Published in final edited form as:

J Behav Med. 2018 June ; 41(3): 357–363. doi:10.1007/s10865-017-9904-5.

The Role of Perceived Threat during Emergency Department Cardiac Evaluation and the Age-Posttraumatic Stress Disorder Link

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Abstract

Evaluation for acute coronary syndrome (ACS) can trigger posttraumatic stress symptoms (PSS). Research suggests that younger, versus older, individuals may be at elevated risk for PSS after ACS evaluation. It has been proposed that younger individuals may be at greater risk because they perceive the suspected ACS event as more threatening than their older counterparts, however, this has yet to be tested. We examined whether perceived threat during ACS evaluation mediated the association between age and PSS after ACS evaluation in an observational cohort study of patients presenting to the emergency department (ED) with suspected ACS. Demographics and perceived threat were assessed in the ED. PSS were measured upon inpatient transfer or by phone 3 days later. The analytic sample comprised 871 adult participants. Multiple linear regression was used to examine 1) associations of age and perceived threat with PSS and 2) whether perceived threat mediated the association. Bootstrapping with percentile-based confidence intervals (CIs) was used to test the indirect effect. Each year of age was associated with lower PSS ($b=-0.12$, $p<.001$), independent of covariates. Older age was associated with lower perceived threat during ACS evaluation ($b=-0.05$, $p<.001$). Greater threat perceptions predicted greater PSS ($b=0.94$, $p<.0001$).

Compliance with Ethical Standards

Informed consent: Informed consent was obtained from all individual participants included in the study.

Conflict of Interest: All authors declare that they have no conflict of interest to report.

The indirect effect (-0.04) was statistically significant (95% CI, -0.07 , -0.02). Younger, versus older, individuals are at risk for greater PSS after ACS evaluation, and elevated perceived threat partially mediated this association. Understanding age differences in PSS development risk and the potential impact of age on threat perceptions may help inform ED treatment.

Keywords

Acute coronary syndrome; age; posttraumatic stress symptoms; posttraumatic stress disorder

Introduction

Acute coronary syndrome (ACS) is a leading cause of hospitalization in the United States, with more than 1.1 million patients presenting to the emergency department (ED) with symptoms of ACS each year (Benjamin, 2017). Being evaluated for suspected ACS can be a highly stressful and potentially traumatic event that can trigger the development of posttraumatic stress disorder (PTSD) (Vilchinsky, Ginzburg, Fait, & Foa, 2017). Meta-analytic evidence suggests that clinically significant PTSD symptoms are moderately prevalent after ACS events (aggregated prevalence estimate of 12%) (Edmondson et al., 2012). Furthermore, research suggests that ACS-induced PTSD is associated with a doubling of risk for recurrent cardiovascular events and mortality (Edmondson & Cohen, 2013; Edmondson et al., 2012; Edmondson & von Kanel, 2017).

Given the negative consequences of ACS-induced PTSD on emotional and cardiovascular health, researchers have been interested in identifying factors that may identify those most vulnerable to developing posttraumatic stress symptoms (PSS) after a suspected ACS event. A growing body of research suggests that younger individuals who experience a life-threatening medical event, such as ACS, may be at increased risk of developing PTSD (Bennett & Brooke, 1999; Dinenberg, McCaslin, Bates, & Cohen, 2014; Edmondson & Cohen, 2013; Gamper et al., 2004; Rocha et al., 2008; Wikman, Bhattacharyya, Perkins-Porras, & Steptoe, 2008). Research is still inconclusive, however, and not all studies have observed this association (Gao, Zhao, Li, & Cao, 2015; Roberge, Dupuis, & Marchand, 2008).

Some researchers have postulated reasons for why younger individuals may be at elevated risk of developing PSS after ACS compared to older individuals. One hypothesis is that younger ACS survivors may view their event as particularly traumatic due to health-related expectations based on age and a lack of prior experience with serious medical events (Bennett & Brooke, 1999). For younger individuals, a suspected ACS event may be their first experience with a potentially life-threatening medical event. This is in contrast to older individuals, who may have more frequent or chronic health issues or who may be more familiar with these events occurring in their peers. Thus, younger, versus older, individuals may be more likely to perceive evaluation for ACS as highly threatening.

Elevated threat perceptions during a traumatic event (i.e., peritraumatic threat) are a well-established risk factor for developing PTSD after a suspected ACS event (Edmondson et al., 2012; Vilchinsky et al., 2017; White, Edmondson, Umland, Sanchez, & Chang, 2016).

Peritraumatic threat perceptions may include feelings of fear, helplessness, and loss of control during the traumatic event itself. Thus, greater perceived threat during the traumatic event has been found to have important implications for the development of psychopathology after the trauma (e.g., posttraumatic stress). Even though elevated peritraumatic threat in younger compared to older individuals may underlie greater rates of PSS observed in younger individuals after suspected ACS, this pathway has yet to be tested.

We conducted the first empirical examination of a potential psychological mechanism underlying age differences in risk for PSS after evaluation for suspected ACS. Using a longitudinal study design with assessments in the ED and upon transfer to an inpatient bed, we tested whether younger age was associated with greater threat perceptions during ACS evaluation in the ED and greater PSS in the first week after ED enrollment. We hypothesized that greater threat perceptions would partially explain the association between age and PSS.

Methods

Participants

English- and Spanish-speaking participants were enrolled during evaluation for suspected ACS in the Columbia University Medical Center emergency department from November 2013 to February 2016 as part of the REactions to Acute Care and Hospitalization (REACH) study, an observational cohort study of ED predictors of medical and psychological outcomes after suspected ACS (Sumner et al., 2015). Potential participants were identified by a provisional diagnosis of “probable ACS” by the treating ED physician, including non-ST-elevation myocardial infarction (NSTEMI) on an electrocardiogram and unstable angina (UA). NSTEMI is defined by a rise and fall of biochemical markers of infarction (e.g., troponin) with one of the following in the absence of ST elevations: (1) ST segment depression; (2) T wave abnormalities; (3) ischemic symptoms without ST segment depression or T wave abnormalities. UA is defined by angina pectoris with no biochemical evidence of myocardial infarction. Exclusion criteria included: ST-elevation myocardial infarction (STEMI) on an electrocardiogram, as this triggers a rapid emergency protocol and transfer to the cardiac catheterization laboratory such that enrollment in the ED was not possible; inability to follow the protocol (due to dementia or substance abuse); need for immediate psychiatric intervention; and lack of availability for follow-up (e.g., due to terminal non-cardiovascular illness). This study was approved by the Columbia University Medical Center Institutional Review Board. All participants provided written informed consent. Of those eligible, 61% enrolled. We do not maintain individual records for potential participants who do not consent to participate due to human subjects concerns, but we do retain a list of reasons for non-participation in order to inform study operations approaches. Reasons for non-participation in the study included severe pain or inability to focus on research questions in the ED, a lack of interest, unavailability for follow-up (e.g., homelessness, imminent travel out of the country), hearing difficulty or no phone for follow-up, rapid transfer or change in medical condition, low fluency in English or Spanish, or a family member objection to participation. The current study analyzed data from 871 individuals who completed the ED and inpatient/telephone follow-up assessments.

Procedure

At study enrollment in the ED, participants completed measures of demographics, including age, sex, and race/ethnicity, and perceived threat during evaluation for suspected ACS in the ED. During inpatient stay or by phone after discharge (median 3 days after enrollment), participants reported PSS (i.e., symptoms of re-experiencing and/or avoiding reminders of the trauma, and hyperarousal) in response to the event that brought them to the ED. Medical covariates reflecting mortality risk and degree of comorbidity, namely the Global Registry of Acute Coronary Events (GRACE) risk score (Eagle et al., 2004) and the Charlson Comorbidity Index (Charlson et al., 1987), respectively, were calculated from medical records. Hospital discharge diagnosis (ACS; non-ACS) was determined by medical record review conducted by a research nurse and confirmed by a board-certified cardiologist.

Measures

Threat perceptions—We assessed participants' threat perceptions in response to evaluation for suspected ACS in the ED with 6 items based on Ozer et al. (2003) (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"). Participants rated the extent to which these statements reflected their experience during evaluation for suspected ACS in the ED on a 4-point Likert scale ranging from 1 ("Not at all") to 4 ("Extremely"). This measure of threat perceptions was calculated by summing responses to these 6 items; responses to these items had good internal consistency (Cronbach's $\alpha=.79$).

PSS—Participants reported early PSS in response to the suspected ACS event that brought them to the ED using 14 items from the Acute Stress Disorder Scale (ASDS; Bryant, Moulds, & Guthrie, 2000). Items were rated on a 1 ("Not at all") to 5 ("Very much") and responses were summed to create a total PSS score (range=14–70; Cronbach's $\alpha=.87$). The ASDS is the most widely used self-report inventory of acute PSS. It has been found to have excellent test-retest reliability and good sensitivity and specificity (Bryant et al., 2000).

Medical Covariates—Medical covariates indicating mortality risk and degree of medical comorbidity, namely the Global Registry of Acute Coronary Events (GRACE) risk score (Eagle et al., 2004) and the Charlson Comorbidity Index (Charlson et al., 1987), respectively, were calculated from medical records. The GRACE score has a range from 1 to 263 points, with higher scores indicating greater mortality risk (Eagle et al., 2004). The Charlson Comorbidity Index can range from 0 to 37; the higher the score, the more severe the comorbidity. Age is typically included in the calculation of both the GRACE risk score and Charlson Comorbidity Index. However, because age was a key independent variable of interest in the current study, we did not include age when calculating these two indices.

Data Analysis

First, we compared younger and older participants on demographic and medical covariates, threat perceptions, and PSS using chi-squared tests or t-tests. Although we included age as a continuous variable in our regression analyses, we defined younger and older participants based on a median split in order to compare groups on these participant characteristics.

Second, multiple linear regression was used to test if perceived threat mediated the association between age (measured continuously) and PSS. Specifically, the PROCESS macro for SPSS was utilized to employ an ordinary least squares regression-based path analytic framework to estimate total, direct, and indirect effects in a single mediator model (Hayes, 2013). Bootstrapping with percentile-based confidence intervals (CIs) was used to test the indirect effect. Models adjusted for sex, race/ethnicity, confirmed ACS status at discharge, GRACE index, and Charlson Comorbidity Index. In a sensitivity analysis, we re-ran our analyses separately for those with ($n=288$) and without ($n=583$) confirmed ACS at discharge. Participants had complete data for all variables. Analyses were conducted using SPSS Version 23 (IBM Corp., Armonk, NY).

Results

Participant Characteristics

Participant characteristics for the full sample, as well as for younger and older participants (based on a median split; median age=60.4 years) are shown in Table 1. The mean age for the younger participants group was 50.5 years ($SD=7.1$; range=22.0–60.4), whereas the mean age for the older participants group was 71.4 years ($SD=8.2$; range=60.4–95.2). Older individuals were significantly more likely than younger individuals to have a confirmed ACS diagnosis at discharge, a higher GRACE risk score, and higher Charlson Comorbidity Index. Younger and older participants also differed significantly in race/ethnicity, with a greater proportion of Black individuals among younger participants and a greater proportion of White individuals among older participants. Younger individuals reported significantly higher levels of perceived threat during evaluation for ACS in the ED, as well as significantly higher PSS levels.

Perceived Threat as a Mediator of the Age-PSS Association

Multiple regression analyses were conducted to assess each component of the proposed mediation model (see Figure 1). Each year of age was significantly associated with lower PSS ($b=-0.12$, $SE=0.03$, $p<.001$), independent of demographic and medical covariates. Results of the mediation analysis using the bootstrapping method indicated that perceived threat was a mediator of the relation between age and PSS. The indirect effect was negative (-0.04) and statistically different from zero (95% CI, -0.07 , -0.02). The direct effect of age on PSS was attenuated, although still significant, in the model that included threat perceptions ($b=-0.08$, $SE=0.03$, $p=0.011$), suggesting partial mediation (see Figure 1). The model with age, perceived threat, and demographic and medical covariates accounted for 19.0% of the variance in PSS ($R^2=.190$). Other than age and perceived threat, female sex was the only other significant predictor in the model ($b=1.49$, $SE=0.68$, $p=.028$). The ratio of indirect to total effect was 0.35; indicating that threat perceptions in the ED explained approximately 35% of the total relationship of age with PSS.

Sensitivity Analysis

Analyses conducted separately in those with and without confirmed ACS at discharge indicated that results were similar in both groups and nearly identical to the results from the full sample. The indirect effect was -0.05 (95% CI, -0.09 , -0.01) for those with confirmed

ACS, and the indirect effect was -0.04 (95% CI, $-0.07, -0.01$) for those without confirmed ACS. The total and direct effects for those with and without confirmed ACS were also highly similar (ACS: total effect: $b=-0.13$, $SE=0.05$, $p=.015$; direct effect: $b=-0.08$, $SE=0.05$, $p=.109$; Non-ACS: total effect: $b=-0.12$, $SE=0.04$, $p=.004$; direct effect: $b=-0.08$, $SE=0.04$, $p=.035$).

Discussion

To the best of our knowledge, this study is the first to specifically test a hypothesis to explain the consistent finding that younger age is a risk factor for the development of PSS after evaluation for suspected ACS. Our findings indicate that younger, compared to older, individuals are at risk for greater PSS after evaluation for ACS in the ED due, in part, to elevated threat perceptions. Thus, threat perceptions are one underlying pathway by which younger age may increase vulnerability to post-ACS-evaluation PSS. A unique strength of our study is that threat perceptions were assessed during the peritraumatic period rather than relying on retrospective reports. This feature of study design, along with assessing PSS after ED recruitment, allowed us to test a mediation model aimed at elucidating why younger age might be associated with risk for PSS after evaluation for ACS.

Park and Folkman's (1997) Meaning Making Model may provide a useful theoretical framework for understanding why younger age may be a risk factor for greater PSS after a suspected ACS event (Park & Folkman, 1997). According to the model, individuals possess a general orienting set of beliefs (global meaning) and also create meaning adaptively in response to particular life events (situational meaning). An individual experiences distress when adaptively created situational meaning is at odds with their broader understanding of life. Traumatic events necessitate the creation of situational meaning in order to process and come to terms with the experience. When an individual is unable to create situational meaning or when there is a discrepancy between their situational meaning and the global meanings they hold, that individual experiences significant distress, potentially resulting in psychopathology.

According to Park (2013), serious illness can be difficult to integrate into one's global meaning and may violate feelings of fairness, predictability, and control in a manner distinctly different from other traumas (Park, 2013). In the context of a suspected ACS event, younger individuals may experience distinct threat and distress in the face of a medical event that is outside of their control and comprehension. The occurrence of a suspected ACS event earlier in life may make it especially unexpected; in contrast, older individuals might find an illness or disease more predictable or "on-time" in a later phase of life (Bennett and Brook, 1999). Thus, in the acute phase of a potentially life-threatening medical event, younger individuals may perceive the event as more threatening than older individuals due to a greater discrepancy in between the experience of the event and their prior beliefs concerning their vulnerability to such events (i.e., global meaning system). It is possible that older adults experiencing multiple potentially life threatening medical events could have a greater lifetime trauma burden as a result. Increased trauma burden has been associated with increased risk of posttraumatic psychopathology across a number of studies (Kessler, 2000; Shalev, Liberzon, & Marmar, 2017). However, other research also

suggests that prior experience with a similar traumatic event could contribute to a sense of psychological preparedness which, in turn, could mitigate the psychological response to a subsequent trauma and help to “immunize” individuals (Basoglu et al., 1997). Further research is necessary to understand whether these processes could be operating for older individuals.

Our study has several limitations that merit acknowledgment. First, our study assessed PSS in the acute aftermath of evaluation for ACS. Even though evidence suggests that early PSS can predict subsequent PTSD (Bryant, 2011), further longitudinal research is needed to examine directly whether younger age is related to PTSD and if peritraumatic threat mediates this association. Second, our study used a questionnaire measure to assess PSS rather than a clinical interview. Thus, our study only refers to symptoms of posttraumatic stress and not a clinical diagnosis. Future research would benefit from including an interview based diagnosis of PTSD to better assess and understand clinical outcomes. Third, approximately one third of participants had confirmed ACS at discharge. However, prior research suggests that the factors most associated with risk of PSS are those subjective factors which influence the experience of ACS evaluation (e.g., perceived life threat), rather than objective clinical severity or diagnosis (see Edmondson & Cohen, 2013, for a review). Moreover, research from the REACH study has shown that levels of threat perceptions during evaluation for ACS are similar in those with and without confirmed ACS at discharge (Velazquez et al., 2016). Despite these limitations, our study is characterized by several strengths, including: 1) a large, racially/ethnically diverse sample; 2) assessment of threat perceptions during the peritraumatic period; and 3) temporal ordering of measured variables for mediation analyses.

Understanding the potential impact of age on threat perceptions may help to inform treatment and interventions in the ED. For example, it may be of interest to identify ways to reduce threat perceptions in younger individuals presenting to the ED with suspected ACS in particular. Evaluation for a potentially life-threatening cardiac event in the ED is a highly stressful experience, and research has demonstrated that the ED can be an especially threatening environment depending upon a number of modifiable factors, such as crowding, acuity of nearby patient conditions, and bed placement in hallways versus standard rooms (Chang, Carter, Suh, Kronish, & Edmondson, 2016; Chang, Sumner, Haerizadeh, Carter, & Edmondson, 2016; Homma et al., 2016). However, good doctor-patient communication in the ED can ameliorate some of those environmental effects. It is of interest to examine whether younger individuals presenting to the ED with suspected ACS are particularly susceptible to these ED factors compared to older individuals. If research supports this notion, then addressing these environmental factors in the ED may be particularly beneficial for prevention in younger individuals. Considering the potential buffering effects of positive communication and social support on PSS after evaluation for ACS, future work should also explore the possibility of specific trainings for clinicians and caretakers to reduce levels of perceived threat during evaluation and treatment in the ED (Homma et al., 2016). Again, such interventions may hold particular promise for younger individuals, although research is needed to directly answer this question.

PSS induced by acute cardiac events is being increasingly acknowledged as a valid psychological condition with far-reaching negative consequences for emotional and physical health (Vilchinsky et al., 2017). Our research suggests that younger individuals may be at elevated risk of developing PSS after evaluation for suspected ACS and that this may be, in part, due to perceiving the experience as more threatening. Prior work suggests that a sense of enduring somatic threat may be at the core of the chronic manifestation of PSS after a suspected ACS event (Edmondson, 2014; Meli et al., 2017). Therefore, it is of interest to examine whether younger individuals are more vulnerable to increased sensitivity to internal somatic threat cues such as rapid heartbeat or transient chest pain, even after the evaluation for suspected ACS is complete and a benign diagnosis is given. Such research has the potential to inform intervention strategies to reduce distress, and potentially improve subsequent cardiac and rehospitalization risk, in these individuals after suspected ACS (Edmondson et al., 2012; Sumner et al., 2017).

Acknowledgments

Funding: This study was funded by the National Heart, Lung, and Blood Institute through grant number R01 HL117832 and R01 HL123368 (PI: D. Edmondson) and grant number K01 HL130650 (PI: J.A. Sumner).

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Figure 1.

a Total effect model

b Mediation model

Note: Models include sex, race/ethnicity, Charlson Comorbidity index, GRACE risk score, and confirmed ACS diagnosis at discharge as covariates of threat perceptions during evaluation for ACS in the ED and posttraumatic stress symptoms. * $p < .001$; ** $p < .0001$

Table 1

Participant characteristics for the full sample and for younger and older participants (based on median split).

	Full Sample (N=871)	Younger Participants (n=436)	Older Participants (n=435)	
	% (n) or Mean (SD)	% (n) or Mean (SD)	% (n) or Mean (SD)	p ^a
Demographics				
Female	45.8 (399)	49.3 (197)	50.6 (202)	.710
Age, years	60.94 (12.93)	50.54 (7.10)	71.36 (8.21)	<.0001
Race/ethnicity				<.0001
White	16.6 (145)	13.0 (57)	20.2 (88)	--
Hispanic	56.6 (493)	54.1 (236)	59.0 (257)	--
Black	19.7 (172)	25.4 (111)	14.0 (61)	--
Other	7.0 (61)	7.3 (32)	6.6 (29)	--
Medical Covariates				
Discharge diagnosis				.013
ACS	33.0 (288)	29.1 (127)	37.0 (274)	--
Non-ACS	66.9 (583)	70.8 (309)	62.9 (274)	--
GRACE risk score	108.37 (38.68)	111.27 (37.65)	105.46 (39.51)	.027
Charlson Comorbidity Index	1.86 (2.06)	1.38 (1.67)	2.34 (2.28)	<.0001
Threat perceptions ^b	10.90 (4.34)	11.44 (4.67)	10.37 (3.92)	<.0001
PSS ^c	24.35 (10.59)	25.90 (11.74)	22.80 (9.04)	<.0001

Note. ACS= acute coronary syndrome; GRACE=Global Registry of Acute Coronary Events; PSS=posttraumatic stress symptoms.

^a p-value refers to omnibus test.

^b Threat perception score ranged from 6–24.

^c PSS total score ranged from 14 to 70.