

ORIGINAL RESEARCH

Analysis of Posttraumatic Stress Disorder, Depression, Anxiety, and Resiliency Within the Unique Population of Spontaneous Coronary Artery Dissection Survivors

Alexis K. Johnson, BS; Sharonne N. Hayes, MD; Craig Sawchuk, PhD, LP; Matthew P. Johnson, MS; Patricia J. Best, MD; Rajiv Gulati, MD, PhD; Marysia S. Tweet, MD

BACKGROUND: Mental health after spontaneous coronary artery dissection (SCAD), a cause of myocardial infarction in young women, remains largely unexplored. We assessed the prevalence and severity of psychiatric symptoms after SCAD.

METHODS AND RESULTS: Individuals with confirmed SCAD who consented to the Mayo Clinic "Virtual" Multicenter SCAD Registry were sent the Posttraumatic Stress Disorder Diagnostic Scale for *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*, Patient Health Questionnaire-9, Generalized Anxiety Disorder-7, Anxiety Sensitivity Index, Connor-Davidson Resilience Scale, 36-Item Short-Form Health Survey, and an SCAD-specific questionnaire. Among 782 patients contacted, 512 surveys were returned. Most respondents were women (97.5%), with median age at time of SCAD and survey completion of 47 and 52 years, respectively. Eighty-two percent had at least one trauma, with mild or more posttraumatic stress disorder symptoms in 28%. Symptoms of anxiety and depression were observed in 41% and 32%, respectively. On multivariable analysis, those of younger age at first SCAD and low resiliency scored higher on measures of trauma, anxiety, and depression. Those with higher anxiety sensitivity had more severe anxiety and posttraumatic stress disorder symptoms. Emotional and social quality of life was higher in those with high resiliency scores. Time from SCAD event to survey completion was associated with lower Generalized Anxiety Disorder-7 score severity.

CONCLUSIONS: Survivors of SCAD have significant rates of posttraumatic stress disorder, depression, and anxiety, which are associated with lower quality of life specifically among those with lower resiliency. Given the prevalence and potential impact, screening and treatment for the psychological distress is advised. Behavioral interventions targeted toward resiliency training may be beneficial for this patient population.

Key Words: acute coronary syndromes ■ anxiety ■ depression ■ myocardial infarction ■ posttraumatic stress disorder ■ spontaneous coronary artery dissection ■ women

Posttraumatic stress disorder (PTSD), depression, and anxiety are common after myocardial infarction (MI), especially among young women; however, the effects of these conditions on quality of life and outcomes after MI are poorly understood.¹⁻³ Spontaneous coronary artery dissection (SCAD)

resulting in MI disproportionately affects young women with few traditional cardiovascular risk factors.^{4,5} SCAD represents ≈35% of acute coronary syndrome in women aged <50 years, occurring, on average, between the aged of 42 and 50 years.^{6,7} Although any MI can be life altering, SCAD may be particularly impactful

Correspondence to: Marysia S. Tweet, MD, Department of Cardiovascular Diseases, Mayo Clinic College of Medicine, 200 First St SW, Rochester, MN 55905. E-mail: tweet.marysia@mayo.edu

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CLINICAL PERSPECTIVE

What Is New?

- Posttraumatic stress disorder (PTSD), depression, and anxiety symptoms are prevalent among those who have experienced spontaneous coronary artery dissection (SCAD).
- PTSD, depression, and anxiety symptom severity levels were worse in those who were younger at time of SCAD; and PTSD Diagnostic Scale for *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*, and Patient Health Questionnaire-9 survey scores were independent of time from event, indicating a need to screen for these conditions even years after SCAD.
- Generalized Anxiety Disorder-7 scores were more likely lower in those completing the survey with a longer time from event, suggesting that symptoms of anxiety may decrease over time.

What Are the Clinical Implications?

- Screening and treatment for psychological stress, including PTSD, depression, and anxiety, in patients after SCAD is advised.
- Participants with higher resiliency scores had better emotional and social quality of life and less severe psychological symptoms of PTSD, anxiety, and depression, suggesting that behavioral interventions targeted toward resiliency training may be beneficial in those who have experienced SCAD.
- More severe anxiety and PTSD symptoms were associated with higher anxiety sensitivity for physical, cognitive, and social concerns, indicating that anxiety sensitivity should be considered when formulating behavioral interventions.

Nonstandard Abbreviations and Acronyms

ASI	Anxiety Sensitivity Index
CD-RISC	Connor-Davidson Resilience Scale
GAD-7	Generalized Anxiety Disorder-7
PDS-5	The PTSD Diagnostic Scale for Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
PHQ-9	Patient Health Questionnaire-9
SCAD	Spontaneous coronary artery dissection
SF-36	36-Item Short-Form Health Survey
UA	Unstable angina

from a mental health perspective. SCAD tends to affect younger individuals with no known cardiovascular risks and is a condition for which there is uncertainty

about the diagnosis and management, a substantial risk for recurrence, and no proven secondary prevention. All these may contribute to a higher mental and emotional impact, warranting further investigation into potential psychological sequelae.

PTSD is more common among survivors of MI than the general public.^{8,9} The prevalence of PTSD is as high as 15% among MI survivors and has been associated with increased mortality, recurrent cardiac events, and decreased quality of life.^{10–13} Some studies suggest that PTSD symptoms are more common among women than men after MI.^{14,15} This might indicate that the predominantly female SCAD population is at increased risk for experiencing PTSD. Although rates of PTSD are higher among survivors of atherosclerotic MI relative to the general public, the prevalence of PTSD has yet to be quantified in the SCAD population.

Similar to PTSD, depression and anxiety are common among all survivors of MI, but especially in young women.^{16,17} Among those diagnosed with depression, there is a significant increase in all-cause mortality, cardiac-related mortality, and MI recurrence.^{11,16} Depression and anxiety have been previously investigated, with findings of increased symptoms of depression and anxiety particularly among those who experienced peripartum SCAD and in younger SCAD patients.¹⁸ Interestingly, the symptom severity of depression and anxiety was lower in those patients who received percutaneous coronary intervention versus less invasive medical management.¹⁹ Given the increased risk for depression and anxiety among SCAD survivors, further investigation into the prevalence of depression and anxiety and the factors associated with these symptoms is particularly important in the follow-up care of SCAD survivors.

SCAD survivors' reaction to the physical, emotional, and cognitive symptoms of anxiety may perpetuate the severity of psychological distress. Anxiety sensitivity is a trait-like phenomenon in which individuals are likely to misinterpret unusual sensations of anxiety as being dangerous. Anxiety sensitivity is a measurable factor that has been shown to be associated with panic disorder and PTSD.²⁰ Symptoms of anxiety may mimic those of an MI, which may factor into psychological symptom severity among SCAD survivors. Understanding the impact of these contributing factors may have implications for designing treatment plans that include evidence-based psychological interventions for anxiety-related disorders.

Resilience, defined by Schetter and Dolbier as the “the process involving an ability to withstand and cope with ongoing or repeated demands and maintain healthy functioning in different domains of life,” has been studied in several populations, including those with life-threatening medical conditions.^{21,22} These studies have demonstrated that individuals with the ability to adapt to

adverse conditions, including acute trauma and medical illness, have lower rates of PTSD, depression, and anxiety.^{21,23} As such, resiliency is now recognized as a potential target for therapy among those who have experienced adversity. Assessing resiliency in the SCAD population and its association with psychological illness may provide an additional avenue for recognizing those who may be at particular risk for adverse outcomes. Likewise, interventions for SCAD survivors may benefit from the addition of resiliency-enhancing skills.

The purpose of this exploratory study is to describe self-reported symptoms of PTSD, depression, and anxiety in a large-scale sample of individuals who have a history of SCAD. We also assessed self-reported resilience and quality of life, the impact of baseline characteristics and variables, and the impact of various SCAD treatment modalities.

METHODS

Subjects

This study was approved by the Mayo Clinic Institutional Review Board, and subjects were those who consented to the Mayo Clinic “Virtual” Multicenter SCAD Registry. The data, analytic methods, and study materials will not be made available to other researchers for the purpose of reproducing the results or replicating the procedure. This registry contains extensive clinical, imaging, and survey data from >1000 patients with angiographically confirmed SCAD. The registry includes prospective patient information, as described elsewhere.²⁴

Survey Instruments

The PTSD Diagnostic Scale for *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (PDS-5), Patient Health Questionnaire-9 (PHQ-9), and Generalized Anxiety Disorder-7 (GAD-7) were used as instruments to measure PTSD, depression, and anxiety, respectively.^{25–27} The Anxiety Sensitivity Index (ASI-3) measures the fear and worry induced by physical sensations of anxiety or arousal and is associated with several psychological disorders.^{20,28} We examined the full-scale score of the ASI-3, as well as the subscale scores of concerns over physical, social, and cognitive domains of anxiety. For comparison purposes, one study that analyzed the validity of the ASI-3 showed a total ASI score of 13.8 (± 10.8) in a control group of college students, with subscores of 3.6 (± 4.1), 2.7 (± 4.0), and 7.6 (± 4.8) for physical, social, and cognitive concerns, respectively.²⁰ The Connor-Davidson Resilience Scale (CD-RISC) is a validated tool used to assess ability to cope with stress. The mean CD-RISC scores in the US general population, psychiatric outpatient population, and generalized

anxiety population are shown to be 80.7, 68.0, and 62.4, respectively.²⁹ Two PTSD sample populations showed CD-RISC scores of 47.8 and 52.8.²⁹ The 36-Item Short-Form Health Survey questionnaire was used to measure quality of life.³⁰ Appropriate permissions were obtained for the CD-RISC and PDS-5 surveys. An accompanying SCAD-specific questionnaire was included to collect updated demographic, medical, psychosocial, and family history data as well as experiences related to PTSD, depression, and anxiety.

Data Collection

An online survey database was created using the Research Electronic Data Capture system, allowing for real-time data collection.³¹ Data collection occurred from December 2017 through December 2018. Individuals who had confirmed SCAD and completed initial registry consent were sent an invitation to complete the aforementioned survey instruments via e-mail. Individuals who did not have an e-mail address were sent paper copies of the surveys, the results of which were manually entered into the Research Electronic Data Capture system database. Patients were able to opt for either the online survey or the mail-in survey on the basis of personal preference. The date at which the patient received a diagnosis of his/her first SCAD was used to define “time of SCAD” for each subject.

Statistical Analysis

Statistical analysis consisted of descriptive statistics, which included frequency and median severity of psychological illness within the population, as defined by the instruments. Spearman correlation coefficients were calculated between resiliency and PTSD, resiliency and depression, resiliency and anxiety, and resiliency and quality-of-life survey scores. Correlation coefficients were also calculated between quality of life (36-Item Short-Form Health Survey score) and PTSD, depression, and anxiety scores. Continuous data, including mean survey scores between groups who had received invasive versus noninvasive treatment, were compared using a 2-sample *t* test. Discrete variables were expressed as frequencies or percentages, and comparisons were performed by χ^2 test or, in the case of the ASI results, ANOVA analysis with Tukey’s honestly significantly different post hoc test. A 2-sided value of $P < 0.05$ was considered statistically significant. The relationship between each survey score (PDS-5, GAD-7, and PHQ-9) and several independent variables (sex, postpartum status, age at first SCAD event, time from first SCAD event, treatment strategy, presentation type, and CD-RISC score) was analyzed with multivariable negative binomial regression. This regression technique was chosen because the results of each survey score

closely resembled a Poisson distribution, with most patients having low scores and fewer having higher scores. Multivariable linear regression models were examined initially and produced nonnormal residuals.³² Statistical analysis was performed using JMP Pro, version 14.1.0, and SAS statistical software, version 9.4 (SAS Institute, Inc, Cary, NC).

RESULTS

Demographics

Of the 782 patients who were sent the survey packet (670 via e-mail and 112 via post), 512 patient surveys were returned, yielding a 65.9% response rate (67% and 41% response rate for e-mail and post,

Table 1. Demographics

Variable	Value (n=512)
Age at time of event, median (IQR), y	47 (41–54)
Age at time of survey, median (IQR), y	52 (46–59)
Elapsed time between event and survey, median (IQR), d	1565 (894–2584)
Sex, n (%)	
Women	499 (97.5)
Men	13 (2.5)
Race, n (%)	
White	473 (92.2)
Black	8 (1.6)
Hispanic	5 (1.0)
Asian	3 (0.6)
Asian-white	3 (0.6)
Hispanic-white	2 (0.4)
American Indian-white	1 (0.2)
Hispanic-Northern African-French	1 (0.2)
Native American	1 (0.2)
Native American-white	1 (0.2)
Polynesian/Puerto Rican	1 (0.2)
Comorbidities at time of event, n (%)	
Hypertension	159 (31.0)
Hyperlipidemia	165 (32.2)
Diabetes mellitus	14 (2.7)
Migraines	164 (32.0)
Hypothyroid	65 (12.7)
Hyperthyroid	12 (2.3)
Fibromuscular dysplasia	186 (36.3)
Postpartum	56 (11.2)
Early postpartum (within 0–3 mo of event)	44 (8.8)
Late postpartum (within 3–12 mo of event)	12 (2.4)
Implantable defibrillator at time of survey	24 (4.7)
Body mass index at time of event, median (IQR), kg/m ²	24 (22–28)

IQR indicates interquartile range.

Table 2. Event Classification and Treatment Strategy at Time of Acute SCAD

Variable	Value, n (%)
Event classification	
UA/NSTEMI	268 (55.1)
STEMI	166 (34.2)
Cardiac arrest	52 (10.7)
SCAD intervention (first event)	
Medical therapy only	265 (51.8)
Thrombolytics*	33 (6.4)
PCI	200 (39.1)
CABG	40 (7.8)

CABG indicates coronary artery bypass grafting; NSTEMI, non-STEMI; PCI, percutaneous coronary intervention; SCAD, spontaneous coronary artery dissection; STEMI, ST-segment-elevation myocardial infarction; and UA, unstable angina.

*Those who received thrombolytics were included in the “medical therapy only” group for statistical analysis purposes.

respectively). Of these patients, 442 completed all surveys, whereas the others were partial responders. Of note, 15.8% of responders had experienced >1 SCAD event. Table 1 contains baseline demographic data.

Of note, 27.9% of patients did not receive a diagnosis of SCAD at the time of their MI and were diagnosed subsequently on clinical or angiographic review, and 14.3% were dismissed after reporting to the emergency department with SCAD symptoms, having to seek medical attention elsewhere to receive a diagnosis. Data about treatment received for the initial SCAD event, as well

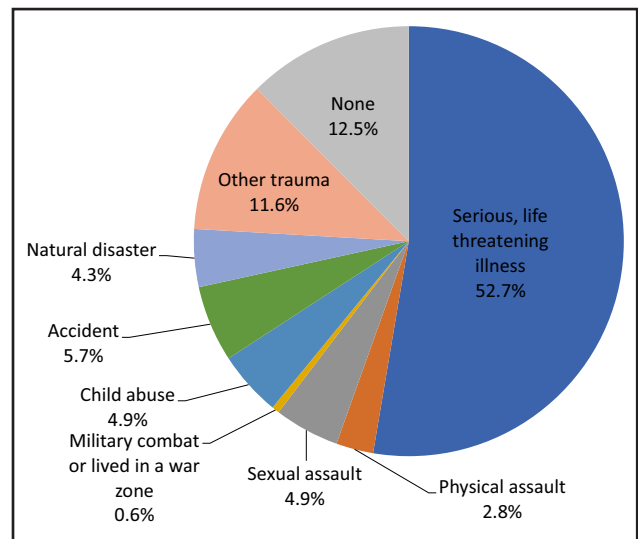


Figure 1. The distribution of all traumatic events experienced by individuals who completed the screening portion of the Posttraumatic Stress Disorder Diagnostic Scale for Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (n=714).

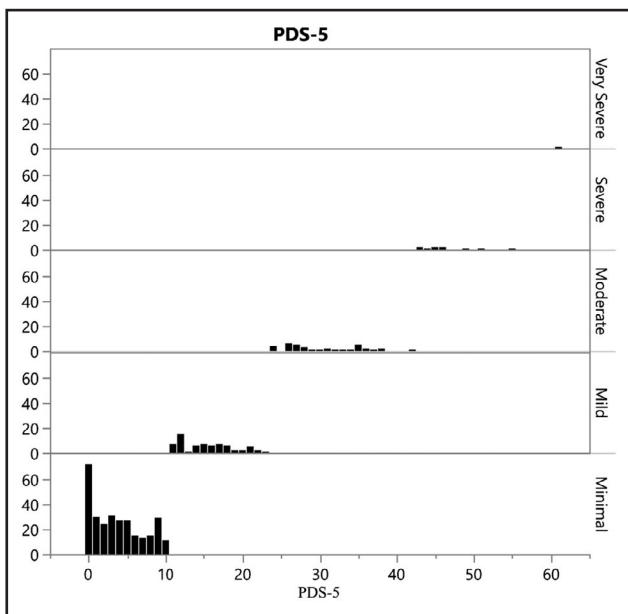


Figure 2. Posttraumatic stress disorder (PTSD) symptom severity distribution based on PTSD Diagnostic Scale for Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (PDS-5) survey responses (n=408). Severity is defined by the survey scoring system, with <11 being minimal, 11 to 23 being mild, 24 to 42 being moderate, 43 to 59 being severe, and >59 being very severe.

as whether the event presented as unstable angina/non-ST-segment-elevation MI (NSTEMI), ST-segment-elevation MI (STEMI), or cardiac arrest, are included in Table 2.

Posttraumatic Stress Disorder

Of the 512 patients who completed the PDS-5, 82.0% (n=425) had experienced at least one type of trauma. The average number of lifetime traumas among this

Table 3. Coefficients for the Negative Binomial Regression Model for Prediction of PDS-5 Score

Term	Estimate	P Value
Sex (women=1, men=0)	1.16	0.033*
Postpartum/peripartum (0=no, 1=yes)	0.01	0.965
Age at first SCAD event	-0.02	0.025*
Time from first SCAD event	-0.001	0.288
Treatment strategy (0=medical, 1=invasive)*	0.03	0.800
Presentation type (0=UA, 1=NSTEMI, 2=STEMI, 3=cardiac arrest)*	0.12	0.801
CD-RISC Score	-0.03	<0.001*

CD-RISC indicates Connor-Davidson Resilience Scale; NSTEMI, non-STEMI; PDS-5, Posttraumatic Stress Disorder Diagnostic Scale for Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition; SCAD, spontaneous coronary artery dissection; STEMI, ST-segment-elevation myocardial infarction; and UA, unstable angina.

*P<0.05.

82% was 1.47 events. The distribution of types of trauma experienced is shown in Figure 1. “Serious, life-threatening illness (heart attack, etc)” was the most frequently endorsed event, comprising 53% of the total traumatic events experienced; 74% of patients who had screened positive for having experienced trauma marked serious, life threatening illness (heart attack, etc) as the incident that bothers them most or as the only incident indicated.

Symptom severity distribution was assessed using the scoring system of each separate survey to define “symptom severity” for each psychological illness (Figure 2). PTSD severity was not measured if “none” was reported on the PDS-5 trauma screen. Probable diagnosis, as defined by the PDS-5 manual to be a score >27, was present in 7.8% of participants.

At least mild PTSD symptoms (as defined by a PDS-5 score of 11–23) were observed in 119 (28%) of those who screened positive for having experienced trauma (n=425). Among this group of 119, ~95% reported these difficulties to be bothersome at least once a week, and 86.0% reported that the difficulties interfered with everyday life at least once a week.

A multivariable negative binomial regression model was calculated to predict PDS-5 score on the basis of sex, postpartum status within 12 months of event, age at time of event, time of survey from event, treatment strategy, event presentation (unstable angina, STEMI, or NSTEMI), CD-RISC score, and treatment strategy at time of acute SCAD. Model coefficients are shown in Table 3. These data show that sex, age at first SCAD, and CD-RISC score all likely impacted PDS-5 score severity, with women, those who are younger, and

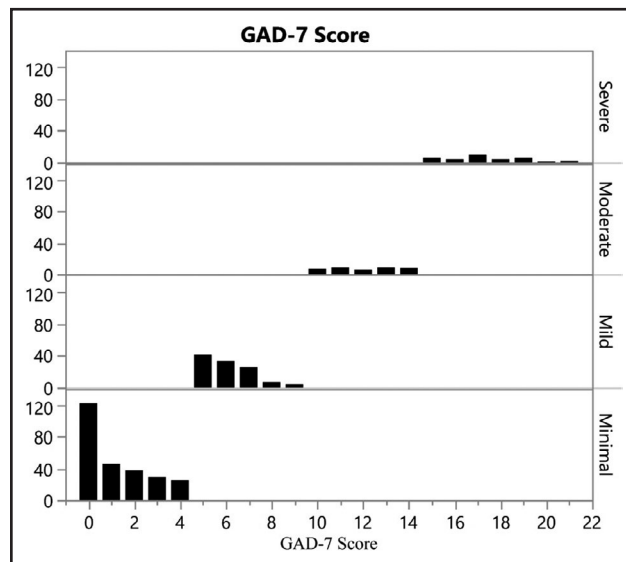


Figure 3. Anxiety symptom severity based on the Generalized Anxiety Disorder-7 (GAD-7) responses, with <5 being minimal, 5 to 9 being mild, 10 to 14 being moderate, and >14 being severe (n=435).

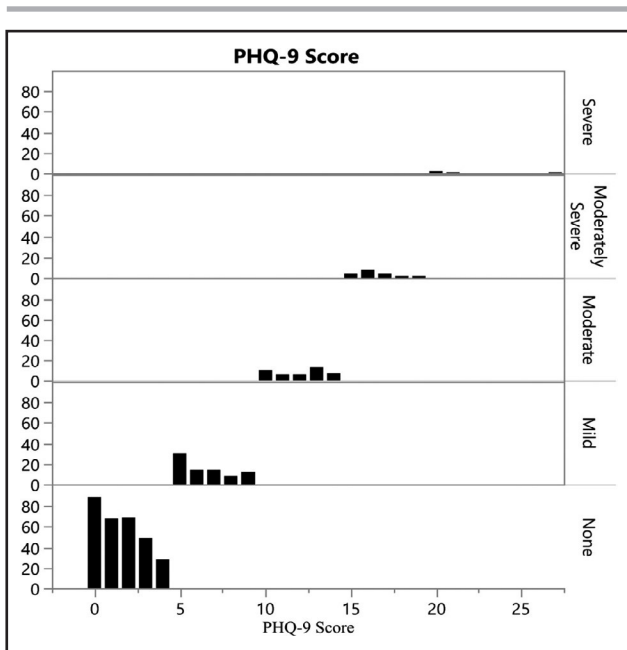


Figure 4. Depression symptom severity based on Patient Health Questionnaire-9 (PHQ-9) responses, with <5 being minimal, 5 to 9 being mild, 10 to 14 being moderate, 15 to 19 being moderately severe, and >19 being severe (n=447).

those who showed lower resiliency more likely to have higher PDS-5 scores.

Anxiety and Depression

For both the GAD-7 and PHQ-9, a score >9 is suggestive of a moderate level of symptom severity, and may indicate a likely diagnosis of an anxiety disorder or major depressive disorder, respectively. Our results showed that 16% had a score >9 for the GAD-7, and 15% of patients had a score >9 for the PHQ-9. At least mild symptom severity (ie, scores between 5 and 9) were observed in 41% and 32% of patients surveyed

Table 4. Coefficients for the Negative Binomial Regression Model for Prediction of GAD-7 Score

Term	Estimate	P Value
Sex (women=1, men=0)	1.10	0.016*
Postpartum/peripartum	-0.08	0.694
Age at first SCAD event	-0.03	0.001*
Time from first SCAD event	-0.002	0.038*
Treatment strategy (0=medical, 1=invasive)	-0.04	0.721
Presentation type (0=UA, 1=NSTEMI, 2=STEMI, 3=cardiac arrest)	-0.03	0.983
CD-RISC Score	-0.40	<0.001*

CD-RISC indicates Connor-Davidson Resilience Scale; GAD-7, Generalized Anxiety Disorder-7; NSTEMI, non-STEMI; SCAD, spontaneous coronary artery dissection; STEMI, ST-segment-elevation myocardial infarction; and UA, unstable angina.

*P<0.05.

for anxiety and depression, respectively. Of those who scored within the mild range or higher on the GAD-7 and PHQ-9, 66.9% and 72.6% reported symptoms to be at least somewhat difficult, respectively. The distribution of symptom severity for anxiety and depression is shown in Figures 3 and 4.

A multivariable negative binomial regression model was calculated to predict GAD-7 score on the basis of sex, postpartum status within 12 months of event, age at time of event, time of survey from event, treatment strategy, event presentation (unstable angina, STEMI, or NSTEMI), CD-RISC score, and treatment strategy at time of acute SCAD. Model coefficients are shown in Table 4. These data show that sex, age at first SCAD, time from first SCAD event, and CD-RISC score all likely impacted GAD-7 score severity, with women, those who are younger, those who showed lower resiliency, and those with a shorter time from event likely to have higher GAD-7 scores.

A multivariable negative binomial regression model was calculated to predict PHQ-9 score on the basis of sex, postpartum status within 12 months of event, age at time of event, time of survey from event, treatment strategy, event presentation (unstable angina, STEMI, or NSTEMI), CD-RISC score, and treatment strategy at time of acute SCAD. Model coefficients are shown in Table 5. Like the model for the GAD-7, these data show that age at first SCAD and CD-RISC score both likely impacted PHQ-9 score severity, with younger and less resilient individuals likely to have higher PHQ-9 scores.

Anxiety Sensitivity

Among all respondents (n=445), the average ASI total score was 16 (±13), with average subscores for physical, cognitive, and social concerns of 7 (±5), 3 (±5), and 5 (±5), respectively. ANOVA analysis with Tukey's honestly significantly different post hoc test showed significant differences between all 3

Table 5. Coefficients for the Negative Binomial Regression Model for Prediction of PHQ-9 Score

Term	Estimate	P Value
Sex (women=1, men=0)	0.61	0.089
Postpartum/peripartum	0.03	0.832
Age at first SCAD event	-0.02	0.002*
Time from first SCAD event	-0.001	0.242
Treatment strategy (0=medical, 1=invasive)	-0.08	0.427
Presentation type (0=UA, 1=NSTEMI, 2=STEMI, 3=cardiac arrest)	-0.08	0.755
CD-RISC Score	-0.04	<0.001*

CD-RISC indicates Connor-Davidson Resilience Scale; NSTEMI, non-STEMI; PHQ-9, Patient Health Questionnaire-9; SCAD, spontaneous coronary artery dissection; STEMI, ST-segment-elevation myocardial infarction; and UA, unstable angina.

*P<0.05.

Table 6. CD-RISC Correlation With PDS-5, GAD-7, and PHQ-9 Scores

Variable	CD-RISC	
	Correlation	P Value
PDS-5	-0.40	<0.0001
GAD-7	-0.47	<0.0001
PHQ-9	-0.50	<0.0001

CD-RISC indicates Connor-Davidson Resilience Scale; GAD-7, Generalized Anxiety Disorder-7; PDS-5, Posttraumatic Stress Disorder Diagnostic Scale for *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*; and PHQ-9, Patient Health Questionnaire-9.

subscores. The correlation between ASI subscores and GAD-7 scores showed that those experiencing more severe anxiety symptoms had higher anxiety sensitivity for physical, cognitive, and social concerns ($R=0.58$, $R=0.62$, and $R=0.54$, respectively

Table 7. SF-36 Subscore Correlations With Self-Reported Measures of PTSD, Anxiety, Depression, and Resilience

Variable	PDS-5	GAD-7	PHQ-9	CD-RISC
Physical functioning				
Correlation	-0.14	-0.10	-0.16	0.13
P value	0.01	0.05	0.003	0.01
Role limitations caused by physical health				
Correlation	-0.17	-0.15	-0.02	0.13
P value	0.001	0.004	0.0002	0.02
Role limitations caused by emotional problems				
Correlation	-0.29	-0.45	-0.50	0.34
P value	<0.0001	<0.0001	<0.0001	<0.0001
Energy/fatigue				
Correlation	-0.24	-0.37	-0.46	0.34
P value	<0.0001	<0.0001	<0.0001	<0.0001
Emotional well-being				
Correlation	-0.38	-0.58	-0.58	0.55
P value	<0.0001	<0.0001	<0.0001	<0.0001
Social functioning				
Correlation	-0.39	-0.44	-0.50	0.34
P value	<0.0001	<0.0001	<0.0001	<0.0001
Pain				
Correlation	-0.11	-0.20	-0.21	0.13
P value	0.03	0.0001	<0.0001	0.02
General health				
Correlation	-0.26	-0.29	-0.32	0.28
P value	<0.0001	<0.0001	<0.0001	<0.0001
Health change				
Correlation	-0.02	-0.04	0.004	0.05
P value	0.66	0.49	0.94	0.35

CD-RISC indicates Connor-Davidson Resilience Scale; GAD-7, Generalized Anxiety Disorder-7; PDS-5, PTSD Diagnostic Scale for *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*; PHQ-9, Patient Health Questionnaire-9; PTSD, posttraumatic stress disorder; and SF-36, 36-Item Short-Form Health Survey.

Table 8. Self-Reported Data on Impact, Diagnosis, and Treatment of Psychological Illness

Variable	Struggled With Illness to the Point It Affected Their Lives, %		Told by a Physician They Had the Diagnosis, %		Prescribed Medication or Received Counseling, %	
	Yes	Unsure	Yes	Unsure	Yes	Unsure
PTSD	12.5	5.6	12.4	2.6	10.4	2.0
Anxiety	22.6	2.6	20.0	2.4	34.9	1.6
Depression	20.0	3.4	18.5	1.2	29.1	1.6

PTSD indicates posttraumatic stress disorder.

[$P<0.0001$]). Correlation between ASI and PDS-5 scores showed that those with more severe PTSD symptoms also had increased anxiety sensitivity for physical, cognitive, and social concerns ($R=0.52$, $R=0.47$, and $R=0.41$, respectively [$P<0.0001$]).

Resiliency

Median CD-RISC scores were 78 (interquartile range, 67–86). Those patients who were more resilient according to the CD-RISC scale had lower scores on measures of PTSD, anxiety, and depression symptom severity. These data are summarized in Table 6.

Quality of Life

The 36-Item Short-Form Health Survey subscores were correlated with PDS-5, GAD-7, PHQ-9, and CD-RISC scores. Those with more severe psychological symptoms, particularly symptoms of depression and anxiety, report lower emotional and social quality of life. Those who scored higher on the resiliency scale had better emotional and social quality of life. The data are summarized in Table 7.

The survey also included questions about the effect of PTSD, anxiety, and depression on participants' lives, whether they had ever been told by a physician they had any of these diagnoses, and whether they had been treated with medications or counseling. There were substantial differences between the rates of those who reported that they had received treatment compared with those who had been diagnosed each condition. Quantification of these survey answers is shown in Table 8.

DISCUSSION

Insights from the mental health assessments in this large cohort study of patients with confirmed SCAD demonstrate the following: SCAD is considered to be traumatic by participants and may contribute to PTSD-related symptoms; there is significant prevalence of depression and anxiety symptoms among those who

have experienced SCAD; women, in particular, were more likely to have more severe PTSD and anxiety symptoms; and more severe symptoms of PTSD, depression, and anxiety are associated with a lower emotional and social quality of life. PTSD, depression, and anxiety symptom severity was worse in those who were younger at time of SCAD, and PDS-5 and PHQ-9 survey scores were independent of time from event, indicating a need to screen for these conditions even years after SCAD. Of note, GAD-7 scores were more likely to be lower in those with a longer time from event, suggesting that symptoms of anxiety may decrease over time. In addition, those with more severe symptoms had lower resiliency scores, whereas those with higher resiliency scores had better emotional and social quality of life. This suggests that resiliency may be an important therapeutic target in psychological symptom management.

SCAD is considered a traumatic event by most (82%) of those who experience it and may be the only or most impactful trauma in up to 74%. Several studies performed in the United States have shown lifetime exposure to any kind of trauma to be between 39.1% and 89.6%, with the prevalence of diagnosed PTSD to be 7.1% to 9.2%.¹⁵ These studies have shown that although trauma exposure is higher in men, PTSD prevalence is higher in women.³³ Numerous factors seem to play a role in this difference, including type of trauma (eg, PTSD is increased in those who have experienced sexual assault, most commonly women) and preexisting mental disorders.¹⁵ Among MI survivors in general, the prevalence of PTSD ranges widely in the literature (0%–32%). Multiple meta-analyses have shown, however, that prevalence is likely to be ≈12% to 15%, with variation dependent on the methods by which each study measured PTSD.³⁴ For example, those studies using screening questionnaires showed higher PTSD prevalence rates than those using diagnostic clinical interviews.^{12,35} Within our population, the presence of self-reported PTSD, as defined by the diagnostic cutoff score of 27, according to the PDS-5, is comparable to that of the general population (8.5%). Over 95% of patients found their symptoms of PTSD to be bothersome on a regular basis, with at least 86% finding their symptoms to be bothersome at least once weekly. There has been debate on the true risk of PTSD after MI as well as discussion on the potential negative impact of labeling patients having experienced MI as being at an increased risk for PTSD.³⁶ Although an important consideration, there may arguably be more clinical risk to missing a diagnosis of PTSD based on observed impact on health outcomes.^{10–13} Our data indicate that PTSD should be assessed and addressed appropriately within this population, even for those who indicate only mild symptom severity.

Like PTSD, higher rates of depression and anxiety have been observed in patients with MI. Our data

showed a similar prevalence of depression (12.5%) and depressive symptoms (32%) among SCAD survivors when compared with other MI populations reported in the literature.³⁷ With the expansion of the number of patients within the Mayo Clinic SCAD Registry, this prevalence was even higher compared with our previous study (15% versus 8%). Symptoms of both anxiety and depression are common among those who have experienced SCAD, especially among younger people. Over 41% reported at least mild symptoms, with 97% of those individuals being more than a year beyond their SCAD. Participants overall indicated on both surveys that these symptoms have a significant impact on their daily lives, particularly depressive symptoms. This indicates that longitudinal follow-up of psychological health should be considered, even years after SCAD occurrence. It is also important to highlight that symptoms of major depressive disorder had the strongest correlations for all 36-Item Short-Form Health Survey quality-of-life subsections.

Patients in our study with higher CD-RISC resiliency scores had less severe psychological symptoms of PTSD, anxiety, and depression. This supports resiliency as a reasonable therapeutic target when addressing such symptoms in this population. Medical and cognitive behavioral therapies have been shown to affect CD-RISC scores among populations with PTSD, anxiety, and depression.^{38,39} Although this supports the necessity for increased use of such interventions in this population when possible, there are limitations to providing these kinds of treatments, including access to both medications and counselors who have expertise in providing cognitive-behavioral therapy. Online programs are a potential solution to improving the ease and timeliness of patient access to important intervention. Certain online resiliency programs have been piloted in numerous populations, including women with cardiovascular disease, and have shown some benefit.^{40,41} Cardiac rehabilitation has also shown to be beneficial in SCAD patients, particularly self-reported physical and emotional benefit.¹⁸ Development of novel interventions, such as online resiliency training, could be considered and, if found effective, could be scaled or included as part of cardiac rehabilitation.

We hypothesized that individuals who had experienced SCAD would have increased fear that physical symptoms of anxiety might represent recurrent SCAD. Anxiety sensitivity, or the fear of the consequences of “arousal-related sensations,” generally amplifies existing symptoms of anxiety.⁴² The ASI-3 is a screening tool that measures anxiety sensitivity, with higher scores indicating increased anxiety sensitivity. As was expected, in our study, those with higher ASI-3 subscores had higher GAD-7 and PDS-5 scores. As the

“physical concerns” subscore is based on questions pertaining to the concern that palpitations lead to cardiac arrest, we expected higher physical concern scores within this SCAD population, as was the case. This may suggest that the SCAD event itself may increase anxiety sensitivity, leaving SCAD survivors at increased risk of developing anxiety disorders and PTSD. This is also something to consider when determining appropriate treatment options. If resiliency is to be a therapeutic target, the impact on anxiety sensitivity should be considered. Resiliency training, coupled with cognitive-behavioral therapy graduated exposure exercises to improve tolerance for uncomfortable physical sensations, may help reduce levels of anxiety sensitivity among SCAD patients.

In this population, quality of life was lower among those with elevated scores on measures of PTSD, anxiety, and depression, emphasizing the importance of formally assessing SCAD patients using validated scales, such as those used in this study. Evidence of adverse psychological symptoms was present well beyond individuals’ SCAD event, supporting mental health assessments be performed regardless as to when SCAD occurred. Trauma, anxiety, and depression were most strongly correlated with social and emotional functioning and well-being, as well as energy. This again stresses the importance of recognizing and addressing the potential impact of psychological symptoms on quality of life. Consideration of these factors is necessary for complete patient care for survivors of SCAD.

As with any survey-based research, there are important limitations to consider in this study. Individuals experiencing PTSD, anxiety, or depression may have difficulty filling out these surveys because of the sensitive nature of the content. A solution for this may be to administer these surveys in a clinic setting to possibly address any problems that arise real time. With this in mind, it is important to recognize that more severe psychological symptoms may be present among those who did not complete the surveys and may actually be a driving factor in the lack of response for some. Therefore, the prevalence and severity of PTSD, depression, and anxiety may be underestimated in this cohort, emphasizing the importance of future study and potential therapeutic interventions. In this study, we did not focus on perceived stress, which has been previously reported.^{43–45} Another limitation is that we did not have a control group, and the relationship or significance of differences between these data could not be statistically validated. Furthermore, the stronger correlations among our self-reported measures may be partially related to overlapping item content across these questionnaires.

More important, we report in this study evidence to support that there is incongruity between the percentage of patients being treated for a psychiatric distress

and the percentage who self-report being told they have a psychiatric diagnosis. We are unable to determine exact cause with the data collected. This may, however, indicate a barrier in communication between patient and provider when discussing the diagnosis of psychiatric illness. Improvements in public awareness and enhanced rates of screening for depression and anxiety in primary care will likely increase both patient and provider awareness of assessing mental health concerns alongside physical health issues.

CONCLUSIONS

SCAD is a life-threatening event that occurs mostly in young women and is considered traumatic by those who experience it. Survivors of SCAD have significant rates of PTSD, depression, and anxiety symptoms, which may also negatively impact overall quality of life. To provide the best quality of care for these patients, screening for and treatment of these symptoms are necessary. Validated screening tools for PTSD, anxiety, and depression are accessible and easy to administer. As such, we suggest administration of these tools to those who have experienced SCAD and, if scored within the clinical range of severity, appropriate follow-up and potential referral to available mental health resources would be indicated. These psychological symptoms are inversely correlated with measures of resiliency, with higher resiliency also correlated with better quality of life. Addressing resiliency and response to evidence-based mental health treatments among SCAD patients may be a particularly important area for future research to improve functioning and overall outcomes.

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Affiliations

From the Mayo Clinic Alix School of Medicine, Rochester, MN (A.K.J.); Department of Cardiovascular Diseases, Mayo Clinic College of Medicine and Science, Rochester, MN (S.N.H., P.J.B., R.G., M.S.T.); and Divisions of Integrated Behavioral Health (C.S.) and Biomedical Statistics and Informatics (M.P.J.), Mayo Clinic, Rochester, MN.

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Disclosures

None.

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