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ORIGINAL RESEARCH

# Posttraumatic Stress Disorder After Spontaneous Coronary Artery Dissection: A Report of the International Spontaneous Coronary Artery Dissection Registry

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**BACKGROUND:** Myocardial infarction secondary to spontaneous coronary artery dissection (SCAD) can be traumatic and potentially trigger posttraumatic stress disorder (PTSD). In a large, multicenter, registry-based cohort, we documented prevalence of lifetime and past-month SCAD-induced PTSD, as well as related treatment seeking, and examined a range of health-relevant correlates of SCAD-induced PTSD.

**METHODS AND RESULTS:** Patients with SCAD were enrolled in the iSCAD (International SCAD) Registry. At baseline, site investigators completed medical report forms, and patients reported demographics, medical/SCAD history, psychosocial factors (including SCAD-induced PTSD symptoms), health behaviors, and health status via online questionnaires. Of 1156 registry patients, 859 patients (93.9% women; mean age, 52.3 years) completed questionnaires querying SCAD-induced PTSD. Nearly 35% (n=298) of patients met diagnostic criteria for probable SCAD-induced PTSD in their lifetime, and 6.4% (n=55) met criteria for probable past-month PTSD. Of 811 patients ever reporting any SCAD-induced PTSD symptoms, 34.8% indicated seeking treatment for this distress. However, 46.0% of the 298 patients with lifetime probable SCAD-induced PTSD diagnoses reported never receiving trauma-related treatment. Younger age at first SCAD, fewer years since SCAD, being single, unemployed status, more lifetime trauma, and history of anxiety were associated with greater past-month PTSD symptom severity in multivariable regression models. Greater past-month SCAD-induced PTSD symptoms were associated with greater past-week sleep disturbance and worse past-month disease-specific health status when adjusting for various risk factors.

**CONCLUSIONS:** Given the high prevalence of SCAD-induced PTSD symptoms, efforts to support screening for these symptoms and connecting patients experiencing distress with empirically supported treatments are critical next steps.

**REGISTRATION:** URL: <https://www.clinicaltrials.gov>; Unique identifier: NCT04496687.

**Key Words:** health status ■ PTSD ■ SCAD ■ sleep ■ trauma ■ treatment

**A**lthough once viewed as a rare cardiovascular condition, spontaneous coronary artery dissection (SCAD) is increasingly acknowledged as an important cause of acute coronary syndrome, particularly among women.<sup>1</sup> Approximately 80% to 90% of patients with SCAD, characterized by the nontraumatic

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## CLINICAL PERSPECTIVE

### What Is New?

- This is the largest study of posttraumatic stress disorder induced by spontaneous coronary artery dissection conducted to date, with >800 patients from an international, multisite registry.
- We demonstrated that >1 in 3 patients met the criteria for probable SCAD-induced PTSD in their lifetime and highlighted links with adverse health correlates.

### What Are the Clinical Implications?

- Findings emphasize the importance of screening for posttraumatic stress disorder symptoms after spontaneous coronary artery dissection and connecting those patients experiencing distress postevent with empirically supported treatments.

## Nonstandard Abbreviations and Acronyms

<b>iSCAD Registry</b>	International SCAD Registry
<b>SCAD</b>	spontaneous coronary artery dissection

and noniatrogenic separation of the coronary arterial wall by intramural hemorrhage, are women, and SCAD may account for up to 35% of acute coronary syndrome cases in women aged <50 years and up to 43% of acute coronary syndrome cases in pregnant women.<sup>1,2</sup> Despite growing awareness of SCAD, its cause, although likely multifactorial, is largely unknown, and optimal evidence-based management strategies are generally lacking, despite the possibility of recurrence.

To date, several investigations have examined the psychological consequences of SCAD. Depression and anxiety are common after an acute cardiac event,<sup>3</sup> and several cross-sectional studies with survivors of SCAD have documented elevated symptoms of these mental health conditions.<sup>4–6</sup> Furthermore, some,<sup>7,8</sup> but not all,<sup>9</sup> research has found that patients with SCAD report higher depression or anxiety symptom levels compared with cardiac patients without SCAD. The predominance of women in the population of patients with SCAD may explain the high prevalence of post-SCAD mental health symptoms, because women have approximately twice the lifetime rates of depression and anxiety compared with men.<sup>10,11</sup> Additionally, approximately 1 in 3 patients report receiving treatment for SCAD-related anxiety or

depression.<sup>4,6</sup> Nevertheless, patients have identified a lack of mental health resources as a leading concern after an initial SCAD event,<sup>12</sup> highlighting the need for greater understanding of the emotional consequences of this cardiac condition and how to best address survivors' mental health needs.

High levels of psychological distress after SCAD may also be due, in part, to the often unexpected and unpredictable onset of SCAD events. Most patients with SCAD lack traditional risk factors associated with cardiovascular disease, which may contribute to the unanticipated nature of the diagnosis. The rare nature of SCAD events and a lack of awareness of SCAD among providers may further exacerbate the emotional impact of these events. These sudden SCAD events can be potentially traumatic experiences that can trigger the development of posttraumatic stress disorder (PTSD) symptoms. There has been a growing awareness of cardiac disease-induced PTSD,<sup>13</sup> although PTSD after SCAD has received relatively little attention to date compared with other mental health outcomes like depression and anxiety. Nevertheless, there is preliminary evidence of elevated rates of PTSD symptoms in SCAD survivors.<sup>5,6</sup>

In this observational cohort study, we conducted a comprehensive evaluation of PTSD after SCAD in a large, multicenter, registry-based patient sample (N=859). Not only did we investigate past-month symptoms of PTSD induced by patients' worst or most distressing SCAD event, but we queried whether patients ever experienced PTSD symptoms in response to SCAD in their lifetime using validated questionnaires. In addition to documenting the prevalence of traumatic experiences, SCAD-induced PTSD, and related treatment seeking, we examined a range of health-relevant correlates of SCAD-induced PTSD. We hypothesized that patients with SCAD would have high rates of SCAD-induced PTSD, and that greater PTSD symptom severity would be associated with adverse health behaviors and health status.

## METHODS

### Registry Cohort

The iSCAD (International SCAD) Registry (<https://clinicaltrials.gov/ct2/show/NCT04496687>) is a prospective, multicenter registry of patients who have had a SCAD event. It is sponsored by the SCAD Alliance, a nonprofit advocacy organization for patients with SCAD. The registry was initiated through collaboration with key stakeholders, including experts in cardiovascular medicine and women's heart health, and survivors of SCAD, and it aims to maintain an independent data repository to advance SCAD research and treatment around the world (for more details, see <https://>

[iscadregistry.bidmc.org](https://iscadregistry.bidmc.org)). At the time of data analysis, there were 22 active sites enrolling patients.

Site investigators identified eligible patients with suspected or diagnosed SCAD. Eligibility criteria included: (1) age >18 years, (2) capable of providing informed consent, and (3) active email address for accessing patient questionnaires. Patients were enrolled in the acute aftermath of a SCAD event or from outpatient cardiovascular medicine clinics based on review of invasive or computed tomography angiographic images. The vast majority of patients were enrolled from outpatient care, with a median of 0.6 years (interquartile range [IQR], 0.2–2.3) since their most recent SCAD event. The iSCAD Registry uses a multimethod approach to data collection. Site investigators completed case report forms about the most recent SCAD event, prior cardiovascular or other medical history, and laboratory and imaging data upon enrollment. At a baseline assessment, patients completed online questionnaires about demographic characteristics, personal and family medical history, information related to circumstances preceding SCAD events, health behaviors, overall disease-specific health status, and psychosocial factors. Although follow-up data are collected in the iSCAD Registry, the current study only analyzed data collected at the baseline assessment. All data are coordinated by the PERFUSE academic research organization; PERFUSE investigators also perform core laboratory adjudication of coronary angiograms to confirm the diagnosis of SCAD. Each enrolling site and the PERFUSE coordinating center received institutional review board approval to conduct this research, and participants provided written informed consent. Because of the sensitive nature of the data collected for this study, requests to access the data set from qualified researchers trained in human subject confidentiality protocols may be sent to the PERFUSE Study Group at [iscad-registry@bidmc.harvard.edu](mailto:iscad-registry@bidmc.harvard.edu). This study followed the strengthening the reporting of observational studies in epidemiology cohort reporting guidelines.<sup>14</sup>

## Measures

### Trauma History and PTSD Symptoms

Lifetime exposure to a range of traumatic events was assessed with the Brief Trauma Questionnaire<sup>15</sup>; patients indicated if they ever experienced 10 types of events. Lifetime cumulative trauma burden was calculated by summing the number of event types reported (range, 0–10). As in prior research,<sup>16</sup> these events were categorized into broad classes of trauma types for analyses: (1) serious accident/disaster, (2) interpersonal or sexual violence, (3) combat, (4) life-threatening illness/serious injury (other than SCAD), (5) violent death of close other, and (6) witnessed traumatic event.

SCAD-induced PTSD symptoms were assessed with the PTSD checklist for the *Diagnostic and Statistical*

*Manual of Mental Disorders, Fifth Edition (DSM-5)*,<sup>17</sup> a reliable and valid self-report measure querying the 20 DSM-5 symptoms of PTSD that can be used for identifying probable PTSD diagnoses.<sup>18,19</sup> Patients identified their worst or most distressing SCAD event and answered all questions with respect to that experience. For each symptom, patients indicated whether they ever experienced the symptom in response to their worst/most distressing SCAD event; if so, they then indicated the extent to which they were bothered by the symptom in the past month. As in prior research,<sup>16</sup> responses were aggregated to reflect probable lifetime and past-month diagnoses of PTSD according to the DSM-5 symptom criteria (see Data S1 for details). This information was combined to classify patients as having: (1) no lifetime PTSD symptoms, (2) some lifetime PTSD symptoms but no probable diagnosis, (3) probable lifetime (but not past-month) PTSD, and (4) probable past-month PTSD (note, these individuals would also meet criteria for lifetime PTSD). In addition, past-month PTSD symptom severity was calculated by summing the responses to the 20 past-month symptom questions (range, 0–80). Patients specified the date of their worst/most distressing SCAD event as well, and we calculated the time in years between this event and enrollment in the iSCAD Registry (date of completion of the baseline questionnaires was not recorded).

### Treatment Seeking for PTSD Symptoms

Patients indicated whether they ever sought treatment by a professional for SCAD-induced PTSD symptoms. If they reported seeking treatment, they indicated the type(s) of providers (clergy, primary care physician, psychologist or social worker, psychiatrist, other) and type(s) of treatment received (medication, psychotherapy or talk therapy, other).

### Correlates

Patients provided information about demographic characteristics, including age, sex, race, Hispanic or Latino ethnicity, marital status, educational attainment, and current employment status. In regard to SCAD history, patients reported age at first SCAD event, whether they had a history of pregnancy-related SCAD (among individuals with at least 1 pregnancy), and whether they experienced acute emotional stress or anxiety when first experiencing symptoms of their most recent SCAD event. Site investigators provided information about the event presentation(s) for the most recent SCAD event and treatment(s) performed during hospitalization; investigators could select all options that applied to the most recent event.

Additionally, patients reported their mental health history, specifically whether they had a history of

depression or anxiety before their most recent SCAD event. Several health behaviors were also self-reported, including current smoking and alcohol consumption. Patients described past-week sleep disturbance using the 6-item Patient-Reported Outcomes Measurement Information System Sleep Disturbance Scale, Short Form 6a.<sup>20,21</sup> Total raw scores (range, 6–30) were converted to T scores<sup>22</sup>; higher scores reflect greater sleep disturbance. Patients provided information on overall disease-specific health status in the past month using the Seattle Angina Questionnaire-7, a 7-item disease-specific patient health status measure assessing symptoms due to chest pain/tightness/angina, functioning, and quality of life.<sup>23</sup> Scores range from 0 to 100; higher scores reflect better health (see Data S1 for details).

## Statistical Analysis

Descriptive statistics were calculated for patients who completed the PTSD assessment and compared with the full iSCAD Registry patient cohort. Prevalence of trauma history, SCAD-induced PTSD, and related treatment seeking were documented, and unadjusted associations between demographic, SCAD history, mental health, health behavior, and disease-specific health status characteristics with SCAD-induced PTSD status were tested using  $\chi^2$  tests for categorical variables and analyses of variance for continuous variables. In addition, multivariable regression was used to identify characteristics associated with past-month SCAD-induced PTSD symptom severity; these models included sex, marital status, employment, age at first SCAD, years between the worst/most distressing SCAD event and iSCAD Registry enrollment, lifetime cumulative trauma burden, and history of depression and anxiety before the most recent SCAD event as predictors. Given a high correlation between age at enrollment and age at first SCAD ( $r=0.93$ ), we only included age at first SCAD in regression analyses. Our approach to selection of the variables included in regression analyses was guided by the broader literature on variables that have been associated with PTSD (including cardiac disease-induced PTSD)<sup>13,24</sup> and by variable associations with SCAD-induced PTSD status in unadjusted analyses. We considered some SCAD-related variables (eg, presentation for most recent SCAD event) for potential inclusion as well; however, these variables were not robustly associated with either SCAD-induced PTSD status or outcomes in the regression analyses, and thus we did not include them in our final models. We also used multivariable linear regression to examine whether past-month SCAD-induced PTSD symptom severity was associated with (1) past-week sleep disturbance and (2) past-month disease-specific health status. In separate models, the

health-relevant correlate was the outcome, past-month SCAD-induced PTSD symptom severity was the predictor of interest, and we adjusted for several risk factor covariates (sex, marital status, employment, age at first SCAD, years between the worst/most distressing SCAD event and iSCAD Registry enrollment, lifetime cumulative trauma burden, and history of depression and anxiety before the most recent SCAD event). Given that 2 PTSD symptoms pertain to sleep disturbance (ie, nightmares and trouble falling or staying asleep), we conducted a sensitivity analysis excluding those symptoms from the past-month SCAD-induced PTSD symptom severity score when examining past-week sleep disturbance. This sensitivity analysis was conducted to investigate whether PTSD-specific sleep items were driving any associations with past-week sleep disturbance. Participants with missing data were excluded from regression analyses; sample size for complete case analysis regression models ranged from  $n=802$  for sleep disturbance to  $n=805$  for past-month PTSD symptom severity (ie, >90% of participants with SCAD-induced PTSD data were included in regression analyses). Analyses were conducted in SAS 9.4 (TS1M5; SAS Institute, Cary, NC) and Stata 17.0 (StataCorp, College Station, TX), and  $P<0.05$  indicated statistical significance.

## RESULTS

### Patient Characteristics

Of the 1156 patients enrolled in the iSCAD Registry through December 27, 2022, 859 individuals completed the PTSD assessment, yielding a 74.3% response rate. Participants completing the PTSD assessment were largely representative of the full iSCAD Registry patient cohort, although they had slightly higher rates of prior depression and anxiety (Table S1). Additionally, participants who did not complete the PTSD assessment had higher rates of missing data on demographics overall compared with completers.

Patient characteristics in the total sample and by SCAD-induced PTSD status are presented in Table 1. Respondents had a mean age of 52.3 years at enrollment, and the vast majority identified as women (93.9%). The sample was predominantly of White race (89.0%) and non-Hispanic or Latino ethnicity (95.3%), and most were married or living with a domestic partner (78.8%). Overall, patients were highly educated, with nearly three-quarters of the sample having at least a college degree (74.5%). Approximately half of the sample was working full-time at enrollment in the iSCAD Registry.

Average age at first SCAD was 49.7 years, and 12.7% of patients with at least 1 pregnancy experienced pregnancy-related SCAD. For the most recent

**Table 1. Patient Characteristics Overall and by SCAD-Induced PTSD Status**

Characteristic	Total (N=859)	SCAD-induced PTSD status				P value	Valid n
		No lifetime PTSD symptoms (n=48)	Lifetime PTSD symptoms, no diagnosis (n=513)	Lifetime PTSD diagnosis, no past-month PTSD diagnosis (n=243)	Past-month PTSD diagnosis (n=55)		
Demographics							
Age at enrollment, y, mean (SD)	52.3 (10.5)	58.1 (12.3)	53.6 (10.0)	49.9 (10.2)	45.8 (9.5)	<0.001*	774
Sex						0.001†	858
Women	806 (93.9%)	39 (81.3%)	483 (94.2%)	230 (95.0%)	54 (98.2%)		
Men	52 (6.1%)	9 (18.8%)	30 (5.8%)	12 (5.0%)	1 (1.8%)		
Race, n (%)						0.183†	827
American Indian/Alaska Native	3 (0.4%)	0 (0.0%)	3 (0.6%)	0 (0.0%)	0 (0.0%)		
Asian	15 (1.8%)	1 (2.2%)	11 (2.2%)	1 (0.4%)	2 (3.8%)		
Black	60 (7.3%)	3 (6.5%)	35 (7.0%)	14 (6.1%)	8 (15.1%)		
Native Hawaiian/Pacific Islander	1 (0.1%)	0 (0.0%)	0 (0.0%)	1 (0.4%)	0 (0.0%)		
White	736 (89.0%)	42 (91.3%)	444 (89.3%)	208 (90.0%)	42 (79.2%)		
Multiracial	8 (1.0%)	0 (0.0%)	3 (0.6%)	5 (2.2%)	0 (0.0%)		
Other	4 (0.5%)	0 (0.0%)	1 (0.2%)	2 (0.9%)	1 (1.9%)		
Hispanic or Latino ethnicity, n (%)	40 (4.7%)	4 (8.3%)	19 (3.7%)	15 (6.2%)	2 (3.6%)	0.273†	859
Marital status, n (%)						0.019†	859
Single	82 (9.5%)	5 (10.4%)	36 (7.0%)	28 (11.5%)	13 (23.6%)		
Married/domestic partner	677 (78.8%)	36 (75.0%)	420 (81.9%)	185 (76.1%)	36 (65.5%)		
Divorced	76 (8.8%)	7 (14.6%)	40 (7.8%)	23 (9.5%)	6 (10.9%)		
Widowed	21 (2.4%)	0 (0.0%)	15 (2.9%)	6 (2.5%)	0 (0.0%)		
Prefer not to say	3 (0.3%)	0 (0.0%)	2 (0.4%)	1 (0.4%)	0 (0.0%)		
Education, n (%)						0.507†	859
Some high school	5 (0.6%)	1 (2.1%)	3 (0.6%)	0 (0.0%)	1 (1.8%)		
High school graduate	58 (6.8%)	4 (8.3%)	34 (6.6%)	17 (7.0%)	3 (5.5%)		
Trade school/apprenticeship	28 (3.3%)	0 (0.0%)	13 (2.5%)	12 (4.9%)	3 (5.5%)		
Some college	125 (14.6%)	8 (16.7%)	67 (13.1%)	39 (16.0%)	11 (20.0%)		
College graduate	359 (41.8%)	21 (43.8%)	229 (44.6%)	92 (37.9%)	17 (30.9%)		
Advanced/professional degree	281 (32.7%)	14 (29.2%)	165 (32.2%)	82 (33.7%)	20 (36.4%)		
Not sure or prefer not to say	3 (0.3%)	0 (0.0%)	2 (0.4%)	1 (0.4%)	0 (0.0%)		
Current employment status, n (%)						<0.001†	859
Not employed outside home	107 (12.5%)	7 (14.6%)	59 (11.5%)	31 (12.8%)	10 (18.2%)		
Retired	110 (12.8%)	9 (18.8%)	78 (15.2%)	21 (8.6%)	2 (3.6%)		
Student	5 (0.6%)	0 (0.0%)	3 (0.6%)	1 (0.4%)	1 (1.8%)		
Unemployed	56 (6.5%)	2 (4.2%)	20 (3.9%)	22 (9.1%)	12 (21.8%)		
Working part-time	118 (13.7%)	3 (6.3%)	83 (16.2%)	25 (10.3%)	7 (12.7%)		
Working full-time	435 (50.6%)	25 (52.1%)	258 (50.3%)	132 (54.3%)	20 (36.4%)		

(Continued)

**Table 1. Continued**

Characteristic	Total (N=859)	SCAD-induced PTSD status				P value	Valid n
		No lifetime PTSD symptoms (n=48)	Lifetime PTSD symptoms, no diagnosis (n=513)	Lifetime PTSD diagnosis, no past-month PTSD diagnosis (n=243)	Past-month PTSD diagnosis (n=55)		
Not sure or prefer not to say	28 (3.3%)	2 (4.2%)	12 (2.3%)	11 (4.5%)	3 (5.5%)		
SCAD history							
Age at first SCAD, y, mean (SD)	49.7 (10.6)	55.6 (12.3)	50.8 (10.0)	47.3 (10.7)	44.3 (8.8)	<0.001*	849
Time between worst SCAD event and registry enrollment, y, median (IQR)	0.7 (0.2–2.6)	0.6 (0.1–2.7)	0.8 (0.2–2.8)	0.7 (0.2–2.3)	0.3 (0.2–1.3)	0.229*	845
History of pregnancy-related SCAD for those with at least 1 pregnancy, n (%)	82/645 (12.7%)	2/33 (6.1%)	40/389 (10.3%)	31/178 (17.4%)	9/45 (20.0%)	0.028†	645
Acute emotional stress/anxiety before SCAD, n (%)‡	110 (12.8%)	3 (6.3%)	61 (11.9%)	33 (13.6%)	13 (23.6%)	0.043†	859
Cardiac arrest presentation, n (%)§	39 (4.5%)	0 (0.0%)	19 (3.7%)	13 (5.3%)	7 (12.7%)	0.007†	859
Cardiogenic shock presentation, n (%)§	3 (0.3%)	0 (0.0%)	1 (0.2%)	2 (0.8%)	0 (0.0%)	0.517†	859
NSTEMI presentation, n (%)§	416 (48.4%)	24 (50.0%)	251 (48.9%)	117 (48.1%)	24 (43.6%)	0.894†	859
STEMI presentation, n (%)§	218 (25.4%)	14 (29.2%)	121 (23.6%)	65 (26.7%)	18 (32.7%)	0.385†	859
Other presentation, n (%)§	318 (37.0%)	22 (45.8%)	188 (36.6%)	87 (35.8%)	21 (38.2%)	0.611†	859
CABG performed, n (%)§	28 (3.7%)	0 (0.0%)	15 (3.3%)	12 (5.5%)	1 (2.0%)	0.231†	765
PCI performed, n (%)§	184 (24.1%)	10 (21.7%)	100 (22.4%)	56 (25.6%)	18 (35.3%)	0.202†	763
Medical therapy only, n (%)§	560 (73.6%)	36 (78.3%)	337 (75.7%)	155 (70.8%)	32 (62.7%)	0.136†	761
Prior mental health							
History of depression, n (%)‡	197 (22.9%)	8 (16.7%)	97 (18.9%)	70 (28.8%)	22 (40.0%)	<0.001†	859
History of anxiety, n (%)‡	267 (31.1%)	5 (10.4%)	138 (26.9%)	97 (39.9%)	27 (49.1%)	<0.001†	859
Trauma-related information							
Lifetime cumulative trauma burden, mean (SD)	1.5 (1.6)	1.1 (1.3)	1.3 (1.4)	1.8 (1.7)	2.2 (2.0)	<0.001*	859
Experienced accident/disaster, n (%)	251 (29.2%)	10 (20.8%)	141 (27.5%)	82 (33.7%)	18 (32.7%)	0.164†	859
Experienced interpersonal or sexual violence, n (%)	299 (34.8%)	13 (27.1%)	154 (30.0%)	105 (43.2%)	27 (49.1%)	<0.001†	859
Experienced combat, n (%)	12 (1.4%)	1 (2.1%)	3 (0.6%)	7 (2.9%)	1 (1.8%)	0.087†	859
Experienced illness/injury, n (%)	239 (27.8%)	10 (20.8%)	135 (26.3%)	76 (31.3%)	18 (32.7%)	0.278†	859
Experienced violent death of close other, n (%)	143 (16.6%)	8 (16.7%)	81 (15.8%)	40 (16.5%)	14 (25.5%)	0.340†	859
Witnessed traumatic event, n (%)	130 (15.1%)	5 (10.4%)	63 (12.3%)	45 (18.5%)	17 (30.9%)	<0.001†	859
No. of lifetime SCAD-induced PTSD symptoms ever experienced, mean (SD)	7.8 (5.1)	0.0 (0.0)	5.5 (3.2)	12.4 (3.1)	16.3 (2.0)	<0.001*	859
Past-month SCAD-induced PTSD symptom severity, mean (SD)	10.5 (11.2)	0.0 (0.0)	6.0 (6.0)	15.9 (8.6)	37.9 (10.9)	<0.001*	859

(Continued)

**Table 1. Continued**

Characteristic	Total (N=859)	SCAD-induced PTSD status				P value	Valid n
		No lifetime PTSD symptoms (n=48)	Lifetime PTSD symptoms, no diagnosis (n=513)	Lifetime PTSD diagnosis, no past-month PTSD diagnosis (n=243)	Past-month PTSD diagnosis (n=55)		
Health behaviors							
Past-week sleep disturbance by PROMIS T score, mean (SD)	51.2 (9.4)	44.1 (8.8)	49.4 (8.6)	54.6 (9.1)	59.9 (8.7)	<0.001*	854
Current smoker, n (%)	20 (2.3%)	1 (2.1%)	6 (1.2%)	8 (3.3%)	5 (9.1%)	0.002†	859
Alcohol consumption, n (%)						0.055‡	850
Never drinker	199 (23.4%)	17 (36.2%)	122 (24.1%)	48 (19.9%)	12 (21.8%)		
<1 drink per wk	375 (44.1%)	11 (23.4%)	215 (42.4%)	118 (49.0%)	31 (56.4%)		
1–7 drinks per wk	220 (25.9%)	13 (27.7%)	134 (26.4%)	62 (25.7%)	11 (20.0%)		
>7 drinks per wk	45 (5.3%)	4 (8.5%)	30 (5.9%)	10 (4.1%)	1 (1.8%)		
Prefer not to say	11 (1.3%)	2 (4.3%)	6 (1.2%)	3 (1.2%)	0 (0.0%)		
Disease-specific health status							
Past-month health status total score, mean (SD)	73.1 (16.9)	83.4 (11.3)	76.0 (15.6)	68.4 (17.3)	58.5 (17.0)	<0.001*	858

CABG indicates coronary artery bypass graft; IQR, interquartile range; NSTEMI, non–ST-segment–elevation myocardial infarction; PCI, percutaneous coronary intervention; PROMIS, Patient-Reported Outcomes Measurement Information System; PTSD, posttraumatic stress disorder; SCAD, spontaneous coronary artery dissection; and STEMI, ST-segment–elevation myocardial infarction.

\*Kruskal-Wallis P value.

† $\chi^2$  P value.

‡For most recent SCAD event.

§Investigators could select as many options as applied to the most recent SCAD event; thus, percentages total >100%.

¶Other presentations included asymptomatic, atypical chest pain, stable angina, and unstable angina.

SCAD event, most patients presented as non–ST-segment–elevation myocardial infarction (48.4%), and 12.8% of patients reported experiencing acute emotional stress/anxiety before the event. Most cases were treated with medical therapy only during hospitalization for the most recent SCAD event (73.6%).

### Trauma History and Prevalence of SCAD-Induced PTSD

The majority of patients (65.0%, n=558) reported experiencing at least 1 traumatic event during their lifetime other than their SCAD event, and the mean cumulative lifetime trauma burden was 1.5 (SD, 1.6). As shown in the Figure, the most frequently reported traumatic event type was interpersonal/sexual violence, with over one-third of patients experiencing this type of trauma in their lifetime, followed by accidents/disasters and illness/injury (other than SCAD).

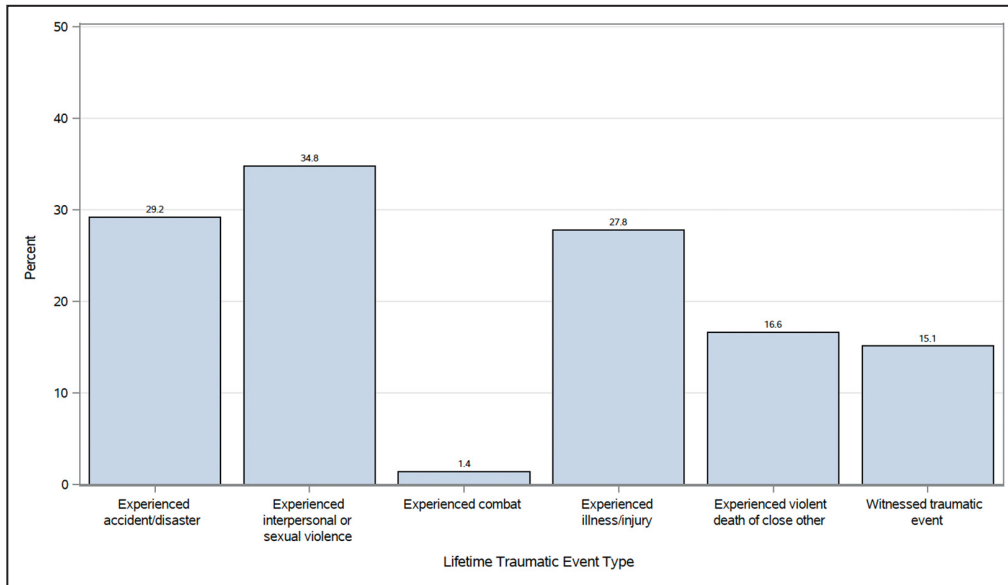
The median time in years between the worst/most distressing SCAD event and enrollment in the iSCAD Registry was 0.7 years (IQR, 0.2–2.6). Nearly 35% of patients (n=298) met criteria for probable SCAD-induced PTSD in their lifetime (Table 1). Of those with probable lifetime SCAD-induced PTSD, 18.5% (n=55; 6.4% of the total sample) met the criteria for probable

past-month PTSD. Furthermore, a sizeable proportion of respondents (59.7%) reported ever experiencing some PTSD symptoms in response to their worst/most distressing SCAD event in their lifetime, although they did not reach the level of a probable diagnosis. In the total sample, the mean number of lifetime SCAD-induced PTSD symptoms ever experienced was 7.8 (SD, 5.1; range, 0–20); the number of lifetime symptoms endorsed was larger for greater and more enduring manifestations of SCAD-induced PTSD symptoms (Table 1). Consistent with probable diagnostic status, mean past-month PTSD symptom severity was greatest among patients with probable past-month PTSD.

### Treatment for SCAD-Induced PTSD

Of the 811 patients who reported at least some lifetime SCAD-induced PTSD symptoms, 34.8% indicated seeking treatment for this distress, with treatment-seeking rates highest among those with probable past-month PTSD (65.5%) and lifetime (but not past-month) probable PTSD (51.4%; Table 2). However, nearly half (46.0%, n=137) of patients with probable SCAD-induced PTSD diagnoses in their lifetime reported never receiving trauma-related treatment. Additionally, nearly a quarter of patients with some lifetime SCAD-induced PTSD





**Figure.** Lifetime prevalence of traumatic event types among iSCAD Registry patients. iSCAD Registry indicates International Spontaneous Coronary Artery Dissection Registry.

symptoms that did not reach the level of a probable diagnosis nevertheless sought treatment by a professional. Overall, psychologists or social workers were the most commonly seen provider (20.1%), followed by primary care physicians (15.3%) and psychiatrists (10.0%). Rates of engagement with these professionals were highest for individuals with probable past-month PTSD, ranging from 21.8% for psychiatrists to 34.5% for psychologists/social workers to 36.4% for primary care physicians. Furthermore, psychotherapy or talk therapy

was the most frequent type of treatment received overall (26.8%). However, 49.1% and 45.5% of individuals with probable past-month PTSD reported receiving psychotherapy or talk therapy and medication, respectively.

**Correlates of SCAD-Induced PTSD Status Demographics**

SCAD-induced PTSD status was significantly associated with several demographic characteristics.

**Table 2.** Prevalence of Treatment Seeking and Receipt for SCAD-Induced PTSD Symptoms

Treatment seeking and receipt	Total (N=811)	SCAD-induced PTSD status			P value
		Lifetime PTSD symptoms, no diagnosis (n=513)	Lifetime PTSD diagnosis, no past-month PTSD diagnosis (n=243)	Past-month PTSD diagnosis (n=55)	
Sought treatment, n (%)	282 (34.8%)	121 (23.6%)	125 (51.4%)	36 (65.5%)	<0.001
Type of professional,* n (%)					
Clergy	21 (2.6%)	6 (1.2%)	13 (5.3%)	2 (3.6%)	0.003
Primary care physician	124 (15.3%)	53 (10.3%)	51 (21.0%)	20 (36.4%)	<0.001
Psychologist or social worker	163 (20.1%)	64 (12.5%)	80 (32.9%)	19 (34.5%)	<0.001
Psychiatrist	81 (10.0%)	29 (5.7%)	40 (16.5%)	12 (21.8%)	<0.001
Other	28 (3.5%)	15 (2.9%)	9 (3.7%)	4 (7.3%)	0.236
Type of treatment,* n (%)					
Medication	145 (17.9%)	56 (10.9%)	64 (26.3%)	25 (45.5%)	<0.001
Psychotherapy or talk therapy	217 (26.8%)	86 (16.8%)	104 (42.8%)	27 (49.1%)	<0.001
Other	19 (2.3%)	12 (2.3%)	7 (2.9%)	0 (0.0%)	0.443

P values reflect  $\chi^2$  comparisons across levels of SCAD-induced PTSD status for a given professional or treatment type. PTSD indicates posttraumatic stress disorder; and SCAD, spontaneous coronary artery dissection.

\*Patients could select 1 or more of these options.

Specifically, younger age at enrollment and being a woman, single, or unemployed were associated with greater and more enduring manifestations of SCAD-induced PTSD symptoms (Table 1).

**SCAD History**

Several SCAD-related characteristics were associated with SCAD-induced PTSD status (Table 1). Younger age at first SCAD was associated with greater and more enduring manifestations of SCAD-induced PTSD. Among patients with at least 1 pregnancy, history of pregnancy-related SCAD was most prevalent among patients with probable past-month PTSD (20.0%). Patients with probable past-month PTSD were also most likely to report that they experienced acute emotional stress/anxiety before their most recent SCAD event (23.6%). Of the various event presentations for the most recent SCAD event, only presenting with cardiac arrest was significantly associated with SCAD-induced PTSD status. The percentage of participants with this presentation was highest among those with probable past-month PTSD (12.7%); in contrast, rates of other presentations were generally comparable across groups. Type of in-hospital treatment for the most recent SCAD event was not significantly associated with SCAD-induced PTSD status.

**Mental Health Factors**

Mean cumulative lifetime trauma burden increased monotonically with greater and more enduring manifestations of SCAD-induced PTSD symptoms (Table 1). Although approximately one-quarter to one-third of the total sample reported a history of depression or anxiety before the most recent SCAD event, prevalence of these mental health conditions was highest among patients with greater and more enduring manifestations of SCAD-induced PTSD symptoms.

**Health Behaviors**

SCAD-induced PTSD status was linked to several health behaviors (Table 1). The greatest past-week sleep disturbance was reported by individuals with probable past-month PTSD (mean T score, 59.9); this group also had the highest rate of current smoking, at nearly 1 in 10 patients. In contrast, alcohol consumption was not significantly associated with SCAD-induced PTSD status.

**Disease-Specific Health Status**

Mean past-month disease-specific health status decreased monotonically with greater and more enduring manifestations of SCAD-induced PTSD symptoms (Table 1).

**Adjusted Analyses of SCAD-Induced PTSD Symptom Severity**

Results of the multivariable regression examining past-month SCAD-induced PTSD symptom severity are presented in Table 3. Being single ( $\beta=0.10, P=0.003$ ), unemployed status ( $\beta=0.13, P<0.001$ ), not being employed outside the home ( $\beta=0.09, P=0.007$ ), younger age at first SCAD ( $\beta=-0.21, P<0.001$ ), fewer years since the worst/most distressing SCAD event and registry enrollment ( $\beta=-0.15, P<0.001$ ), greater lifetime cumulative trauma burden ( $\beta=0.18, P<0.001$ ), and a history of anxiety before the most recent SCAD event ( $\beta=0.20,$

**Table 3. Parameters From Adjusted Regression Model Examining Patient Characteristics Associated With Past-Month SCAD-Induced PTSD Symptom Severity**

Variable in regression model	b (95% CI)	$\beta$	P value
Sex (women=reference)	-2.47 (-5.34 to 0.39)	-0.05	0.090
Marital status			
Divorced	-0.16 (-2.65 to 2.33)	-0.00	0.900
Single	3.65 (1.26 to 6.03)	0.10	0.003*
Widowed	-0.34 (-4.78 to 4.10)	-0.00	0.881
Married/domestic partner (reference)	...	...	...
Employment status			
Employed part-time	0.61 (-1.45 to 2.67)	0.02	0.563
Not employed outside home	3.02 (0.84 to 5.20)	0.09	0.007*
Retired	0.47 (-1.96 to 2.90)	0.01	0.704
Student	2.23 (-6.44 to 10.90)	0.02	0.614
Unemployed	5.50 (2.68 to 8.32)	0.13	<0.001*
Employed full-time (reference)	...	...	...
Age at first SCAD	-0.22 (-0.30 to -0.14)	-0.21	<0.001*
Time between worst SCAD event and registry enrollment, y	-0.44 (-0.63 to -0.25)	-0.15	<0.001*
Lifetime cumulative trauma burden	1.26 (0.81 to 1.71)	0.18	<0.001*
Reported depression before most recent SCAD event	1.59 (-0.23 to 3.41)	0.06	0.087
Reported anxiety before most recent SCAD event	4.64 (3.01 to 6.27)	0.20	<0.001*

Sample size for regression models based on complete case analysis=805. Model  $R^2=22.13\%$ . Both unstandardized (b) and standardized ( $\beta$ ) regression coefficients are presented for completeness. PTSD indicates posttraumatic stress disorder; and SCAD, spontaneous coronary artery dissection.

\*Significant at  $P<0.05$ .

**Table 4. Parameters From Adjusted Regression Models Examining the Associations of Past-Month SCAD-Induced PTSD Symptom Severity With Past-Week Sleep Disturbance and Past-Month Disease-Specific Health Status**

Variable in regression model	Past-week sleep disturbance			Past-month disease-specific health status		
	b (95% CI)	$\beta$	P value	b (95% CI)	$\beta$	P value
Sex (women=reference)	-2.94 (-5.31 to -0.56)	-0.08	0.016*	2.11 (-2.26 to 6.48)	0.03	0.344
Marital status						
Divorced	1.24 (-0.84 to 3.31)	0.04	0.241	1.68 (-2.12 to 5.48)	0.03	0.387
Single	-0.66 (-2.65 to 1.33)	-0.02	0.514	0.40 (-3.26 to 4.05)	0.01	0.831
Widowed	-2.18 (-5.86 to 1.51)	-0.04	0.247	-5.59 (-12.54 to 1.36)	-0.05	0.115
Married/domestic partner (reference)	...	...	...	...	...	...
Employment status						
Employed part-time	-0.64 (-2.34 to 1.07)	-0.02	0.465	-1.05 (-4.19 to 2.09)	-0.02	0.513
Not employed outside home	-0.05 (-1.88 to 1.78)	-0.00	0.959	-0.67 (-4.01 to 2.67)	-0.01	0.695
Retired	1.01 (-1.01 to 3.03)	0.04	0.326	-1.86 (-5.58 to 1.85)	-0.04	0.325
Student	-0.88 (-8.07 to 6.31)	-0.01	0.810	-5.47 (-18.69 to 7.76)	-0.03	0.417
Unemployed	2.37 (0.01 to 4.73)	0.06	0.049*	-7.28 (-11.62 to -2.94)	-0.11	0.001*
Employed full-time (reference)	...	...	...	...	...	...
Age at first SCAD	0.02 (-0.05 to 0.08)	0.02	0.634	0.07 (-0.05 to 0.18)	0.04	0.267
Time between worst SCAD event and registry enrollment, y	-0.04 (-0.20 to 0.12)	-0.02	0.608	0.62 (0.33 to 0.92)	0.14	<0.001*
Lifetime cumulative trauma burden	0.47 (0.08 to 0.85)	0.08	0.018*	-0.14 (-0.85 to 0.56)	-0.01	0.687
Reported depression before most recent SCAD event	1.33 (-0.18 to 2.85)	0.06	0.085	-0.48 (-3.27 to 2.30)	-0.01	0.734
Reported anxiety before most recent SCAD event	1.03 (-0.35 to 2.41)	0.05	0.145	-1.32 (-3.86 to 1.21)	-0.04	0.306
Past-month PTSD symptoms	0.35 (0.30 to 0.41)	0.42	<0.001*	-0.55 (-0.66 to -0.45)	-0.37	<0.001*

Sample size for regression models based on complete case analysis=802 for sleep disturbance and 804 for disease-specific health status. Both unstandardized (b) and standardized ( $\beta$ ) regression coefficients are presented for completeness. Model  $R^2=26.08\%$  for sleep disturbance and  $21.52\%$  for disease-specific health status. PTSD indicates posttraumatic stress disorder; and SCAD, spontaneous coronary artery dissection.

\*Significant at  $P<0.05$ .

$P<0.001$ ) were significantly associated with higher past-month SCAD-induced PTSD symptom levels. Age and time-related factors, along with trauma and anxiety-related variables, had some of the strongest associations with past-month SCAD-induced PTSD symptom severity.

### Adjusted Associations of SCAD-Induced PTSD Symptom Severity With Sleep Disturbance and Disease-Specific Health Status

In regression models adjusting for demographic, SCAD-related, and mental health variables, past-month SCAD-induced PTSD symptom levels were significantly positively associated with past-week sleep disturbance ( $\beta=0.42$ ,  $P<0.001$ ) and significantly negatively associated with past-month disease-specific health status ( $\beta=-0.37$ ,  $P<0.001$ ; Table 4). In both sets of models, PTSD symptoms emerged as the significant predictor with the largest effect size,

with only sex ( $\beta=-0.08$ ,  $P=0.016$ ), unemployed status ( $\beta=0.06$ ,  $P=0.049$ ), and trauma burden ( $\beta=0.08$ ,  $P=0.018$ ) also significantly associated with sleep disturbance, and only unemployed status ( $\beta=-0.11$ ,  $P=0.001$ ) and years between the worst/most distressing SCAD event and registry enrollment ( $\beta=0.14$ ,  $P<0.001$ ) also significantly associated with disease-specific health status. Furthermore, when excluding the sleep-related symptoms of PTSD from the total symptom severity score in a sensitivity analysis, past-month SCAD-induced PTSD symptoms remained significantly positively associated with sleep disturbance, albeit with a slightly attenuated effect size ( $\beta=0.34$ ,  $P<0.001$ ).

## DISCUSSION

In the largest study of SCAD-induced PTSD conducted to date, with >800 patients from a multisite registry, we demonstrated that developing PTSD symptoms in response to a SCAD event is common, with nearly

35% of patients meeting criteria for probable SCAD-induced PTSD in their lifetime and 6.4% of the total sample meeting criteria for probable past-month PTSD. Furthermore, nearly half of patients who developed probable SCAD-induced PTSD reported never receiving trauma-related treatment, highlighting a notable treatment gap.

Probable SCAD-induced PTSD prevalence in this sample (34.7% for lifetime and 6.4% for past-month) was substantially higher than rates observed in the general population. Rates of lifetime PTSD in the United States are estimated at 6.1% to 8.3% overall among trauma-exposed individuals,<sup>25,26</sup> although women are approximately twice as likely to develop PTSD in their lifetime than men.<sup>26,27</sup> In addition, a large recent study of middle-aged and older women estimated lifetime and past-month prevalence of probable PTSD among trauma-exposed individuals, measured in the same way as we did here, at 10.5% and 1.5%, respectively.<sup>16</sup> Furthermore, the PTSD prevalence rates we observed in this sample of patients with SCAD are high even compared with PTSD induced by other cardiovascular events. For example, clinically significant symptoms of PTSD have been observed in ≈12% of patients after acute coronary syndrome,<sup>28</sup> 25% of patients after stroke or transient ischemic attack,<sup>29</sup> and 32% of patients after cardiac arrest.<sup>30</sup> However, much of the literature on PTSD induced by cardiovascular events has examined rates of elevated PTSD symptoms rather than applying the *DSM-5* PTSD diagnostic criteria, as we did here. Additionally, our sample was predominantly women, which contrasts with much cardiovascular research in which women have traditionally been underrepresented.<sup>31</sup> Moreover, research examining lifetime, in addition to past-month, symptoms of PTSD triggered by cardiovascular events has been lacking. Research on SCAD-induced PTSD to date has only examined current PTSD symptoms, with 1 large study estimating probable PTSD based on an elevated symptom score cutoff in 7.8% of the sample.<sup>6</sup> Together, our findings highlight that symptoms of PTSD after SCAD that align with the diagnostic criteria for the disorder may occur in >1 in 3 patients at some point after their SCAD event, pointing to the need for greater awareness of this particular mental health consequence of SCAD among treatment providers.

Rates of lifetime trauma exposure (beyond the SCAD event that patients experienced) were also high, with 65% reporting at least 1 other traumatic event. Although this finding is not unique, with the vast majority of individuals (50%–89%) experiencing a traumatic event during their lifetimes,<sup>25–27,32</sup> the rates of exposure to certain trauma types were notable. In particular, over one-third of patients had experienced some form of interpersonal or sexual violence in their lifetime. Although

high rates of trauma exposure in patients presenting with cardiovascular events have been noted,<sup>33</sup> these findings in patients with SCAD suggest that an appreciation of prior traumatic experiences may serve patients in their interactions with health care providers. Further research is needed to determine whether incorporating elements of trauma-informed care into cardiology clinical settings may be beneficial for patients.<sup>34</sup>

Over a third of patients who experienced some symptoms of PTSD in response to their SCAD event indicated seeking treatment for this distress, with rates highest among those with probable past-month PTSD (65.5%) and lifetime (but not past-month) probable PTSD (51.4%). Patients receiving treatment most often interacted with psychologists or social workers, followed by their primary care physician, and psychotherapy was generally received more often than pharmacotherapy. The extent to which patients consulted with their cardiovascular care providers on SCAD-induced PTSD symptoms was not assessed specifically, although only 3.5% of patients who reported treatment seeking specified interacting with a professional other than clergy, primary care physicians, psychologists or social workers, or psychiatrists. Because the patient–cardiovascular provider relationship can be a particularly salient one for patients with SCAD, exploring psychological treatment seeking and receipt in the context of this relationship is an important topic for future research with high clinical relevance. We also found that nearly half of patients with probable SCAD-induced PTSD in their lifetime reported never receiving trauma-related treatment. Lack of access to evidence-based mental health care is well established,<sup>35</sup> and our results mirror other research demonstrating that a sizeable proportion of individuals with PTSD do not get treatment, ranging from approximately one-third of middle-aged and older women with PTSD in the United States to half of individuals with PTSD in high-income countries.<sup>16,25</sup> Thus, it is of interest to examine whether efforts to connect patients who are struggling with PTSD symptoms after SCAD with mental health professionals can help to close this treatment gap. Because patients receive medical care by a cardiologist, and many of these patients are ultimately seen in specialized clinics with expertise in SCAD, offering mental health care through these treatment settings may be a promising avenue for engaging patients. Another notable finding is that nearly a quarter of patients whose SCAD-induced PTSD symptoms did not reach the level of a probable diagnosis reported seeking trauma-related treatment. This result suggests that even subthreshold symptoms of PTSD after SCAD may be associated with clinically meaningful distress or impairment, a finding that is echoed in the broader PTSD literature,<sup>36,37</sup> and may benefit from being addressed in treatment.

Several demographic and psychosocial correlates of SCAD-induced PTSD were identified in this large registry sample, including younger age (along with younger age at first SCAD), being a woman, single, or unemployed, fewer years between the worst/most distressing SCAD event and registry enrollment, greater cumulative lifetime trauma burden, and a history of anxiety or depression. Several of these factors (eg, younger age, being a woman, unemployment) have been linked to PTSD either in patients with SCAD<sup>6</sup> or in the broader PTSD literature.<sup>24</sup> In contrast, relatively few SCAD-related medical factors (eg, treatment strategy) were robustly related to manifestations of SCAD-induced PTSD, consistent with prior research in patients with SCAD.<sup>6</sup> Some,<sup>4,38</sup> but not all,<sup>6</sup> research in patients with cardiac events has found that undergoing percutaneous coronary intervention is associated with lower rates of psychological distress, including PTSD, but we did not observe differential associations between various treatments for the most recent SCAD event and PTSD. Longitudinal research that tracks SCAD-related psychological distress before and after receiving various treatments is needed to better understand how interventions may relate to emotional responses to SCAD. Additionally, of the various event presentations for the most recent SCAD event, only presenting with cardiac arrest was significantly associated with SCAD-induced PTSD. The percentage of participants with this presentation was highest among those with probable past-month SCAD-induced PTSD, which parallels findings of particularly high rates of PTSD symptoms in patients with cardiac arrest defined more broadly.<sup>30</sup> Together, these results suggest that cardiac arrest may be an important presentation with respect to PTSD risk.

We also observed links between SCAD-induced PTSD and relevant health behaviors. Probable past-month SCAD-induced PTSD was associated with greater rates of current smoking and sleep disturbance, though not alcohol use. The mean sleep disturbance score for this group of patients was nearly 1 SD above the mean of the US general population. In adjusted models, past-month SCAD-induced PTSD symptom severity was positively associated with past-week sleep disturbance, and it had the largest effect size by far of the various potential risk factors. Sleep disturbance is a hallmark symptom of PTSD that also has relevance for cardiovascular health,<sup>39</sup> and it is possible that SCAD-induced PTSD symptoms may contribute to sleep problems in this patient population. However, results were similar in a sensitivity analysis in which the PTSD-specific sleep items were excluded from the total symptom severity score, suggesting that broad manifestations of PTSD, and not just sleep-related symptoms, may have relevance for sleep patterns in patients with SCAD. Given the cross-sectional

nature of the study, it is not possible to determine the directionality of this association and whether there is a causal link; longitudinal research is needed to address these relations.

SCAD-induced PTSD symptoms were also associated with worse disease-specific health status in the past month, with mean disease-specific health status reflecting symptoms of chest pain, chest tightness, and angina, and related impairment decreasing monotonically with greater and more enduring manifestations of SCAD-induced PTSD symptoms. In models accounting for a range of risk factors, past-month PTSD symptom severity was negatively associated with past-month disease-specific health status. Furthermore, only 2 other characteristics were significantly associated with disease-specific health status (unemployed status and years between the worst and most-distressing SCAD event and registry enrollment), and SCAD-induced PTSD symptom severity had a substantially larger effect size. Longitudinal research is needed to assess whether SCAD-induced PTSD is an aspect of mental health in patients with SCAD that is particularly relevant for functional status and outcomes.

Several limitations of the current investigation merit acknowledgement. First, all data were collected as part of the iSCAD Registry baseline assessment and thus cannot address the causal or directional nature of associations. We look forward to harnessing the follow-up assessments administered in the iSCAD Registry to explore changes in SCAD-induced PTSD symptoms over time and in relation to treatment seeking and health outcomes. A longer follow-up window will also provide an opportunity to reassess rates of treatment seeking for SCAD-induced PTSD symptoms. Second, because our sample comprised patients participating in a multisite registry, our study is characterized by limitations such as selection bias, recall bias, and issues with misclassification and representativeness. Our sample was predominantly White, non-Hispanic or non-Latina women. Additional research in more diverse patient samples, as demonstrated in recent community-based cohorts,<sup>40,41</sup> is needed. Third, data were missing for some variables, and over a quarter of patients in the iSCAD Registry did not complete the baseline questionnaires that included the assessment of SCAD-induced PTSD. We also lacked information for patients who were approached for the iSCAD Registry but did not elect to participate. Nevertheless, patients who completed the PTSD questionnaire were similar to those in the full registry cohort, and our 74.3% response rate is higher than in other registry samples.<sup>6</sup> Fourth, we used a self-reported questionnaire to assess SCAD-induced PTSD symptoms and assign probable diagnostic status based on *DSM-5* symptom criteria, as in prior research.<sup>16</sup> Although this questionnaire is well validated,

can be used to assign provisional diagnoses of PTSD, and is more feasible for use in clinical settings,<sup>18,19</sup> research with gold-standard clinical interviews to determine full diagnostic criteria is needed. By focusing on assessing symptoms of SCAD-induced PTSD, we also were unable to determine whether patients had a history of PTSD symptoms that developed in response to other types of traumatic experiences as well. Despite these limitations, this largest study analyzing SCAD-induced PTSD conducted to date has several unique strengths, including (1) integrating patients from multiple clinics, (2) incorporating information from patients and provider site investigators, (3) assessing lifetime and past-month probable diagnoses of SCAD-induced PTSD, and (4) investigating associations between SCAD-induced PTSD and a range of health-relevant correlates.

## CONCLUSIONS

Our investigation of >800 patients with SCAD suggests that SCAD-induced PTSD symptoms are a common mental health consequence for these patients. Furthermore, these symptoms are linked to clinical characteristics that are relevant to the course of disease, including adverse health behaviors and disease-specific health status. Moreover, nearly half of patients who developed probable SCAD-induced PTSD reported never receiving trauma-related treatment. The high prevalence of SCAD-induced PTSD symptoms and this treatment gap are particularly notable given that a lack of mental health resources after SCAD is a leading concern for patients.<sup>12</sup> Efforts to support screening for PTSD symptoms after SCAD and connecting those patients experiencing distress postevent with empirically supported treatments are critical next steps.

## Patient Perspective

As a survivor who has journeyed through the challenges of SCAD, I am thankful for the ongoing research dedicated to understanding the intricate connection between SCAD and PTSD. I think it is incredibly important that those engaged in post-SCAD care recognize that the emotional aftermath of SCAD can be just as, if not more, stressful than the event itself. SCAD survivors require not only medical support but also emotional support to truly heal after facing SCAD.

As a patient diagnosed with a rare disease, it is important to acknowledge the additional emotional aspect that is required in the healing process. The diagnosis of a rare condition, where even medical professionals have limited information, increased my anxiety and uncertainty surrounding its cause and likelihood of recurrence. Although the initial heart attack

and hospitalization were emotionally challenging for me, the period following my discharge from the hospital proved even more challenging. The uncertainty took a toll on my emotional healing and perspective for my future health.

During my time in the hospital, although I experienced moments of anxiety, it was when I was discharged that my anxiety seemed to intensify. Losing the comforting presence of medical professionals and the reassuring presence of the machines that monitored my heart's every beat left me feeling vulnerable and uncertain about the path ahead.

I vividly recall the realization that, with SCAD, life could slip away in the blink of an eye, with no warning, no chance to seek help. Faced with this unsettling uncertainty and the gravity of SCAD's potential impact, adapting to a sense of "normalcy" was a challenge. With time, I found strength through cardiac rehabilitation, where I learned to trust my healing heart once more and the fearful moments gradually gave way to a newfound sense of confidence. The journey after my discharge was undeniably stressful, but it also carried the precious gift of a second chance at life.

It was not until the 1-year mark of my SCAD journey that I found myself grappling with PTSD. The moment arrived unexpectedly, as my spouse and I were leaving a restaurant. I glanced at my watch and realized it was the exact time we had dialed 911 a year earlier. Just then, an ambulance rushed past us, heading in the direction of my home, the same path it had taken that day. At that moment, I was overwhelmed with anxiety. Later that evening, as I lay in bed, the memories flooded back as I recalled the smell of the hospital sheets, the hospital machines beeping, and the profound fear that gripped me during my hospital stay. These recollections weighed heavily on my already anxious heart, and it became apparent that I needed help. I made an appointment with my cardiologist, as well as my physician, and was diagnosed with PTSD.

Twelve years have passed since my diagnosis of PTSD, and although my life has returned to normal, there are moments when my PTSD resurfaces. Whenever my heart flutters or the mere thought of something resembling the feeling of my SCAD experiences, anxiety instantaneously takes over me. External triggers, like appointments with physicians, the wailing sirens of ambulances, or the hospital environment, cause me to have anxiety. Even my annual cardiology appointment fills me with anxiety. The fear of discovering something awry and facing hospitalization looms over me. This anxiety extends to my visits to the primary doctor and dentist as well. These settings take me back to those moments of crippling fear and uncertainty.

PTSD is another aspect of SCAD that SCAD survivors are faced with. There is an urgent need for health

care providers to acknowledge its significance, diagnose it, and provide the necessary care. Survivors bear the weight of this emotional battle alongside their physical struggles, and it is important that it is addressed with compassion and understanding.

I am so thankful for the compassion and empathy displayed by my medical team. They understood that my journey was not just about the physical toll on my body; it encompassed the emotional turbulence I was navigating as well. Their holistic approach, addressing not only my physical needs but also my emotional and mental well-being, played a crucial role in my journey to heal from SCAD.

## ARTICLE INFORMATION

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## Supplemental Material

Data S1

Table S1

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