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Patterns of Peritraumatic Threat Perceptions in Patients Evaluated for Suspected Acute Coronary Syndrome According to Prior and Current Posttraumatic Stress Symptoms

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Abstract

Objective: Prior posttraumatic stress disorder (PTSD) and elevated threat perceptions predict posttraumatic psychopathology after evaluation for acute coronary syndrome (ACS), but most research has measured threat retrospectively. We investigated how threat perceptions during ACS evaluation in the emergency department (ED) and upon recall were associated with posttraumatic psychopathology burden due to prior trauma and the suspected ACS.

Methods: Perceived threat was assessed in the ED, and ED threat recall was assessed upon inpatient transfer/discharge, along with acute stress disorder (ASD) symptoms due to suspected ACS and PTSD symptoms due to prior trauma. The sample comprised 894 participants (mean age=60.7±13.1 years; 46.8% female; 56.3% Hispanic; 20.5% Black). One-way ANOVAs examined how those with consistent posttraumatic psychopathology (prior PTSD/ASD;14.8%), prior posttraumatic psychopathology (prior PTSD/no ASD;6.8%), new-onset posttraumatic psychopathology (no PTSD/ASD;15.7%), or no posttraumatic psychopathology (no PTSD/no ASD;62.8%) differed in threat perception, threat recall, and their discrepancy.

Results: Threat perception scores ranged from 6 to 24. Participants with consistent posttraumatic psychopathology had higher threat perceptions ($M=14.01$) than those with prior posttraumatic psychopathology ($M=12.02$) and new-onset posttraumatic psychopathology ($M=12.21$) ($p<.001$); the latter two did not differ significantly but had higher threat perceptions than those with no posttraumatic psychopathology ($M=9.84$) ($p<.001$). Similar results were observed for threat recall ($p<.001$). The new-onset posttraumatic psychopathology group also had a greater increase in perceived threat versus the no posttraumatic psychopathology group ($p=.06$). Results were similar adjusting for potential confounders.

Conclusions: Assessing threat perceptions during ACS evaluation and hospitalization may help identify those at risk for emotional difficulties post-ACS.

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Keywords

Acute coronary syndrome; posttraumatic stress disorder; acute stress disorder; threat perceptions

Introduction

Presenting to the emergency department (ED) with suspected acute coronary syndrome (ACS) can be a very stressful and potentially traumatic experience. Patients with suspected ACS frequently report sensations of fear, vulnerability, and loss of control (1, 2), and these potentially life-threatening medical events can trigger the development of posttraumatic stress disorder (PTSD). PTSD is characterized by symptoms such as re-experiencing the trauma even when in safe situations (e.g., having strong and unwanted thoughts or nightmares), avoiding places or people that are reminders of the trauma, having negative alterations in mood and cognition (e.g., feeling emotionally numb, thinking the world is a dangerous place), and feeling keyed up or on edge (3). Meta-analytic evidence suggests that there is a 12% aggregated prevalence of clinically meaningful PTSD symptoms after an ACS event (4), and a growing body of research suggests that PTSD after acute cardiac events has long-term negative consequences for both cardiovascular health and psychosocial functioning (for a review, see 5). Not only is ACS-induced PTSD associated with a two-fold increase in the risk of morbidity and mortality due to subsequent cardiovascular events (4), but it is also linked to lower quality of life, lower health-related quality of life, and less social activity (6, 7, 8, 9). As such, it has become important to understand predictors of posttraumatic psychopathology after being evaluated for ACS in an effort to identify those most vulnerable.

Research suggests that both prior and current reactions to trauma are important factors that can influence the development of posttraumatic stress in response to a current trauma such as a suspected ACS event (10). For example, PTSD in response to prior non-cardiac traumas has been identified as a risk factor for developing posttraumatic psychopathology after an acute cardiac event (11, 12, 13). Furthermore, aspects of the peri-traumatic experience also predict risk for posttraumatic psychopathology in response to a current trauma. Indeed, perceived threat during trauma is one of the most robust predictors of posttraumatic psychopathology (for a review, see 14), including posttraumatic stress that develops after an acute cardiac event (15, 16, 17). This body of work has led researchers to conclude that the extent to which individuals feel threatened as a traumatic event is unfolding may be an important factor for understanding who may go on to develop posttraumatic psychopathology in response to that event (14). However, rather than assessing these threat perceptions as the traumatic event is happening, most studies have asked participants to recall after the fact how threatened they felt during the trauma. Indeed, most studies assessing perceived threat during an acute cardiac event have relied on retrospective recall after the event (16, 17, 18, 19, 20).

Very few studies have assessed threat perceptions during the cardiac index trauma (i.e., truly peri-traumatic threat perceptions), and even fewer have assessed threat perceptions at multiple points in time following an acute cardiac trauma. Such reliance on retrospective,

rather than real-time, assessments is subject to recall biases and may not accurately reflect individuals' peri-traumatic experience. For example, participants who did (versus did not) develop posttraumatic psychopathology may be more likely to recall having felt threatened during the traumatic event even though they may not have differed on these perceptions during the event. In other words, the presence of posttraumatic psychopathology may color individuals' recollections of how threatening the trauma was (14, 21). Research that directly compares peri-traumatic threat perceptions and recalled threat perceptions is needed to improve our understanding of threat perceptions both during and after being evaluated for a suspected cardiac event and how they relate to manifestations of posttraumatic psychopathology.

Although no studies to date have assessed threat perceptions during acute cardiac events, the closest is the study by Marke and Bennett (22), which measured perceived threat multiple times (in hospital and at 1- and 6-month follow-up assessments) in a sample of 150 patients experiencing their first ACS event. Perceived threat increased over the three assessments, and in-hospital perceived threat was positively correlated with PTSD symptoms at 1- and 6-month follow-up. However, it is not clear how change in these perceived threat measures over time related to ACS-induced PTSD symptoms in this study. Furthermore, these participants had no prior history of psychopathology; current diagnosis of psychopathology was one of the exclusion criteria. Thus, it is uncertain how previous manifestations of posttraumatic stress might have influenced threat perceptions in response to the ACS event. These limitations, along with those in the broader literature, make it difficult to thoroughly understand the relationship between threat perceptions and posttraumatic stress after a suspected ACS event.

In the current study, we addressed these existing limitations by examining how prior and current manifestations of posttraumatic psychopathology (i.e., posttraumatic psychopathology burden) were associated with threat perceptions in a large cohort of patients recruited during evaluation for suspected ACS in the emergency department (ED). We defined prior posttraumatic psychopathology as probable PTSD status due to a prior trauma and current posttraumatic psychopathology as probable acute stress disorder (ASD) status in response to the suspected ACS event. We examined four levels of posttraumatic psychopathology burden: those with consistent posttraumatic psychopathology (prior PTSD/ASD), those with prior posttraumatic psychopathology (prior PTSD/no ASD), those with new-onset posttraumatic psychopathology (no PTSD/ASD), and those with no posttraumatic psychopathology (no PTSD/no ASD). Furthermore, we considered three indicators of threat perceptions: 1) perceived threat in the ED during ACS evaluation (i.e., peri-traumatic threat), 2) threat recall upon inpatient transfer or discharge, and 3) threat discrepancy (i.e., the difference in the two threat perception measures). We hypothesized that a greater posttraumatic psychopathology burden would be associated with greater elevations in threat perceptions.

Methods

Participants and procedure

English- or Spanish-speaking patients were enrolled in the REactions to Acute Care and Hospitalization (REACH) study during evaluation for ACS in the ED from November 2013 to February 2016. The REACH study is an ongoing observational cohort study of ED predictors of medical and psychological outcomes after evaluation for suspected ACS (23, 24, 25). Patients provisionally diagnosed with probable ACS by the treating ED physician at the New York-Presbyterian Hospital-Columbia University Medical Center were eligible. Exclusion criteria included patients that required emergency transfer for cardiac catheterization, as recruitment in the ED is not possible. In addition, patients were excluded from participation if they were deemed unable to follow the protocol by the attending physician or the research coordinator due to mental impairment or active substance abuse. A total of 1,000 patients (61% of those eligible) were enrolled from November 2013 to February 2016. All participants provided written informed consent. The study was approved by the Institutional Review Board at the Columbia University Medical Center.

In the ED, patients reported on demographics and completed measures of their ED experience, including current perceived life threat and vulnerability during evaluation for suspected ACS. During inpatient stay or by phone after discharge, a second assessment was conducted (median of 3 days post enrollment, 75% within 8 days). This interview assessment queried recall of threat perceptions during evaluation for suspected ACS, ASD symptoms that developed in response to evaluation for ACS, lifetime trauma exposure, and other psychopathology (PTSD in response to prior trauma and depression). Hospital discharge diagnosis was determined by medical record review conducted by a research nurse and confirmed by a board-certified cardiologist.

Measures

Threat perception in the ED, threat recall, and threat discrepancy.—We assessed participants' threat perceptions in response to evaluation for suspected ACS in the ED and threat recall upon inpatient admission or after discharge with the same 6 items (i.e., "I am afraid," "I am worried I am going to die," "I feel helpless," "I feel vulnerable," "I worry I am not in control of my situation," "I believe this event will have a big impact on my life") based on Ozer et al. (14). Patients rated the extent to which these statements reflected their experience in the ED on a 4-point Likert scale ranging from 1 ("Not at all") to 4 ("Extremely"); responses were summed to create a total threat score (range=6–24). Responses to these items had good internal consistency (Cronbach's $\alpha=.79$ for ED threat perceptions and $\alpha=.81$ for threat recall). Threat discrepancy was calculated by subtracting the in-ED threat perception score from the threat recall score (i.e., positive discrepancy scores indicated an increase in threat perceptions over time).

ASD symptoms in response to evaluation for suspected ACS.—Participants reported ASD symptoms (i.e., early posttraumatic stress symptoms: re-experiencing and/or avoiding reminders of the trauma, hyperarousal) in response to the event that brought them to the ED using 14 items from the Acute Stress Disorder Scale (ASDS; 26). Items were rated

on a 1 (“Not at all”) to 5 (“Very much”) scale, and responses were summed to create a total ASDS score (total score range=14–70; Cronbach’s $\alpha=.87$). The ASDS is the most widely used self-report inventory of acute posttraumatic stress responses. Consistent with prior research indicating that ASDS total scores ≥ 28 suggest probable ASD (26), we defined ASD based on this cutoff.

PTSD symptoms in response to prior trauma.—PTSD symptoms in response to prior trauma were assessed with the PTSD Checklist-Civilian version (PCL-C; 27), a PTSD screening instrument that assesses the 17 *DSM-IV* diagnostic criteria for PTSD (28). *DSM-IV* PTSD symptoms were assessed, as the study began prior to the publication of *DSM-5*. Participants rated the extent to which they were bothered by PTSD symptoms in the past month in response to the most distressing traumatic event reported on the Life Events Checklist (29), which assessed lifetime exposure to 16 different traumatic events (e.g., natural disaster exposure, physical assault), plus “any other very stressful event or experience.” PCL-C responses were rated on a scale from 1 (“Not at all”) to 5 (“Extremely”). PTSD symptom severity in response to prior trauma was calculated by summing responses to the 17 items (total score range=17–85; Cronbach’s $\alpha=.94$). Consistent with prior research (30), a score ≥ 34 was used to indicate probable PTSD in response to previous trauma.

Depressive symptoms.—The 8-item Patient Health Questionnaire depression scale (31) was used to assess past 2-week depressive symptoms. Responses to items were scored on a 1 (“Not at all”) to 3 (“Nearly every day”) scale and summed to generate a total depressive symptom score (total score range=0–24; Cronbach’s $\alpha=.84$). In line with previous research (31), a score ≥ 10 was used to indicate depression.

Covariates.—Demographics, including age, sex, and race/ethnicity (White, African American, Hispanic, Other), were included as covariates. Medical covariates indicating mortality risk and degree of medical comorbidity, namely the Global Registry of Acute Coronary Events (GRACE) risk score (32) and the Charlson Comorbidity Index (33), respectively, were calculated from medical records. The GRACE score has a range from 1 to 263 points, with higher scores indicating greater mortality risk. The Charlson Comorbidity Index can range from 0 to 37; the higher the score, the more severe the comorbidity. Hospital discharge diagnosis (confirmed ACS, non-ACS diagnosis) was included as a covariate in analyses as well.

Statistical Analysis

The analytic sample comprised 894 participants who had data on PTSD in response to prior trauma, ASD in response to evaluation for suspected ACS, and ED threat perceptions. Participants were categorized according to posttraumatic psychopathology burden, namely probable PTSD in response to a previous trauma (prior PTSD) and probable ASD in response to the evaluation for suspected ACS (ASD). This classification approach resulted in four groups: those with 1) consistent posttraumatic psychopathology (prior PTSD/ASD; $n=132$, 14.8%), 2) prior posttraumatic psychopathology (prior PTSD/no ASD; $n=61$, 6.8%), 3) new-onset posttraumatic psychopathology (no PTSD/ASD; $n=140$, 15.7%), or 4) no

posttraumatic psychopathology (no PTSD/no ASD; $n=561$; 62.8%). We compared these four groups on demographic and medical characteristics using chi-squared tests and one-way analyses of variance (ANOVAs). We also used one-way ANOVAs to assess unadjusted differences in threat perception in the ED, threat recall, and threat discrepancy across the four posttraumatic psychopathology burden groups; post-hoc pairwise comparisons were conducted using a Bonferroni correction. In addition, we conducted one-way analyses of covariance (ANCOVAs) to examine how adjusting for demographics (age, sex, race/ethnicity), medical covariates (GRACE risk score, Charlson Comorbidity Index, confirmed ACS status at discharge), and depression status influenced our results. Again, post-hoc pairwise comparisons were conducted using a Bonferroni correction. In all analyses, missing data were imputed for total scores if <50% of the items were missing. The EM algorithm (as implemented in Proc MI of SAS version 9.4) was used to impute the expected values, conditional on the participant's responses to all answered items, for sporadic missing items of the PTSD, ASD, threat perception, threat recall, and threat discrepancy total scores. In sensitivity analyses, we conducted 4 (posttraumatic psychopathology burden) $\times$ 2 (confirmed ACS status at discharge) ANOVAs for our three threat measures to assess whether confirmed ACS status interacted with posttraumatic psychopathology burden to influence threat perceptions.

Results

Participant characteristics

Demographics and clinical characteristics for the full sample and according to posttraumatic psychopathology burden are presented in Table 1. The no posttraumatic psychopathology group had fewer females than the other groups, and participants with prior posttraumatic psychopathology were younger than those in the other groups. The posttraumatic psychopathology groups also differed significantly in race/ethnicity. Not surprisingly, the no posttraumatic psychopathology group had the lowest rate of depression. Notably, groups did not differ on medical characteristics, namely GRACE risk score, Charlson Comorbidity Index, or ACS diagnosis at discharge.

Group Differences in Threat Perception in the ED, Threat Recall, and Threat Discrepancy

The three sets of threat measures for the posttraumatic psychopathology burden groups are shown in Figure 1. Groups differed significantly on threat ratings in the ED; $F(3,890)=44.26$, $p<.001$. Participants with consistent posttraumatic psychopathology had significantly greater threat perceptions ($M=14.01$, $SD=4.80$) than all three groups ($ps .001$). Furthermore, those with prior posttraumatic psychopathology ($M=12.02$, $SD=4.73$) and new-onset posttraumatic psychopathology ($M=12.21$, $SD=4.46$) had significantly greater threat perceptions in the ED than those with no posttraumatic psychopathology ($M=9.84$, $SD=3.72$; $ps<.010$), although they did not differ significantly from each other ($p>.99$). Results were consistent in a one-way ANCOVA that included demographics, medical covariates, and depression. Posttraumatic psychopathology burden was still significantly associated with ED threat perceptions when adjusting for these covariates; $F(3,862)=16.15$, $p<.0001$. In this adjusted model, those with consistent posttraumatic psychopathology and those with new-onset posttraumatic psychopathology had significantly greater ED threat perceptions than those

with no posttraumatic psychopathology (Table 2). The difference in ED threat perceptions for the consistent posttraumatic psychopathology group and new-onset posttraumatic psychopathology groups approached, but did not reach, statistical significance ($p=.056$). Depression status was the only significant covariate, with depression being associated with greater ED threat perceptions ($p<.0001$).

All groups reported significantly greater threat levels at recall compared to in the ED ($p<.003$). Despite this overall increase in threat ratings over time, the pattern of group differences observed for ED threat perceptions continued to be observed for threat recall; $F(3,889)=57.97$, $p<.001$. Participants with consistent posttraumatic psychopathology had significantly greater threat recall ($M=15.73$, $SD=4.71$) than all other groups ($p<.038$). Again, the prior posttraumatic psychopathology ($M=13.80$, $SD=4.84$) and the new-onset posttraumatic psychopathology ($M=14.28$, $SD=4.84$) had significantly greater threat recall than those with no posttraumatic psychopathology ($M=10.92$, $SD=4.08$; $p<.001$), but they did not differ from each other ($p>.99$). As with ED threat perceptions, unadjusted and adjusted results for threat recall were similar. Posttraumatic psychopathology burden remained significantly associated with threat recall in a one-way ANCOVA that included demographics, medical covariates, and depression; $F(3,861)=26.47$, $p<.0001$. In this adjusted model, threat recall for those with no posttraumatic psychopathology was significantly lower than the threat recall for each of the other groups (Table 2). Age and depression status were significant covariates, with younger age and depression associated with greater threat recall ($p<.001$).

There was also an indication of group differences in threat discrepancy; $F(3,889)=2.85$, $p=.036$. Post-hoc pairwise comparisons suggested this was driven by the new-onset posttraumatic psychopathology group. The new-onset posttraumatic psychopathology group had a greater increase in perceived threat ($M=2.07$, $SD=4.92$) from ED to recall than the no posttraumatic psychopathology ($M=1.07$, $SD=3.75$), although this approached, but did not reach, the level of statistical significance ($p=.062$). The threat discrepancy scores for those with prior posttraumatic psychopathology ($M=1.79$, $SD=4.25$) and consistent posttraumatic psychopathology ($M=1.72$, $SD=4.53$) were not significantly different from those for any other group ($p>.63$). Results were consistent in the one-way ANCOVA. In this adjusted model, posttraumatic psychopathology burden was still significantly associated with threat discrepancy; $F(3,861)=3.11$, $p=.026$. Those with new-onset posttraumatic psychopathology showed a significantly greater increase in threat perceptions from ED to recall compared to those with no posttraumatic psychopathology when adjusting for demographics, medical covariates, and depression (Table 2). GRACE risk score was the only significant covariate, with higher risk scores associated with greater threat discrepancy ($p=.025$).

Sensitivity analyses indicated that there were no significant Posttraumatic Psychopathology Burden $\times$ Confirmed ACS Status interactions for any of the threat measures; $F(3,886)=0.22$, $p=.885$ for ED threat perceptions; $F(3,885)=1.94$, $p=.122$ for threat recall; $F(3,885)=1.61$, $p=.186$ for threat discrepancy. These findings suggested that the associations of the different posttraumatic psychopathology burden groups with the threat measures did not vary for those with and without confirmed ACS at discharge.

Discussion

Posttraumatic psychopathology can develop after exposure to an event like suspected ACS that is perceived as threatening and overwhelms an individual's ability to cope. Understanding the role that perceived threat plays in developing posttraumatic psychopathology is important for understanding mechanisms of risk and has the potential to inform prevention efforts for patients evaluated for suspected ACS. In the current study, we used a novel approach that assessed threat at multiple time points, including during the peri-traumatic period, and that considered both prior and current posttraumatic psychopathology in terms of posttraumatic psychopathology burden when investigating associations with perceived threat. From our analyses, we report three main findings. First, the level of threat perceived by patients evaluated in the ED for suspected ACS increased from the peri-traumatic period to the recall period, regardless of posttraumatic psychopathology burden. Second, threat perceptions in the ED and at recall were greater as posttraumatic psychopathology burden increased; those with the highest posttraumatic psychopathology burden had the greatest threat ratings, followed by those with intermediate posttraumatic psychopathology burden, and then those with no posttraumatic psychopathology burden. Third, preliminary evidence suggested that individuals who developed probable ASD in response to the suspected ACS event as their first manifestation of posttraumatic psychopathology showed greater increases in threat perceptions over time compared to those with no posttraumatic psychopathology.

This study is unique in capturing threat perceptions during the peri-traumatic period (i.e., evaluation for suspected ACS in the ED); almost all research on PTSD after acute cardiac events has assessed threat perceptions retrospectively at discharge, or weeks or months after the event (16, 17, 18, 19, 20). Furthermore, by assessing threat perceptions in the ED and at inpatient transfer or discharge, we were able to conduct within-individual comparisons of how threat perceptions changed from the peri-traumatic period to recall. Although the rank order of threat perceptions across the posttraumatic psychopathology burden groups remained consistent in-ED and at recall, the absolute levels of threat increased from the ED to recall for all groups. This pattern is consistent with the study by Marke and Bennett (22), which also observed increases in mean threat ratings over time in patients after an ACS event. Marke and Bennett (22) only studied individuals without a history of psychopathology, and our findings indicate that this pattern of increasing threat perception over time is observed in those with and without posttraumatic psychopathology. Together, these results suggest that retrospective reports of peri-traumatic threat may be inflated, even though rank order differences as a function of posttraumatic psychopathology burden are similar at peri-traumatic and retrospective assessments. We acknowledge, however, that our peri-traumatic threat assessments were captured at one point in time when participants were being evaluated in the ED. Thus, it is possible that participants had subsequent experiences in the ED that resulted in greater perceptions of threat that were then reported accurately at the retrospective assessment. It is unlikely that this occurred systematically for each participant in the current study, but it is a limitation of our in-ED assessment nonetheless.

Consistent with previous research (10), our findings also demonstrate the utility of considering prior and current posttraumatic psychopathology when examining mechanisms

of risk for posttraumatic psychopathology, such as perceived threat. For example, those individuals with the greatest posttraumatic psychopathology burden in terms of past and current manifestations showed the greatest risk (i.e., the greatest elevations in threat). In addition, there was some initial evidence suggesting that those individuals who had new-onset posttraumatic psychopathology after the suspected ACS event showed greater increases in threat perceptions over time compared to those with no posttraumatic psychopathology. This finding is consistent with the cognitive model established by Ehlers and Clark (34), which posits that posttraumatic psychopathology develops when individuals process a trauma with excessive negative appraisals and its sequelae to create a continued sense of serious, current threat. As the trauma is appraised during and after the event, individual differences in appraisal and memory can lead to differences in threat perception upon recall. Our finding suggests that those individuals who experienced new-onset acute posttraumatic psychopathology were more likely than those without any posttraumatic psychopathology to perceive the experience as more and more threatening. It is of interest for future research to collect repeated assessments of threat perceptions in individuals who do and do not go on to develop their first manifestation of posttraumatic psychopathology after suspected ACS in order to better understand trajectories of threat perceptions and how they relate to psychopathology.

Several limitations of the current study merit acknowledgement. First, although the overall sample size was large, some posttraumatic psychopathology burden groups were small, limiting statistical power. Second, of all patients approached in the ED, only 61% agreed to participate. Nevertheless, the socio-demographics of the sample are reflective of the catchment area serving New York-Presbyterian Hospital-Columbia University Medical Center (35). Third, our sample was recruited from a single urban hospital, and results may not be generalizable to the entire population of patients assessed for ACS. Fourth, although all patients were evaluated for ACS in the ED, approximately two-thirds received a non-ACS discharge diagnosis. However, prior research suggests that factors that influence the subjective experience of evaluation for ACS, and not objective clinical severity or diagnosis, are most associated with risk of PTSD after evaluation for ACS (2), and we have found that threat perceptions during ED evaluation did not differ between patients with and without confirmed ACS (36). Furthermore, sensitivity analyses indicated that there were no significant interactions between the posttraumatic psychopathology burden and confirmed ACS status variables. Notwithstanding these limitations, our study is characterized by several strengths, including a large sample of patients diverse in sex and race/ethnicity and repeated assessments of threat perceptions.

Conclusion

This work revealed differences in threat perception over time in patients evaluated for suspected ACS with varying degrees of past and current posttraumatic psychopathology burden. These findings may have the potential to inform ED practice to minimize risk for posttraumatic psychopathology after suspected ACS. Specifically, assessing threat perceptions during evaluation for ACS and upon hospitalization may hold promise for identifying those who are vulnerable to develop emotional difficulties after a suspected ACS event. Patients who report consistently elevated threat or who show increases in threat

perceptions over time might be especially likely to benefit from efforts aimed at making the ACS evaluation experience more predictable. ED factors, such as crowding and poor patient-doctor communication, have been associated with risk for PTSD after ACS evaluation (e.g., 23, 37). Targeting these modifiable factors may help to reduce levels of perceived threat in individuals with suspected ACS.

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Abbreviations:

ACS	acute coronary syndrome
ANCOVA	analysis of covariance
ANOVA	analysis of variance
ASD	acute stress disorder
ASDS	Acute Stress Disorder Scale
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, 4 th edition
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5 th edition
ED	emergency department
GRACE	Global Registry of Acute Coronary Events
PCL-C	PTSD Checklist, Civilian version
PTSD	posttraumatic stress disorder
REACH	REactions to Acute Care and Hospitalization

References

1. Edmondson D, Kronish IM, Wasson LT, Giglio JF, Davidson KW and Whang W. A test of the diathesis-stress model in the emergency department: Who develops PTSD after an acute coronary syndrome? *J Psychiatr Res* 2014;53:8–13. [PubMed: 24612925]
2. Edmondson D and Cohen BE. Posttraumatic stress disorder and cardiovascular disease. *Prog Cardiovasc Dis* 2013;55:548–556. [PubMed: 23621964]
3. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington: American Psychiatric Association; 2013.
4. Edmondson D, Richardson S, Falzon L, Davidson KW, Mills MA and Neria Y. Posttraumatic stress disorder prevalence and risk of recurrence in acute coronary syndrome patients: a meta-analytic review. *PLoS ONE* 2012;7:e38915. [PubMed: 22745687]
5. Vilchinsky N, Ginzburg K, Fait K and Foa EB. Cardiac-disease-induced PTSD (CDI-PTSD): A systematic review. *Clin Psychol Rev* 2017;55:92–106. [PubMed: 28575815]
6. Chung MC, Berger Z and Rudd H. Coping with posttraumatic stress disorder and comorbidity after myocardial infarction. *Compr Psychiatry* 2008;49:55–64. [PubMed: 18063042]

7. Ginzburg K and Ein-Dor T. Posttraumatic stress syndromes and health-related quality of life following myocardial infarction: 8-year follow-up. *Gen Hosp Psychiatry* 2011;33:565–571. [PubMed: 21958446]
8. Shaffer JA, Kronish IM, Burg M, Clemow L and Edmondson D. Association of acute coronary syndrome-induced posttraumatic stress disorder symptoms with self-reported sleep. *Ann Behav Med* 2013;46:349–357. [PubMed: 23720185]
9. Wikman A, Bhattacharyya M, Perkins-Porras L and Steptoe A. Persistence of posttraumatic stress symptoms 12 and 36 months after acute coronary syndrome. *Psychosom Med* 2008;70:764–772. [PubMed: 18725431]
10. Younger CG, Burton MS, Price M, Zimmerman L, Kearns MC, Houry D and Rothbaum BO. The contributions of prior trauma and peritraumatic dissociation to predicting post-traumatic stress disorder outcome in individuals assessed in the immediate aftermath of a trauma. *West J Emerg Med* 2012;13:220–224. [PubMed: 22900118]
11. Ayers S, Copland C and Dunmore E. A preliminary study of negative appraisals and dysfunctional coping associated with post-traumatic stress disorder symptoms following myocardial infarction. *Br J Health Psychol* 2009;14:459–471. [PubMed: 18789186]
12. Kutz I, Shabtai H, Solomon Z, Neumann M and David D. Post-traumatic stress disorder in myocardial infarction patients: prevalence study. *Isr J Psychiatry Relat Sci* 1994;31:48–56. [PubMed: 8206738]
13. Whitehead DL, Perkins-Porras L, Strike PC and Steptoe A. Post-traumatic stress disorder in patients with cardiac disease: predicting vulnerability from emotional responses during admission for acute coronary syndromes. *Heart* 2006;92:1225–1229. [PubMed: 16424065]
14. Ozer EJ, Best SR, Lipsey TL and Weiss DS. Predictors of posttraumatic stress disorder and symptoms in adults: a meta-analysis. *Psychol Bull* 2003;129:52–73. [PubMed: 12555794]
15. Bennett P, Owen RL, Koutsakis S and Bisson J. Personality, social context and cognitive predictors of post-traumatic stress disorder in myocardial infarction patients. *Psychol Health* 2002;17:489–500.
16. Holbrook TL, Hoyt DB, Stein MB and Sieber WJ (2001) Perceived threat to life predicts posttraumatic stress disorder after major trauma: risk factors and functional outcome. *J Trauma Acute Care Surg* 51(2): 287–293.
17. Roberge MA, Dupuis G and Marchand A. Post-traumatic stress disorder following myocardial infarction: prevalence and risk factors. *Can J Cardiol* 2010;26:170–175.
18. Ginzburg K, Solomon Z and Bleich A. Repressive coping style, acute stress disorder, and posttraumatic stress disorder after myocardial infarction. *Psychosom Med* 2002;64:748–757. [PubMed: 12271105]
19. Hari R, Begre S, Schmid JP, Saner H, Gander ML and von Kanel R. Change over time in posttraumatic stress caused by myocardial infarction and predicting variables. *J Psychosom Res* 2010;69:143–150. [PubMed: 20624512]
20. Wiedemar L, Schmid JP, Muller J, Wittmann L, Schnyder U, Saner H, and von Kanel R. Prevalence and predictors of posttraumatic stress disorder in patients with acute myocardial infarction. *Heart Lung* 2008;37:113–121. [PubMed: 18371504]
21. Otgaar H, Muris P, Howe ML, and Merckelbach H. What drives false memories in psychopathology? A case for associative activation. *Clin Psychol Sci*. 2017;5:1048–1069. [PubMed: 29170722]
22. Marke V, Bennett P. Predicting post-traumatic stress disorder following first onset acute coronary syndrome: Testing a theoretical model. *Br J Clin Psychol*. 2013;52:70–81. [PubMed: 23398113]
23. Chang BP, Sumner JA, Haerizadeh M, Carter E and Edmondson D. Perceived clinician-patient communication in the emergency department and subsequent post-traumatic stress symptoms in patients evaluated for acute coronary syndrome. *Emerg Med J* 2016;33:626–631. [PubMed: 27126406]
24. Meli L, Alcántara C, Sumner JA, Swan B, Chang BP and Edmondson D (2017) Enduring somatic threat perceptions and post-traumatic stress disorder symptoms in survivors of cardiac events. *J Health Psychol*. 10.1177/1359105317705982.

25. Sumner JA, Kubzansky LD, Elkind MS, Roberts AL, Agnew-Blais J, Chen Q, Cerda M, Rexrode KM, Rich-Edwards JW, Spiegelman D, Suglia SF, Rimm EB and Koenen KC. Trauma Exposure and Posttraumatic Stress Disorder Symptoms Predict Onset of Cardiovascular Events in Women. *Circulation* 2015;132:251–259. [PubMed: 26124186]
26. Bryant RA, Moulds ML, and Guthrie RM. Acute stress disorder scale: a self-report measure of acute stress disorder. *Psychol Assess.* 2000;12:61–68. [PubMed: 10752364]
27. Weathers FW, Litz BT, Herman DS, Huska JA, and Keane TM. The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. In annual convention of the International Society for Traumatic Stress Studies, San Antonio, TX 1993 Oct 24 (Vol. 462).
28. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed., text rev. Arlington: American Psychiatric Association; 2000.
29. Blake DD, Weathers FW, Nagy LM, Kaloupek DG, Gusman FD, Charney DS and Keane TM. The development of a Clinician-Administered PTSD Scale. *J Trauma Stress* 1995;8:75–90. [PubMed: 7712061]
30. Gray MJ, Litz BT, Hsu JL and Lombardo TW. Psychometric properties of the life events checklist. *Assessment* 2004;11:330–341. [PubMed: 15486169]
31. Kroenke K, Strine TW, Spitzer RL, Williams JB, Berry JT and Mokdad AH. The PHQ-8 as a measure of current depression in the general population. *J Affect Disord* 2009;114:163–173. [PubMed: 18752852]
32. Eagle KA, Lim MJ, Dabbous OH, Pieper KS, Goldberg RJ, Van de Werf F, Goodman SG, Granger CB, Steg PG, Gore JM, Budaj A, Avezum A, Flather MD and Fox KA. A validated prediction model for all forms of acute coronary syndrome: estimating the risk of 6-month postdischarge death in an international registry. *JAMA* 2004;291: 2727–2733. [PubMed: 15187054]
33. Charlson ME, Pompei P, Ales KL and MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987;40:373–383. [PubMed: 3558716]
34. Ehlers A, Clark DM. A cognitive model of posttraumatic stress disorder. *Behav Res Ther.* 2000;38(4):319–45. [PubMed: 10761279]
35. Cornelius T, Meli L, Thorson KR, Chang BP, Edmondson D, and West T. The unintended consequences of bringing close others to emergency departments following an acute coronary event. Manuscript in preparation.
36. Velazquez Z, Edmondson D, Moise N, Chang BP, Wei Y and Kronish IM. Are patients who rule out for acute coronary syndrome at risk for posttraumatic stress disorder? Poster presented at the meeting of the Society of Behavioral Medicine, San Diego, CA, March 2017.
37. Edmondson D, Shimbo D, Ye S, Wyer P and Davidson KW. The association of emergency department crowding during treatment for acute coronary syndrome with subsequent posttraumatic stress disorder symptoms. *JAMA Intern Med* 2013;173: 472–474. [PubMed: 23400256]

Figure 1.

Mean emergency department threat perception and threat recall ratings according to posttraumatic psychopathology burden group status. Groups with different letters are significantly different, $p < .001$.

Table 1.

Participant characteristics for the full sample and according to posttraumatic psychopathology burden.

Characteristic	Total (N=894) % (n) or Mean (SD)	No Prior Posttraumatic Psychopathology ^a (n=561) % (n) or Mean (SD)	Prior Posttraumatic Psychopathology ^b (n=61) % (n) or Mean (SD)	New-onset Posttraumatic Psychopathology ^c (n=140) % (n) or Mean (SD)	Consistent Posttraumatic Psychopathology ^d (n=132) % (n) or Mean (SD)	p
Female	46.8 (418)	42.6 (239)	55.7 (34)	53.6 (75)	53 (70)	.014
Age, years	60.7 (13.1)	61.6 (13.3)	60.3 (14.2)	60.5 (12.8)	56.9 (11.4)	.003
Race/ethnicity						.042
White	16.3 (143)	16.5 (90)	21.7 (13)	17.5 (24)	12.2 (16)	
Hispanic	56.3 (493)	59.2 (324)	58.3 (35)	51.8 (71)	48.1 (63)	
African American	20.5 (179)	18.5 (101)	15 (9)	21.2 (29)	30.5 (40)	
Other	6.9 (60)	5.9 (32)	5 (3)	9.5 (13)	9.2 (12)	
Depression ^e	26.6 (238)	11.2 (63)	42.6 (26)	43.6 (61)	66.7 (88)	<.001
Diagnosis						.193
ACS	32.7 (292)	34.8 (195)	31.1 (19)	32.1 (45)	25.0 (33)	
Non-ACS	67.3 (602)	65.2 (366)	68.9 (42)	67.9 (95)	75.0 (99)	
GRACE risk score	150.9 (51.01)	152.33 (50.92)	162.82 (36.48)	143.2 (56.16)	147.5 (50.45)	.056
Charlson Comorbidity Index	1.89 (2.07)	1.96 (2.15)	2.05 (2.06)	1.53 (1.83)	1.92 (1.94)	.157

Note. ACS=acute coronary syndrome; GRACE=Global Registry of Acute Coronary Events.

^aNo prior posttraumatic stress disorder [PTSD; defined as a score 34 on the PTSD Checklist, Civilian Version (PCL-C)] or acute stress disorder [ASD; defined as a score 28 on the Acute Stress Disorder Scale (ASDS)].

^bPrior PTSD but no ASD.

^cNo prior PTSD but ASD.

^dPrior PTSD and ASD.

^eDepression defined as a score 10 on the Patient Health Questionnaire (PHQ-8).

Table 2.

Estimated marginal means for emergency department (ED) threat perceptions, threat recall, and threat discrepancy from analyses of covariance (ANCOVAs) adjusting for demographics, medical covariates, and depression.

	ED Threat Perception (n=875)	Threat Recall (n=874)	Threat Discrepancy (n=874)
	Mean (SE)	Mean (SE)	Mean (SE)
Posttraumatic Psychopathology Burden			
No Posttraumatic Psychopathology	10.19 (0.18) ^a	11.24 (0.20)	1.04 (0.19) ^a
Prior Posttraumatic Psychopathology	11.57 (0.53) ^{a,b}	13.46 (0.56) ^a	1.89 (0.54) ^{a,b}
New-onset Posttraumatic Psychopathology	11.83 (0.35) ^b	14.06 (0.38) ^a	2.23 (0.36) ^b
Consistent Posttraumatic Psychopathology	13.14 (0.39) ^b	14.88 (0.41) ^a	1.73 (0.39) ^{a,b}

Note. SE=standard error. ANCOVAs adjusted for age, sex, race/ethnicity, confirmed acute coronary syndrome status at discharge. GRACE risk score, Charlson Comorbidity Index, and depression (defined as a score ≥ 10 on the Patient Health Questionnaire). Means that have no superscript in common are significantly different from each other (Bonferroni, $p < 0.05$).