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## Impact of Prior Trauma Exposure on the Development of PTSD Symptoms after Suspected Acute Coronary Syndrome

Justin Young<sup>1,2</sup>, Adam Schweber<sup>1,2</sup>, Jennifer A. Sumner<sup>1,3</sup>, Bernard P Chang<sup>4</sup>, Talea Cornelius<sup>1</sup>, Ian M. Kronish<sup>1</sup>

<sup>1</sup>Center for Behavioral Cardiovascular Health, Columbia University Irving Medical Center, 622 W. 168<sup>th</sup> St, New York, New York, USA

<sup>2</sup>Columbia University Vagelos College of Physicians and Surgeons, 630 W. 168<sup>th</sup> St, New York, New York, USA

<sup>3</sup>Department of Psychology, University of California Los Angeles, 1285 Franz Hall, Box 951563, Los Angeles, CA, USA.

<sup>4</sup>Department of Emergency Medicine, Columbia University Irving Medical Center, 622 W. 168<sup>th</sup> St, New York, New York, USA

### Abstract

**Objective:** To determine the association between PTSD symptoms due to prior trauma and prior trauma type with PTSD symptoms after suspected acute coronary syndrome (ACS).

**Method:** A consecutive sample of patients presenting to the emergency department (ED) for suspected ACS were surveyed. Logistic regression was used to estimate the odds of elevated ACS-related PTSD symptoms [PCL-S 33] at 1-month associated with PTSD symptoms due to prior trauma and prior trauma type at the time of suspected ACS, adjusting for demographics, comorbidities, depression, and etiology of ACS symptoms.

**Results:** Of 984 patients, 81.6% reported 1 prior trauma type and 22.5% reported PTSD symptoms due to prior trauma at the time of suspected ACS. One month later, 18.0% had ACS-related PTSD symptoms. Patients with versus without PTSD symptoms due to prior trauma at the time of the suspected ACS had increased odds of ACS-related PTSD symptoms one month later (42.1% vs 9.9%; aOR 4.49, 95% CI:3.05–6.60;  $p < .001$ ). Prior life-threatening illness was the only

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Corresponding Author: Ian Kronish, MD, MPH, Florence Irving Associate Professor of Medicine, Associate Director, Center for Behavioral Cardiovascular Health, Columbia University Irving Medical Center, 622 W.168<sup>th</sup> Street, PH9-311, New York, New York 10032, O:212-342-1335; F:212-342-3431, ik2293@columbia.edu.

Author Statement

**Young, Kronish:** Conceptualization, Methodology

**Cornelius, Schweber:** Data analyses

**Young, Cornelius, Sumner, Kronish:** Writing- Original draft preparation

**Young, Sumner, Schweber, Cornelius, Chang, Kronish:** Writing- Reviewing and Editing

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trauma type significantly associated with ACS-related PTSD symptoms (aOR 1.57, 95% CI:1.03–2.39;  $p=.04$ ).

**Conclusions:** PTSD symptoms from prior trauma and history of life-threatening medical illness at the time of suspected ACS increased risk of ACS-related PTSD symptoms one month later.

### Keywords

ACS-induced PTSD; Cardiovascular disease; Posttraumatic stress disorder; Trauma; Trauma-informed care

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## 1. Introduction

The experience of acute, life-threatening medical events, such as acute coronary syndrome (ACS), can lead to the development of posttraumatic stress disorder (PTSD).<sup>1,2,3,4,5,6,7</sup> Approximately one in eight patients develop elevated PTSD symptoms after ACS,<sup>8</sup> which doubles the risk of recurrent cardiovascular events and mortality.<sup>9, 10</sup> Even patients who present to the emergency department (ED) with suspected ACS but subsequently rule out are at risk for having PTSD symptoms attributed to the suspected ACS event.<sup>11</sup>

Outside of a medical setting, prior trauma exposure is a consistent predictor of PTSD after new traumas, especially for those with pre-existing PTSD from prior trauma.<sup>12, 13, 14, 15</sup> PTSD from medical events differs from traditional conceptualizations of PTSD, as the trauma originates from within the body (e.g., blocked coronary artery), and thus patients are often preoccupied with fears of recurrent events coming from within their bodies as opposed to memories of the past trauma.<sup>16</sup> Prior exposure to acute, life-threatening medical illness may especially predispose individuals to PTSD symptoms after an ACS through stress sensitization from related experiences.<sup>17</sup> In contrast, trauma from non-medical events may also predispose patients to PTSD symptoms after medical events due to a more generalized disruption of psychological and neurobiological systems responsible for recovery after trauma.

It has not yet been studied whether specific types of prior trauma exposure differentially predispose patients towards the development of ACS-induced PTSD symptoms. Accordingly, the aim of our study was to describe the prevalence of prior exposure to diverse types of trauma and associated PTSD symptoms within an adult population presenting to the ED for suspected ACS. We further sought to test the association of prior types of trauma exposure, and prior PTSD symptoms with risk for PTSD symptoms after suspected ACS.

## 2. Methods

### 2.1 Patients and Protocol

Patients were drawn from a sample of 1,741 patients enrolled between 2013 and 2016 into the Reactions to Acute Care and Hospitalization (REACH) study.<sup>18</sup> REACH is a prospective observational cohort of consecutive patients presenting to the ED of an urban academic medical center in New York City with suspected symptoms of ACS.

Patients were eligible if given a provisional diagnosis of “probable ACS” by an ED physician. Patients with ST-segment elevations upon presentation were excluded, as they were immediately taken to the cardiac catheterization laboratory. Patients were also excluded if they were unable to provide informed consent or complete study questionnaires from cognitive or functional impairment, needed immediate psychiatric intervention, had terminal non-cardiovascular illness, or did not speak English or Spanish. All patients provided written informed consent, and the study protocol was approved by the Institutional Review Board of Columbia University Irving Medical Center.

Patients completed self-report measures of sociodemographic characteristics, prior trauma exposure, and pre-existing PTSD symptoms as baseline questionnaires administered one to three days after presentation to the ED, asked in person in the hospital setting or by telephone after discharge. All measures were available in English or professionally translated Spanish, and interviews were conducted by research coordinators who were fluent in the patients’ preferred language. Patients were contacted by telephone one month after discharge to assess PTSD symptoms related to the suspected ACS event.

## 2.2 Measures

### **Dependent Variable:**

**PTSD Symptoms Related to Index Suspected ACS Event:** PTSD symptoms after the suspected ACS were assessed 1 month after presentation using the PCL-S, with symptoms cued to the “heart problem, emergency room visit, and hospitalization that occurred one month ago when [they] enrolled in the study”

### **Key Predictors:**

**Prior Type of Trauma Exposure:** Lifetime trauma exposure was assessed using the Life Events Checklist (LEC), a 16-item inventory of potentially traumatic life events.<sup>19</sup> Patients indicated all types of events previously experienced; if any were reported, they identified the most distressing event. Trauma types were sorted into five categories: war-related, assaultive violence, life-threatening illness, other’s death or harm, and other injury or shocking event.<sup>20,21,22</sup>

**PTSD Symptoms Related to a Prior Traumatic Event:** PTSD symptoms present in the month prior to ED presentation due to a prior traumatic event were measured using the PTSD Checklist-Specific Stressor (PCL-S), a 17-item survey assessing the *DSM-IV* symptoms of PTSD; symptoms were cued to the most distressing event prior to the index event as per responses on the LEC.<sup>23, 24, 25, 26, 27</sup> A PCL-S score  $\geq 33$  in a general population corresponds to elevated PTSD symptoms.<sup>28, 29</sup>

**Covariates:** Sociodemographic characteristics were assessed by interview at study baseline. Baseline depressive symptoms were assessed with the eight-item Patient Health Questionnaire (PHQ-8).<sup>30, 31</sup> A PHQ-8 score  $\geq 10$  has high sensitivity and specificity for diagnosing depression.<sup>32, 33</sup> Medical comorbidity was assessed using the Charlson Comorbidity Index.<sup>34</sup> Patient risk for mortality from the suspected ACS event was assessed using the Global Registry of Acute Coronary Events (GRACE) score.<sup>35</sup> Reason for the index

ACS symptoms (i.e., ACS confirmed or ruled-out) was determined based on independent review of the medical chart by two board-certified physicians blinded to PTSD status.<sup>36, 37</sup>

## 2.4 Cohort Assembly

Of the 1,741 patients in the cohort enrolled during the time period of this substudy, 361 patients were unavailable for 1-month follow-up and 396 patients were missing all data from one or more key variables, leaving 984 patients to be included in the current analyses. Those excluded did not differ from retained patients on any outcome variables or focal predictor variables; however, there were more true ACS patients retained (34.9% v. 26.4%;  $p < .001$ ).

## 2.5 Statistical Analysis

Demographic and clinical covariates were compared between patients with and without elevated PTSD symptoms from prior trauma at baseline t-tests, nonparametric Wilcoxon tests, and chi-square tests. Odds of a positive PTSD screen at 1 month were modeled using PROC LOGISTIC in SAS v. 9.4. Covariates for adjusted analyses were selected based on a prior review of predictors of PTSD and included age, gender, ethnicity, race, depression at ED presentation, Charlson index, GRACE score, and ACS status.<sup>38, 39</sup> Subsequently, categories of prior trauma were added to the model. These were dummy coded such that patients could experience multiple trauma types. As a sensitivity analysis, linear regression was used to examine the association between PTSD symptoms at time of index ACS event, prior trauma type, and risk of ACS-related PTSD symptoms (continuous).

## 3. Results

The mean age of patients was 61 years, 47.5% identified as female, and 56.7% identified as Hispanic (Table 1). Approximately one-third (34.9%) of patients had confirmed ACS, 10.8% had a different cardiac reason for their presenting symptoms, and the remaining 54.7% had a non-cardiac reason.

More than three-quarters (81.6%) of patients experienced at least one type of prior traumatic event. Among patients exposed to at least one prior type of trauma, the median number of trauma types was 3 (range 1 to 17), with the most common types including sudden accidental death (54.6%) and transportation accident (35.5%; Figure 1). Overall, patients with elevated PTSD symptoms due to prior trauma had been exposed to a greater number of types of traumatic events as compared to patients without elevated PTSD symptoms (median 4, interquartile range 2–7 versus median 2, interquartile range 1–4;  $p < 0.001$ ).

Across the entire sample of patients, 25.1% had elevated PTSD symptoms from their most distressing trauma prior to the suspected ACS. Among patients with elevated PTSD symptoms from prior trauma, 42.1% had elevated PTSD symptoms attributed to their suspected ACS one month later. Among patients without prior elevated PTSD symptoms, only 9.9% had elevated PTSD symptoms after suspected ACS.

After adjustment for demographic and clinical characteristics, patients with versus without elevated PTSD symptoms from prior trauma had significantly greater odds of having PTSD from the suspected ACS event (adjusted OR 4.49, 95% CI: 3.05–6.60,  $p < .001$ ; Table 2).

When expanding the model to include trauma types, experiencing life-threatening illness was associated with risk of developing PTSD symptoms, over and above elevated PTSD symptoms from prior trauma (adjusted OR 1.57, 95% CI: 1.003–2.39,  $p=.04$ ). Other trauma types were not significantly associated with a risk of developing PTSD symptoms (all  $p>0.2$ ). In this expanded model, PTSD symptoms from prior trauma (adjusted OR 3.60, 95% CI: 2.39–5.43,  $p<.001$ ) and depressive symptoms (adjusted OR 2.67, 95% CI: 1.81–3.93,  $p<.001$ ) at the time of the index suspected ACS remained significant predictors of ACS-related PTSD symptoms one month later. This pattern of results replicated in sensitivity analyses examining continuous PTSD symptoms as the outcome variable.

#### 4. Discussion

Prior exposure to trauma was common in patients presenting to the ED with suspected ACS, with more than 80% of patients experiencing at least one type of prior trauma. Furthermore, approximately one in five patients had elevated PTSD symptoms from their most distressing prior trauma. This prevalence was within the range of PTSD estimates in the primary care setting (2–39%).<sup>40</sup> This remains important as acute chest pain causes nearly 10% of all non-accident related presentations to the ED.<sup>41, 42</sup>

Patients with elevated PTSD symptoms from prior trauma were at markedly increased risk of having PTSD symptoms related to the suspected ACS one month later. This suggests that, consistent with PTSD that develops after non-medical traumatic events, prior trauma-related psychopathology is associated with vulnerability to ACS-induced PTSD symptoms.<sup>43</sup> Given the high prevalence of pre-existing PTSD symptoms in patients presenting to the ED for suspected ACS and the association of PTSD at the time of suspected ACS with risk for subsequent ACS-related PTSD, a trauma-informed approach to the care of suspected ACS may be warranted. Trauma-informed care (TIC) seeks to reduce distress associated with illness through emphasis on emotional, physical, and psychological safety for trauma survivors and providers.<sup>44, 45</sup>

Small studies have shown prior trauma to be associated with the development of PTSD symptoms following myocardial infarction.<sup>46, 47</sup> Our results expand this knowledge by showing that the only trauma type independently associated with elevated PTSD symptoms following suspected ACS was life-threatening illness. This finding differs from research showing that assaultive trauma types (e.g., combat experience) have higher conditional probabilities of PTSD than non-assaultive traumatic events.<sup>48,49</sup> One possible explanation is that the unique traumatization experience of illness, comprised of internal somatic cues rather than external trauma cues, makes patients particularly vulnerable to traumatization by future medical events such as ACS through stress sensitization. Patients with prior trauma due to life-threatening illness may perceive themselves to be at greater risk of mortality or other adverse outcomes during the suspected ACS event. An alternative explanation, particularly if the prior life-threatening medical illness was a cardiac event, is that elevated PTSD symptoms at one month represented a continuation or exacerbation of pre-existing cardiac-related PTSD. Critically, the associations uncovered in this study emerged even when controlling for medical covariates (i.e., comorbidity, ACS type, and GRACE score).

Baseline depressive symptoms were also independently associated with elevated PTSD symptoms following suspected ACS. This finding is consistent with prior studies suggesting depression may be a risk factor for the development of PTSD, although additional research is necessary to confirm a relationship between baseline depression and subsequent PTSD given their high co-morbidity and potential shared response biases.<sup>50, 51</sup>

Study strengths included a large sample, diverse patient population, and measures of PTSD symptoms both before and after a suspected ACS. Yet, there were several limitations. The sample was enrolled from a single urban ED and excluded patients with ST-segment elevation myocardial infarction, limiting generalizability. Only a subset of patients had a confirmed ACS, though prior evidence suggests patients evaluated in the ED for suspected ACS have similar risk for developing PTSD whether or not ACS is confirmed. Additionally, PTSD symptoms were assessed using a survey instrument based on DSM-IV, while the gold standard remains psychiatric interview. ACS-related PTSD symptoms were asked with reference to the index heart problem, ED visit, or hospitalization, and thus may have been induced by traumatic aspects of their evaluation not specific to their ACS symptoms. PTSD symptoms related to prior trauma were assessed soon after presentation with a distressing suspected cardiac event; the heightened arousal associated with this suspected ACS event may have inflated PTSD symptom scores attributed to prior trauma. A substantial proportion of the enrolled sample was either unavailable follow-up or were missing data such that estimates of the prevalence of PTSD and trauma should be interpreted cautiously. Nevertheless, this is one of the largest surveys of PTSD in patients with suspected ACS events. While analyses adjusted for depressive symptoms, other mental disorders predictive of PTSD such as anxiety and conduct disorder were not included as potential confounders.<sup>68</sup>

In conclusion, among patients presenting to an ED for suspected ACS, there was a high burden of prior trauma and elevated PTSD symptoms. Patients with PTSD symptoms from prior trauma were at markedly increased risk of having PTSD symptoms one month after a suspected ACS. The specific type of prior trauma experienced was important, as only life-threatening illness was independently associated with risk for developing clinically significant ACS-induced PTSD symptoms. These findings can increase awareness about the psychological effect of prior trauma on patients who are evaluated for acute cardiac events and the importance of eliciting trauma history when assessing risk for development of adverse psychological consequences after suspected ACS.

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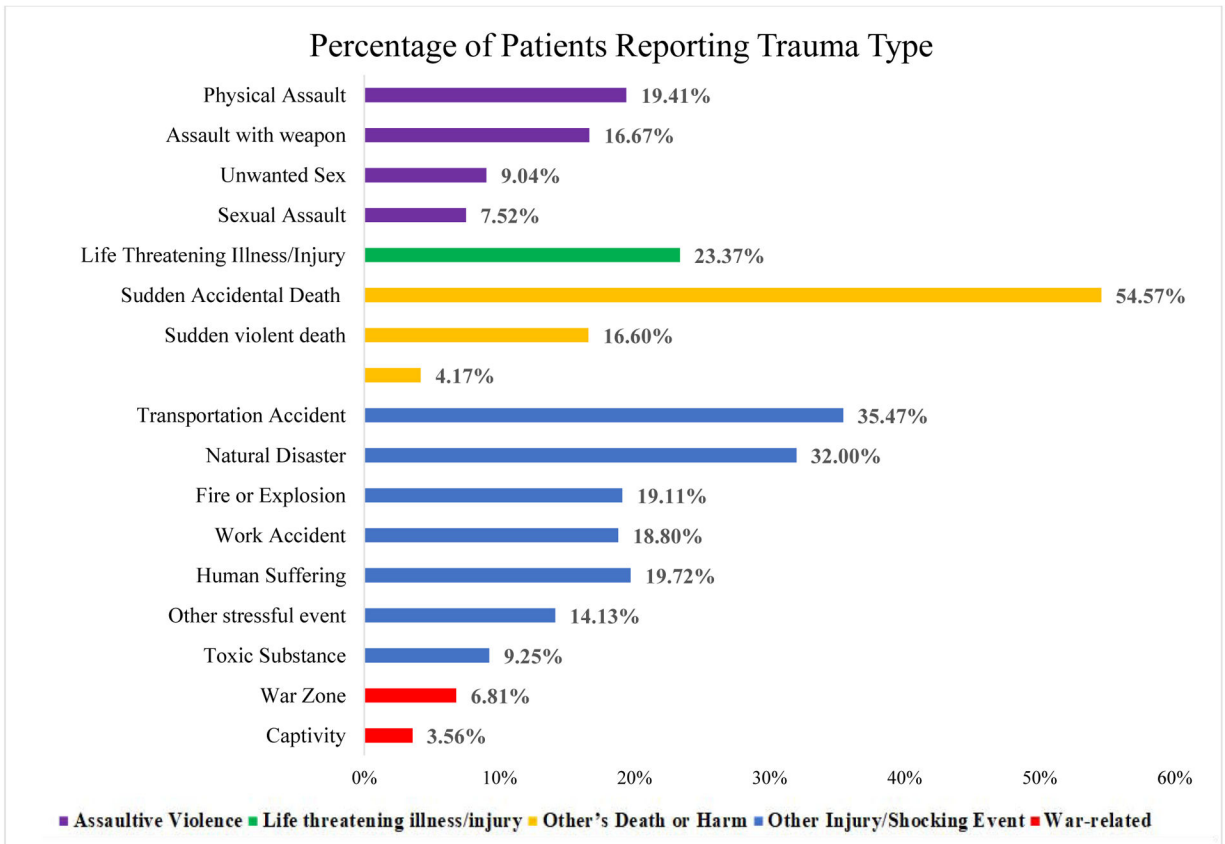
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**Figure 1:** Percentage of Patients Presenting to the Emergency Department with Suspected Acute Coronary Syndrome Reporting Exposure to Each Trauma Type  
Type of prior trauma exposure was evaluated using the Life Events Checklist.

**Table 1:**

Demographic and Medical Characteristics of Suspected Acute Coronary Syndrome (ACS) Patients With and Without Elevated PTSD Symptoms Due to Prior Trauma Exposure at Time of Suspected ACS Event (N=984)

Characteristic	PTSD (PCL-S $\geq 33$ ) due to prior trauma (N=247)	No PTSD (PCL-S $<33$ ) due to prior trauma (N=737)	P value
Age, mean (SD)	59.00 (12.63)	62.22 (12.68)	<.001
Female, N (%)	129 (52.23%)	338 (45.86%)	.08
Race/ethnicity, N (%)			.22
Hispanic	140 (56.68%)	418 (56.72%)	
Non-Hispanic Black	59 (23.89%)	139 (18.86%)	
Non-Hispanic White	37 (14.98%)	135 (18.32%)	
Other	11 (4.45%)	45 (6.11%)	
Depressive symptoms (PHQ-8 $\geq 10$ ), N (%)	146 (59.11%)	128 (17.37%)	<.001
GRACE Risk Score, mean (SD)	91.18 (29.65)	94.99 (29.51)	.08
Charlson comorbidity index, median [IQR]	2 [0, 3]	1 [0, 3]	.03
Etiology of suspected ACS symptoms, N (%)			.29
Non-cardiac	139 (56.28%)	396 (53.73%)	
Cardiac, non-ACS	31 (12.55%)	75 (10.18%)	
ACS confirmed	77 (31.17%)	266 (36.09%)	

Abbreviations: ACS, Acute Coronary Syndrome; GRACE, Global Registry of Acute Coronary Events; PCL-S, PTSD Checklist for a Specific Stressor; PHQ-8, Patient Health Questionnaire.

**Table 2:**

Association of PTSD Symptoms due to Prior Trauma with PTSD symptoms 1-month after Suspected Acute Coronary Syndrome, with and without Adjusting for Prior Trauma Exposure (N=984)

Characteristic	Model 1 (covariates and prior PTSD symptoms) aOR (95% CI)	p-value	Model 2 (Model 1 plus trauma types) aOR (95% CI)	p-value
Age	0.99 (0.97–1.02)	.50	0.99 (0.97–1.02)	.54
Race/ethnicity				
Non-Hispanic Black	1.23 (0.78–1.94)	.25	1.06 (0.66–1.69)	.52
Non-Hispanic White	1.04 (0.61–1.77)	.70	0.90 (0.52–1.54)	.17
Other race/ethnicity	2.38 (1.15–4.91)	.03	2.14 (1.02–4.54)	.04
Hispanic	1 (Ref)		1 (Ref)	
Female (versus male)	1.0	.37	1.0	.22
GRACE	1.00 (0.99–1.01)	.99	1.00 (0.99–1.01)	.96
Charlson index	1.10 (0.99–1.22)	.08	1.09 (0.97–1.22)	.14
ACS Symptom Etiology				
Confirmed ACS	1.12 (0.75–1.67)	.60	1.15 (0.77–1.73)	.58
Other cardiac	0.99 (0.55–1.79)		1.04 (0.57–1.90)	.91
Non-cardiac	1 (Ref)		1 (Ref)	
PHQ-8 10	2.69 (1.83–3.95)	<.001	2.67 (1.81–3.93)	<.001
PTSD due to prior trauma (PCL-S 33)	4.49 (3.05–6.60)	<.001	3.60 (2.39–5.43)	<.001
Prior Life-Threatening Illness			1.57 (1.03–2.39)	.04
War-Related Trauma			1.17 (0.66–2.07)	.59
Assaultive Violence			1.10 (0.81–1.82)	.35
Other's Death or Harm			1.03 (0.68–1.56)	.89
Other Injury or Shocking Event			1.33 (0.84–2.11)	.22

PTSD symptoms were categorized as present if PTSD Checklist for a Specific Stressor (PCL-S) score  $\geq 33$ .

Abbreviations: aOR, Adjusted Odds Ratio; ACS, Acute Coronary Syndrome; GRACE, Global Registry of Acute Coronary Events; PCL-S, PTSD Checklist for a Specific Stressor; PHQ-8, 8-Item Patient Health Questionnaire.