: EMS=emergency medical service, HR=heart rate, ER=emergency room

*
p<.05
**
p<.01

p<.001

Table 2
Bivariate correlations among peritraumatic responses, demographic variables and PTSD symptoms

Variables	1	2	3	4	5	6	7	8
1. Initial PTSD Symptoms	–							
2. Peritraumatic dissociation	.49***	–						
3. Perceived life threat	.25***	.11*	–					
4. Injury severity	–.07	.06	.08	–				
5. Income	–.20***	–.16**	–.19***	.04	–			
6. Age	–.23***	–.19***	–.16**	.04	.30***	–		
7. 6 week PTSD symptoms	.46***	.32***	.09	–.03	–.16*	–.16*	–	
8. 6 month PTSD symptoms	.45***	.38***	.16*	–.02	–.23**	–.12	.70***	–

* p<.05

** p<.01

*** p<.001