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Cardiac Rehabilitation

Prevalence of Anxiety, Depression, and Distress in SCAD and Non-SCAD AMI Patients

A Comparative Study

Barbara M. Murphy, PhD; Michelle C. Rogerson, PhD; Stephanie Hesselson, PhD; Siiri E. Iismaa, PhD; Valerie Hoover, PhD; Michael Le Grande, MPH; Robert M. Graham, MD, AO, MBBS, FRACP, FAA, FAHMS; Alun C. Jackson, PhD

Purpose: Spontaneous coronary artery dissection (SCAD) is an increasingly recognized cause of acute myocardial infarction (AMI), particularly in younger women without classic cardiac risk factors. Spontaneous coronary artery dissection is considered to be particularly stressful; however, few studies have quantified SCAD survivor stress levels. This study compared anxiety, depression, and distress levels in SCAD and non-SCAD AMI patients.

Method: A sample of 162 AMI (35 [22%] SCAD) patients was recruited from hospitals and via social media, in Australia and the United States. All had had their AMI in the past 6 mo. Participants completed an online questionnaire comprising the Generalized Anxiety Disorder-2 (GAD2), Patient Health Questionnaire-2 (PHQ2), Kessler-6 (K6), and Cardiac Distress Inventory (CDI). *T*-tests, χ^2 tests, Mann-Whitney tests, and analysis of covariance were used to compare SCAD and non-SCAD samples. Logistic regression was used to identify the unique predictors of anxiety, depression, and distress, controlling for relevant confounders.

Results: Patients with SCAD were more commonly female and significantly younger than non-SCAD patients. Patients with SCAD scored significantly higher on the GAD2, PHQ2, K6, and CDI and a significantly larger proportion was classified as anxious, depressed, or distressed using these instruments. In logistic regression, together with mental health history, having had a SCAD-AMI predicted anxiety, depression, and distress, after controlling for female sex, younger age, and other confounding variables.

Conclusion: This study supports the view that anxiety, depression, and distress are more common after SCAD-AMI than after traditional AMI. These findings highlight the psychosocial impacts of SCAD and suggest that psychological support should be an important component of cardiac rehabilitation for these patients.

KEY PERSPECTIVE

What is novel?

- Emerging evidence suggests that spontaneous coronary artery dissection (SCAD) is a particularly stressful type of acute myocardial infarction (AMI). However, few studies have compared the prevalence of anxiety and depression in patients with typical atherosclerotic AMI and those with SCAD-AMI. This study is particularly novel in that it compares rates of anxiety, depression, and distress in patients with typical AMI and those with SCAD-AMI, and identifies the unique predictors of anxiety, depression, and distress in these patients. The findings highlight that, even after controlling for other key red flags for post-event mental health problems, having an SCAD-AMI is a unique predictor of anxiety, depression, and distress. Prior mental health history also emerged as a unique predictor of poor post-event mental health.

What are the clinical and research implications?

- The study findings suggest an urgent need to develop and trial psychosocial interventions for survivors of SCAD to support their psychological recovery and improve their long-term prognosis.

Key words: anxiety • depression • distress • information provision • psychocardiology • SCAD • secondary prevention • stress

Increasing research attention is being paid to the psychosocial consequences of spontaneous coronary artery dissection (SCAD), a cause of acute myocardial infarction (AMI) that is particularly common in young women with few classic cardiac risk factors.[1-4] Spontaneous coronary artery dissection accounts for up to 35% of AMIs in women aged < 50 yr,[3,4] and is the most common cause of pregnancy-related AMI.[5,6] Unlike typical AMI, which is generally due to atherosclerosis, SCAD-AMI is nonatherosclerotic and occurs when a coronary vessel develops a hematoma within the arterial wall, which bulges inward obstructing blood flow to the heart.[3] Hospital readmission and recurrence are more common post-SCAD than following typical AMI.[7-10]

Studies suggest high levels of anxiety, depression, and stress in survivors of SCAD.[11-15] Indeed, emotional stress is often reported as the precipitating trigger for the acute SCAD event.[3,6,9,11,16-18] Uncertainty and lack of information provision surrounding the diagnosis and optimal management, and the likelihood of recurrence, contribute to the psychosocial sequelae of SCAD.[11,19] Emerging evidence therefore suggests that SCAD may be more stressful than typical AMI.

Author Affiliations: *Australian Centre for Heart Health, Melbourne, Victoria, Australia (Drs Murphy, Rogerson, and Jackson and Mr Le Grande); Melbourne School of Psychological Sciences, University of Melbourne, Melbourne, Victoria, Australia (Drs Murphy and Jackson and Mr Le Grande); Victor Chang Cardiac Research Institute, Sydney, New South Wales, Australia (Drs Hesselson, Iismaa, and Graham); St Vincent's Clinical School, University of New South Wales, Sydney, Australia (Drs Iismaa and Graham); Division of Cardiovascular Medicine, Stanford University School of Medicine, Stanford, California (Dr Hoover); and Centre on Behavioral Health, University of Hong Kong, Pokfulam, HongKong, China (Dr Jackson).*

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Correspondence: *Barbara M. Murphy, PhD, Australian Centre for Heart Health, 75 Chetwynd St, Melbourne, VIC 3051 (barbara.murphy@australianhearthealth.org.au).*

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However, very few studies have been undertaken to compare rates of post-event mental health conditions in patients with SCAD versus patients with atherosclerotic AMI. One early study demonstrated that survivors of SCAD have higher levels of anxiety, depression and distress than those who have typical atherosclerotic AMI.[13] However, a more recent study found that SCAD survivors' rates of depression and stress were no different to those seen in patients with typical atherosclerotic AMI.[20,21] More studies are needed to fully understand the comparative rates of anxiety, depression, and distress in AMI patients with and without SCAD to facilitate the development of more tailored supports for this relatively underresearched and poorly understood group.[3,4]

Several patient-related factors have been shown to increase anxiety and depression risk after typical AMI, and these need to be considered in investigations of the psychosocial impacts of SCAD. A history of anxiety or depression is a known risk factor or "red flag" for poor post-event mental health,[22-24] as is being younger at the time of the event, particularly being of pre-retirement age.[22,23,25,26] Low socioeconomic status and financial strain, indicated by factors such as not having private health insurance and not being a home owner, also predict poor post-event mental health.[22,23,27,28] In Australia, having private health insurance is associated with outright home ownership, luxury vehicle ownership, and a six-figure income,[29] hence its relevance as an indicator of financial security. Other known red flags include social isolation, indicated by living alone or self-reported loneliness[22,23,27,30] and having diabetes.[22,23,31] Attendance at cardiac rehabilitation (CR) has been shown to ameliorate post-event anxiety and depression risk, providing a protective effect.[30] Finally, given that SCAD is more likely in women,[3,4,20] who as a group have a tendency toward higher distress,[15,22,32,33] patient sex also needs to be taken into account when attributing post-event mental health problems to the SCAD event.

The aims of the present study were twofold: first, to report and compare rates of anxiety, depression, and distress in AMI patients with and without SCAD, while accounting for relevant covariates; and second, to determine whether having had a SCAD was a unique predictor of anxiety, depression, and distress in AMI patients after controlling for other known predictors of poor mental health post-AMI.

METHODS

This study had ethics approval from the Monash Health Human Research Ethics Committee (approval number: RES-19-0000631A—55979) and the Stanford University Institutional Review Board. Eligible participants were those who have had an AMI in the previous 6 mo. Patients who did not have adequate English language proficiency to read and understand the consent form and questionnaire were excluded.

Two samples of patients were recruited. One was a sample of patients with AMI consecutively admitted to two hospitals in Melbourne, Australia, over an 8-mo period. The other was a convenience sample of AMI survivors recruited from CR programs, general practice settings, and social media following promotion of the study by the Australian Centre for Heart Health, with assistance from Stanford University (United States) and Heart Support Australia. Participants in the hospital sample were recruited during their hospital stay and were recontacted at approximately 8-wk post-discharge and invited to complete the questionnaire. Participants in the convenience sample were required to have had their event within the past 6 mo and were invited to complete the questionnaire as soon as possible. The sample was recruited as part of a larger international study of cardiac-related emotions that was open to people who had experienced a broad range of cardiac events.[34-36] The present study was limited to those who had had an AMI within the past 6 mo.

Questionnaires were completed either in hard copy or online via the Research Electronic Data Capture (REDCap) platform. All participants were directed to the website of the Australian Centre for Heart Health to use an online link to the REDCap questionnaire or to request a hard copy of the questionnaire for completion at home and return in a reply-paid envelope. The questionnaire took approximately 25 min to complete. No identifying information was collected as no participant follow-up was involved.

MEASURES

Anxiety, Depression, and Distress

The Generalized Anxiety Disorder-2 (GAD2)[37] questionnaire is a validated brief screen for anxiety, comprising two items from the GAD7. The Patient Health Questionnaire 2-item (PHQ2)[38] is a validated brief screen for depression, comprising two items from the PHQ9. Total scores for both the GAD2 and the PHQ2 range from 0-6, with scores $\geq$3 indicative of probable clinical anxiety or depression, respectively.[37,38] The GAD2 and the PHQ2 have been used previously to assess rates of anxiety and depression in cardiac samples.[39,40] The Kessler Psychological Distress Scale-6 (K6)[41] is a validated brief measure of psychological distress. Scores range from 0-24, with scores $\geq$13 indicative of high distress.[41] The Cardiac Distress Inventory (CDI) is a 55-item measure of cardiac distress, which gives an indication of the nature and level of cardiac-related distress experienced in the past 4 wk.[35,36] The CDI comprises eight domains addressing fear and uncertainty, disconnection, overwhelm, death concerns, impacts on roles and relationships, cognitive challenges, physical health challenges, and health system challenges. The CDI-Short Form (CDI-SF) comprises 12 items from the CDI, with scores $\geq$13 indicative of high cardiac distress.[42]

Sociodemographic and Clinical Questions

Questions regarding sociodemographic and clinical characteristics were also included. Sociodemographic information included sex, age, partner status (partnered/unpartnered), living arrangements (live alone/live with others), employment status, education, private health insurance (yes/no [Y/N]), presence of a close confidante (Y/N), and loss of a close relative or friend in the past 12 mo (Y/N; defined as "recent bereavement"). Clinical information included event type (SCAD AMI/non-SCAD AMI), cardiovascular risk factors (high blood pressure, high cholesterol, diabetes, obesity, and sleep apnea), significant comorbidity (musculoskeletal conditions, thyroid conditions, heart failure, stroke, respiratory, and kidney conditions), and CR attendance status (Y/N). Participants also self-reported on whether they had current mental health conditions, namely anxiety (Y/N) and depression (Y/N), or a history of a mental health condition prior to the cardiac event, namely history of anxiety (Y/N) and history of depression (Y/N).

DATA ANALYSIS

The sociodemographic and clinical characteristics of SCAD-AMI and non-SCAD-AMI samples were compared using χ^2 tests (for categorical variables) and *t* tests (for continuous variables). Benjamini-Hochberg adjusted *P* values were calculated to control for type 1 error due to multiple comparisons.

In comparing SCAD-AMI and non-SCAD-AMI samples on measures of anxiety, depression, and distress, both mean scale scores and categorical prevalence ratings were considered. To compare mean scale scores, Mann-Whitney tests were used due to the nonnormal distribution of scale scores. In addition, analysis of covariance (ANCOVA) was used to control for the effects of *a priori* identified confounders, namely female sex, age $<$ 60 yr, mental health history, living alone, not having health insurance, having diabetes, and CR nonattendance. All these variables were entered as covariates. To compare categorical prevalence ratings using relevant clinical cut-offs (GAD2 $\geq$ 3 for anxiety; PHQ2 $\geq$ 3 for depression; K6 $\geq$ 6 for distress; and CDI-SF $\geq$ 13 for cardiac distress), χ^2 tests were used. To control for the effects of *a priori* identified confounders, multivariate logistic regression was used to identify the unique predictors of anxiety, depression, distress, and cardiac distress, while controlling for female sex, age $<$ 60 yr, mental health history, living alone, not having health insurance, having diabetes, and CR nonattendance.

RESULTS

A total of 162 AMI patients was recruited, with 35 (22%) patients with SCAD and 127 (78%) patients without SCAD. Most (139 [86%]) resided in Australia, with 23 (14%) from North America. Two thirds (109 [67%]) were recruited through participating hospitals, and one third (53 [33%]) through convenience sampling. Patients with SCAD were more likely to be recruited through convenience sampling (27 [77%]), whereas patients without SCAD were more likely to be recruited through participating hospitals (101 [79%]) (χ^2 = 40.03, $P < .001$). The convenience sample comprised respondents who were significantly younger than hospital patients (59.4 $\pm$ 13.5 vs 63.8 $\pm$ 10.9 yr, respectively; F = 4.85, $P < .029$) and more likely female (79 vs 30%; χ^2 = 34.31, $P < .001$). Importantly, there were no differences in rates of anxiety, depression, or distress in patients with SCAD recruited via the two different sampling methods (χ^2 = 0.65, P = .418, for PHQ2; χ^2 = 2.90, P = .089, for GAD2; χ^2 = 0.39, P = .529, for K6; χ^2 = 2.19, P = .139, for CDI-SF).

DIFFERENCES BETWEEN PATIENTS WITH AND WITHOUT SCAD IN SELF-REPORTED SOCIODEMOGRAPHIC AND CLINICAL CHARACTERISTICS

The age of patients overall was 62.3 $\pm$ 11.9 yr, with patients with SCAD significantly younger than patients without SCAD (53.7 $\pm$ 10.6 vs 64.7 $\pm$ 22.73 yr; F = 27.32, $P < .001$). Due to patients with SCAD being more likely recruited via the convenience sample, the time since the acute AMI event was on average 1 mo longer for patients with than without SCAD (3.0 $\pm$ 2.0 vs 2.0 $\pm$ 1.3 mo; F = 13.33, $P < .001$). Other characteristics of SCAD and non-SCAD samples are shown in Table 1.

In terms of sociodemographic characteristics, patients with SCAD-AMI were significantly more likely than non-SCAD AMI patients to be female, aged $<$60 yr, university educated, to live with others, and to have private health insurance. There were no differences between the two groups in the proportions who were married/partnered, in the paid workforce, had a close confidant, or had experienced a recent bereavement.

In terms of cardiovascular risk factors, patients with SCAD were significantly less likely than patients without SCAD to report having high cholesterol or diabetes, and significantly more likely to report having obesity. In terms of comorbid physical health conditions, patients with SCAD were more likely than patients without SCAD to report having a thyroid condition. Unlike patients without SCAD, no patients with SCAD reported having heart failure or stroke, and few had respiratory or kidney conditions; however, comparisons did not reach statistical significance due to the low prevalence of these conditions overall. In terms of self-reported current and past mental health problems, patients with SCAD were significantly more likely than patients without SCAD to self-report experiencing current and past anxiety, and current but not past depression. The two samples did not differ in CR attendance rates.

DIFFERENCES BETWEEN PATIENTS WITH AND WITHOUT SCAD IN MEAN SCALE SCORES ON MEASURES OF ANXIETY, DEPRESSION, DISTRESS, AND CARDIAC DISTRESS

Mean scores on the GAD2, PHQ2, K6, CDI, CDI-SF, and the CDI domains are shown for patients with and without SCAD in Table 2. As shown, patients with SCAD scored significantly higher than their counterparts without SCAD on the GAD2, PHQ2, K6, CDI, and CDI-SF, and on all eight CDI domains. After controlling for relevant confounders, these differences remained significant for the K6, the CDI, and the CDI-SF, and approached significance for the GAD2. However, for the PHQ2, the difference was no longer significant. In terms of CDI domains, after controlling for confounders, the differences remained significant for the domains of fear and uncertainty, overwhelm, roles and relationships, and health system challenges, and approached significance for cognitive challenges. The differences were no longer significant for the domains of disconnection, death concerns, and physical health challenges.

DIFFERENCES BETWEEN SCAD AND NON-SCAD PATIENTS IN PREVALENCE OF ANXIETY, DEPRESSION, DISTRESS, AND CARDIAC DISTRESS USING CLINICAL CUT-OFFS

Prevalence rates of anxiety, depression, distress, and cardiac distress based on recommended clinical cut-offs on the GAD2, PHQ2, K6, and CDI-SF are shown in Table 3. As shown, patients with SCAD were significantly more likely than patients without SCAD to be categorized as having probable anxiety, depression, distress, and cardiac distress using the GAD2, PHQ2, K6, and CDI-SF cut-offs, respectively.

PREDICTORS OF ANXIETY, DEPRESSION, DISTRESS, AND CARDIAC DISTRESS

Results of the logistic regression analyses are shown in Table 4. After controlling for *a priori* identified confounders, having an SCAD emerged as a significant predictor of anxiety, depression, distress, and cardiac distress. Notably, having a mental health history also emerged as a significant predictor of each outcome.

DISCUSSION

The findings of the present study suggest that survivors of SCAD-AMI are more likely than their counterparts without SCAD to experience anxiety, depression, distress, and cardiac distress in the 6 mo after their acute event. Importantly, SCAD-AMI remained as a unique predictor of these psychological states even after controlling for previously identified red flags for poor post-event mental health status, namely female sex, younger age, mental health history,

Table 1.

Baseline Sociodemographic and Clinical Characteristics[a]

Characteristics	SCAD n = 35	Non-SCAD n = 127	Total n = 162	χ^2	*P* Value
Sociodemographic					
Sex, female	33 (*94.3*)	42 (33.1)	75 (46.3)	41.34	<.001[b]
Age, <60 yr[c]	26 (*74.3*[d])	44 (34.9)	70 (43.5)	17.27	<.001[b]
Married or partnered	29 (82.9)	84 (66.1)	113 (69.8)	3.63	.057
Living alone	2 (5.7)	30 (*23.8*)	32 (19.9)	5.63	.018[b]
In paid workforce	25 (71.4)	64 (50.4)	89 (54.9)	4.90	.027
University education	22 (*62.9*)	37 (29.1)	59 (36.4)	13.48	<.001[b]
Has private health insurance[e]	24 (*68.6*)	50 (41.3)	74 (47.4)	8.08	.004[b]
Has close confidant	29 (82.8)	106 (83.5)	135 (83.3)	0.53	.469
Recently bereaved[f]	11 (31.4)	30 (25.2)	41 (26.6)	0.53	.464
Cardiovascular risk factors					
High blood pressure	7 (20.0)	50 (39.4)	57 (35.2)	4.51	.034
High cholesterol	4 (11.4)	44 (*34.6*)	48 (29.6)	7.09	.008[b]
Diabetes	1 (2.9)	35 (*27.6*)	36 (22.2)	9.69	.002[b]
Obesity	9 (*25.7*)	11 (8.7)	20 (12.3)	7.37	.007[b]
Sleep apnea	2 (5.7)	11 (8.7)	13 (8.0)	0.32	.570
Comorbid conditions					
Musculoskeletal condition	8 (22.9)	29 (22.8)	37 (22.8)	0.00	.998
Thyroid condition	2 *(5.7)*	0 (0)	2 (1.2)	7.34	.007[b]
Heart failure	0 (0.0)	7 (5.5)	7 (4.3)	2.01	.156
Stroke	0 (0.0)	5 (3.9)	5 (3.1)	1.42	.233
Respiratory problems	1 (2.9)	9 (7.1)	10 (6.2)	0.85	.357
Kidney problems	1 (2.9)	9 (7.1)	10 (6.2)	0.85	.357
Current mental health problems					
Self-reported anxiety	12 (*34.3*)	21 (16.5)	33 (20.4)	5.33	.021[b]
Self-reported depression	13 (*37.1*)	22 (17.3)	35 (21.6)	6.36	.012[b]
Mental health history					
History of anxiety	17 (*48.6*)	22 (17.3)	39 (24.1)	14.66	<.001[b]
History of depression	14 (40.0)	29 (22.8)	43 (26.5)	4.15	.042
History of any mental health condition	20 (*57.1*)	40 (31.5)	60 (37.0)	7.74	.005[b]
Other					
Attended cardiac rehabilitation[g]	20 (57.1)	60 (50.4)	80 (51.9)	0.49	.484

Abbreviations: CDI, Cardiac Distress Inventory 55-item; CDI-SF, Cardiac Distress Inventory Short Form (12-item); GAD2, Generalized Anxiety Disorder 2-item; K6, Kessler 6-item; non-SCAD, traditional acute myocardial infarction; PHQ2, Patient Health Questionnaire 2-item; SCAD, spontaneous coronary artery dissection.

[a]Data presented as n (%). Statistical test = χ^2. *df* = 1 for all tests. Significance level set at $P < .027$ after Benjamini-Hochberg adjustment.

[b]Indicates significant comparisons.

[c]n = 126 for non-SCAD, n = 161 for total.

[d]*Italicized* indicates significantly higher proportions.

[e]n = 121 for non-SCAD, n = 156 for total.

[f]Having lost of relative or friend in the past 12 mo.

[g]n = 119 for non-SCAD, n = 154 for total.

social isolation, socioeconomic disadvantage, diabetes, and nonattendance at CR using logistic regression.[22,23,25-28,30-33] Therefore, the current findings confirm that the emotional difficulty associated with SCAD cannot be attributed simply to the fact that most patients with SCAD are younger females, or to their increased likelihood of having a mental health history. Of note, though, the findings regarding post-SCAD depression were not retained after multivariate adjustment using ANCOVA. Qualitative investigations with survivors of SCAD similarly suggest that anxiety and distress are more prominent and pressing issues than is depression,[19] supporting this finding. Not surprisingly, having a mental health history emerged as a highly significant predictor of all outcomes, as is typically seen in non-SCAD AMI samples.[22-24]

The current study is one of the first to assess the relative prevalence of psychological difficulties in AMI patients with and without SCAD. The findings confirm those of an early Canadian study, which similarly demonstrated that survivors of SCAD have higher levels of anxiety, distress,

Table 2.

Differences in Scores on the PHQ2, GAD2, K6, and CDI for Patients With and Without SCAD[a]

Instrument	SCAD n = 35	Non-SCAD n = 127	Total n = 162	Unadjusted		Adjusted[b]	
				z	*P* Value	*F*	*P* Value
Scale scores							
GAD2	*2.71*[c] ± 1.7	1.27 ± 1.38	1.60 ± 1.58	4.59	<.001	3.61	.059
PHQ2	*2.00* ± 1.78	1.22 ± 1.48	1.39 ± 1.58	2.49	.013	0.59	.445
K6	*14.94* ± 5.17	11.06 ± 4.50	11.92 ± 4.92	3.94	<.001	4.83	.030
CDI	*48.04* ± 26.38	25.69 ± 21.81	30.52 ± 24.59	4.55	<.001	5.88	.016
CDI-SF	*12.89* ± 7.23	7.05 ± 6.41	8.31 ± 7.00	4.29	<.001	5.53	.020
Domains of the CDI							
Fear and uncertainty	*38.45* ± 23.85	20.07 ± 18.05	24.04 ± 20.80	4.17	<.001	4.22	.037
Disconnection	*17.86* ± 17.20	9.78 ± 15.47	11.53 ± 16.16	3.30	.001	0.67	.412
Overwhelm	*40.54* ± 22.02	19.83 ± 18.33	24.31 ± 20.94	4.82	<.001	10.58	.001
Death concerns	*40.47* ± 29.30	21.71 ± 24.24	25.77 ± 26.48	3.48	<.001	2.27	.134
Roles and relationships	*24.16* ± 19.04	12.23 ± 14.69	14.81 ± 16.42	3.76	<.001	4.14	.044
Cognitive challenges	*30.71* ± 26.33	15.73 ± 21.96	18.96 ± 23.71	3.67	<.001	3.11	.080
Physical health challenges	*27.62* ± 15.59	19.96 ± 16.74	21.62 ± 16.71	2.74	.006	0.35	.553
Health system challenges	*19.43* ± 23.17	6.98 ± 12.51	9.67 ± 16.19	3.55	<.001	6.29	.013

Abbreviations: CDI, Cardiac Distress Inventory 55-item; CDI-SF, Cardiac Distress Inventory Short Form (12-item); GAD2, Generalized Anxiety Disorder 2-item; K6, Kessler 6-item; non-SCAD, traditional acute myocardial infarction; PHQ2, Patient Health Questionnaire 2-item; SCAD, spontaneous coronary artery dissection.

[a]Data presented as mean ± SD. Statistical test = Mann-Whitney test. *df* = 1 for all tests. Significance level set at $P < .05$.

[b]Statistical test = ANCOVA adjusting for female sex, aged < 60, mental health history, living alone, diabetes, no health insurance, and not attend cardiac rehabilitation program. n = 35 for SCAD, n = 119-127 for non-SCAD.

[c]*Italicized* indicates significantly higher mean scores.

and depression than those who experience a traditional AMI.[13] However, a more recent US study found that rates of stress and depression were no different after SCAD than after non-SCAD AMI.[21] Importantly, in the latter study, the baseline rates of stress and depression were relatively high even for patients with typical atherosclerotic AMI, at 77% and 33%, respectively,[21] which might account for why a difference was not detected.

The rates of anxiety and depression reported here for survivors of SCAD are considerably higher than those seen previously in typical AMI populations. Previous studies of patients with typical atherosclerotic AMI have tended to report anxiety rates of up to 30%[22,43-45] and depression rates of around 20%.[22,43-46] In contrast, over half the patients with SCAD in the current study were classified as anxious and over a third as depressed. Distress rates varied from over a third for general distress to almost half for cardiac distress.

The rates of anxiety and depression reported here are also somewhat higher than those reported in earlier studies of survivors of SCAD. Studies undertaken in the United States[15,47] and the Netherlands[48] have reported rates of 12-16% for anxiety and 8-15% for depression. Importantly, the mean time since the acute SCAD was 4.3,[47] 3.7,[15] and 2.5 yr[48] in those studies, much later than in the current study where the mean time since SCAD was 3 mo. This delay in assessment likely accounts for the lower rates in the earlier studies, as anxiety and depression symptoms resolve over time.[47]

Table 3.

Proportions of Patients With and Without SCAD Classified as Anxious, Depressed, or Distressed Using the GAD2, PHQ2, K6, and CDI-SF[a]

Characteristics	SCAD n = 35	Non-SCAD n = 127	Total n = 162	χ^2	*P* Value
Anxious (GAD2)	18 (*51.4*[b])	16 (13.3)	34 (21.9)	22.96	<.001
Depressed (PHQ2)	13 (*37.1*)	17 (14.3)	30 (19.5)	9.01	.003
Distressed (K6)	12 (*34.3*)	9 (7.1)	21 (13.0)	17.19	<.001
Cardiac distressed (CDI-SF)	17 (*48.6*)	22 (17.3)	39 (24.1)	14.66	<.001

Abbreviations: CDI-SF, Cardiac Distress Inventory Short Form (12-item); GAD2, Generalized Anxiety Disorder 2-item; K6, Kessler 6-item; non-SCAD, traditional acute myocardial infarction; PHQ, Patient Health Questionnaire 2-item; SCAD, spontaneous coronary artery dissection.

[a]Data presented as n (%). Anxious = GAD2 ≥ 3; depressed = PHQ2 ≥ 3; distressed = K6 ≥ 13; cardiac distressed = CDI-SF ≥ 13. Statistical test = χ^2 test. *df* = 1 for all tests. Significance level set at $P < .05$.

[b]*Italicized* indicates significantly higher proportions.

Table 4.

Results of Logistic Regression to Predict Anxiety, Depression, Distress, and Cardiac Distress[a]

	OR	95% CI	*P* Value
Predictors of anxiety (GAD2)			
SCAD-AMI	4.75	1.48-15.21	.009
Mental health history	4.36	1.69-11.25	.002
Sex, female	1.50	0.50-4.46	.468
Age, <60 yr	1.14	0.42-3.06	.800
Live alone	0.44	0.09-2.24	.324
No health insurance	2.10	0.80-5.54	.133
Diabetes	2.79	0.84-9.21	.093
Not attend CR	0.45	0.17-1.13	.089
Predictors of depression (PHQ2)			
SCAD-AMI	3.20	1.01-10.11	.047
Mental health history	3.59	1.45-8.88	.006
Sex, female	1.05	0.36-3.01	.936
Age, <60 yr	1.02	0.40-2.63	.966
Live alone	1.06	0.30-3.78	.927
No health insurance	0.77	0.30-1.95	.579
Diabetes	1.39	0.45-4.37	.567
Not attend CR	0.64	0.26-1.55	.321
Predictors of distress (K6)			
SCAD-AMI	4.51	1.26-16.21	.021
Mental health history	5.52	1.76-17.31	.003
Sex, female	1.85	0.47-7.35	.381
Age, <60 yr	0.96	0.30-3.06	.944
Live alone	1.82	0.37-8.92	.462
No health insurance	0.71	0.24-2.15	.547
Diabetes	0.509	0.93-2.78	.436
Not attend CR	0.713	0.24-2.15	.199
Predictors of cardiac distress (CDI-SF)			
SCAD-AMI	3.19	1.10-9.24	.033
Mental health history	3.82	1.68-8.69	.001
Sex, female	1.94	0.75-5.13	.168
Age, < 60 yr	0.75	0.30-1.88	.539
Live alone	0.70	0.21-2.27	.550
No health insurance	1.43	0.62-3.33	.404
Diabetes	2.35	0.84-6.64	.106
Not attend CR	0.68	0.30-1.54	.352

Abbreviations: AMI, acute myocardial infarction; CDI-SF, Cardiac Distress Inventory Short Form; CR, cardiac rehabilitation; GAD2, Generalized Anxiety Disorder 2-item; K6, Kessler 6-item; PHQ2, Patient Health Questionnaire 2-item; SCAD, spontaneous coronary artery dissection.
[a]Anxiety = GAD2 ≥ 3; depression = PHQ2 ≥ 3; distress = K6 ≥ 13; cardiac distress = CDI-SF ≥ 13. n = 35 for SCAD, n = 119-127 for non-SCAD. Statistical test = logistic regression. Significance level set at $P < .05$.

Using the recently developed Cardiac Distress Scale,[35] patients with SCAD were shown to have high rates of distress across a broad range of cardiac-specific domains. In particular, patients with SCAD reported more fear and uncertainty, and feelings of overwhelm than their counterparts without SCAD. These findings reinforce those from two recent qualitative studies of survivors of SCAD that have highlighted fear and anxiety, uncertainty and confusion, loneliness and isolation, and loss and grief as major challenges faced in the aftermath of SCAD.[19,49] Illness uncertainty has been identified as a key challenge in SCAD recovery,[19,49] particularly given the rarity, uncertain diagnosis, high recurrence, and unclear management of the condition. The rarity of the condition and the concomitant lack of opportunities to engage with and find support through fellow survivors of SCAD also contributes to SCAD survivors' sense of loneliness and isolation.[19] Negative impacts on the roles and relationships of survivors of SCAD were also highlighted, again reinforcing qualitative findings.[19,49] Patients with SCAD also scored higher on the domain of health system challenges, which includes items addressing a lack of information, validation, and support (three of the five items ask about "not getting clear directions about managing the condition," "not getting as much information as I want about my heart condition," and "not having my concerns taken seriously").[35] This finding underscores how the current lack of knowledge about and understanding of SCAD among health professionals is central to SCAD survivors' challenging recovery process.[11,19]

Patients with SCAD in the present study were more likely than their counterparts without SCAD to self-report having a history of anxiety or depression, prior to their cardiac event. This is perhaps not surprising, given that emotional stress has been identified as a precipitator of acute SCAD events.[3,6,9,11,16,17] This finding questions whether prevention of anxiety and depression could ameliorate the risk of SCAD in people with fibromuscular dysplasia or other indicators of risk, including genetic markers[50] or, indeed, the risk of SCAD recurrences in survivors of SCAD. These questions are worthy of attention in future studies.

The cardiovascular risk profile of AMI patients with SCAD in the current study also differed markedly from AMI patients without SCAD, as has been reported elsewhere. Those who had SCAD were less likely than patients with typical atherosclerotic AMI to report having high blood pressure, high cholesterol, or diabetes, consistent with past studies.[1-4,10,20,48] While patients with SCAD were more likely than patients without SCAD to report obesity, the prevalence rate of 26% is consistent with previous SCAD studies, which have found obesity in 18% to 27%.[10,20,21,51] This rate is also below population rates of 30% in Australia[52] and 40% in the United States.[53] Indeed, it is possible that the rate of 9% obesity in our non-SCAD sample may represent underreporting.

Patients with SCAD were also more likely to report having a thyroid condition, although the sample size was too small to confirm this finding statistically. Spontaneous coronary artery dissection has been found to be associated with underlying systemic vascular conditions such as fibromuscular dysplasia, connective tissue disorders, migraine headache, and inflammatory disorders,[3,6,9,17,18,48,51,54,55] although we did not measure these conditions in the current study.

STUDY LIMITATIONS

Some study limitations should be acknowledged. First, the small number of patients with SCAD limits the study to some extent. Participants were recruited as part of a larger study of emotions in patients across a broad range of cardiac events.[35,36] Nonetheless, the findings contribute to our understanding of the psychological consequences of this relatively rare and underresearched condition. Second and related, patients with SCAD were more likely to be recruited via convenience sampling, which may have introduced a self-selection bias into the study. However, there were

no differences in rates of anxiety, depression, or distress in patients with SCAD recruited via the two different sampling methods. This suggests that the relatively high rates of anxiety, distress, and depression reported here for patients with SCAD are not due to sampling bias. Third, the GAD2 and the PHQ2 were designed as screening measures rather than diagnostic assessments of anxiety and depression. Importantly, the inclusion of additional measures of distress (the K6 and the CDI), together with these brief measures of anxiety and depression, represents a broad psychological assessment. While the CDI has excellent psychometric properties,[35,42] it is only recently developed; thus, these results should be interpreted with some caution. Studies involving translation and validation of the CDI are currently underway in several countries and results will be forthcoming. Fourth, the study relied on self-reporting of key variables, including mental health history, CR attendance, and the SCAD event itself. The study would have been strengthened by verification of SCAD-AMI by either angiogram results or health professional reports, and a more nuanced assessment of CR attendance, to account for CR dose, discontinuation, and completion. Reliance on self-reporting regarding mental health history, while typical in studies of this kind, also potentially limits the reliability of the study findings. As the data were collected as part of a larger study that was not designed specifically as an investigation of patients with SCAD-AMI, data on SCAD-related factors such as migraine, fibromuscular dysplasia, and other connective tissue disorders were not collected. There is a need for carefully designed studies to further investigate the differences between SCAD and non-SCAD AMI to potentially replicate the findings presented here and therefore fine-tune our understanding of the differing mental health needs of these two AMI populations.

CONCLUSION

This study supports the view that patients with SCAD experience more distress, anxiety, and, to a lesser extent, depression than do their AMI counterparts without SCAD, adding to the growing body of knowledge regarding the psychosocial impact of SCAD.[11-15,19,49] These findings underscore the importance of providing survivors of SCAD with tailored information and support to assist with their physical and emotional recovery. Previous research has highlighted the need for professionally-facilitated online support programs for SCAD survivors.[11,14,19,49] The present findings provide further evidence of the urgent need to better assist survivors of SCAD in their recovery. This could include providing tailored support within existing CR programs, as well as designing SCAD-specific CR programs and other supports. Future studies could investigate the specific support preferences of survivors of SCAD, and trial innovative options for addressing the psychological challenges experienced after SCAD-AMI.

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REFERENCES

1. Low TT, Houdmont M, Sim HW, Chan KH, Loh PH, Loh JP. Spontaneous coronary artery dissection: clinical implications and diagnostic challenges. Overlooked and underappreciated in Asia? *Clin Cardiol*. 2020;43(11):1240-1247.
2. Saw J, Aymong E, Mancini GB, Sedlak T, Starovoytov A, Ricci D. Nonatherosclerotic coronary artery disease in young women. *Can J Cardiol*. 2014;30(7):814-819.
3. Hayes SN, Kim ESH, Saw J, et al. Spontaneous coronary artery dissection: current state of the science: a scientific statement from the American Heart Association. *Circulation*. 2018;137(19):e523-e557.
4. Hayes SN, Tweet MS, Adlam D, et al. Spontaneous coronary artery dissection: JACC state-of-the-art review. *J Am Coll Cardiol*. 2020;76(8):961-984.
5. Tweet MS, Hayes SN, Codsi E, Gulati R, Rose CH, Best PJM. Spontaneous coronary artery dissection associated with pregnancy. *J Am Coll Cardiol*. 2017;70(4):426-435.
6. Iismaa SE, Hesselson S, McGrath-Cadell L, et al. Spontaneous coronary artery dissection and fibromuscular dysplasia: vasculopathies with a predilection for women. *Heart Lung Circ*. 2021;30(1):27-35.
7. Gad MM, Mahmoud AN, Saad AM, et al. Incidence, clinical presentation, and causes of 30-day readmission following hospitalization with spontaneous coronary artery dissection. *JACC Cardiovasc Interv*. 2020;13(8):921-932.
8. Virk HUH, Tripathi B, Kumar V, et al. Causes, Trends, and predictors of 90-day readmissions after spontaneous coronary artery dissection (from a nationwide readmission database). *Am J Cardiol*. 2019;124(9):1333-1339.
9. Saw J, Humphries K, Aymong E, et al. Spontaneous coronary artery dissection: clinical outcomes and risk of recurrence. *J Am Coll Cardiol*. 2017;70(9):1148-1158.
10. Ryan C, Lewei D, Derek P, et al. Characteristics and clinical outcomes of patients with spontaneous coronary artery dissection. *J Am Heart Assoc*. 2019;8(10):e012570.
11. Wagers TP, Stevens CJ, Ross KV, Leon KK, Masters KS. Spontaneous coronary artery dissection (SCAD): female survivors' experiences of stress and support. *J Cardiopulm Rehabil Prev*. 2018;38(6):374-379.
12. Edwards KS, Vaca KC, Naderi S, Tremmel JA. Patient-reported psychological distress after spontaneous coronary artery dissection: evidence for post-traumatic stress. *J Cardiopulm Rehabil Prev*. 2019;39(5):E20-E23.
13. Saw JWL, Starovoytov A, Birnie T, et al. Comparison of psychosocial questionnaires between spontaneous coronary artery dissection (SCAD) and non-SCAD populations undergoing cardiac rehabilitation program after myocardial infarction. *J Am Coll Cardiol*. 2016;67(13 suppl):1936.
14. Neubeck L, McHale S, Ross M, MacGillivray S, Galbraith M, Hanson C. Spontaneous coronary artery dissection: a systematic review of physical and psychosocial recovery following discharge from hospital. *Eur J Cardiovasc Nurs*. 2022;21(7):665-676.
15. Liang JJ, Tweet MS, Hayes SE, Gulati R, Hayes SN. Prevalence and predictors of depression and anxiety among survivors of myocardial infarction due to spontaneous coronary artery dissection. *J Cardiopulm Rehabil Prev*. 2014;34(2):138-142.
16. Smaardijk VR, Mommersteeg PMC, Kop WJ, Adlam D, Maas A. Psychological and clinical characteristics of female patients with spontaneous coronary artery dissection. *Netherlands Heart J*. 2020;28(9):485-491.
17. Graham RM, McGrath-Cadell L, Muller DWM, Holloway CJ. The mystery and enigma of spontaneous coronary artery dissection. *Heart Lung Circ*. 2018;27(4):401-405.
18. McGrath-Cadell L, McKenzie P, Emmanuel S, Muller DWM, Graham RM, Holloway CJ. Outcomes of patients with spontaneous coronary artery dissection. *Open Heart*. 2016;3(2):e000491.
19. Murphy B, Rogerson M, Hesselson S, Iismaa S, Graham RM, Jackson A. Psychosocial impacts of spontaneous coronary artery dissection: a qualitative study. *PLoS One*. 2022;17(9):e0273978.
20. Murugiah K, Chen L, Dreyer RP, et al. Health status outcomes after spontaneous coronary artery dissection and comparison with other acute myocardial infarction: the VIRGO experience. *PLoS One*. 2022;17(3):e0265624.
21. Murugiah K, Chen L, Dreyer RP, et al. Depression and perceived stress after spontaneous coronary artery dissection and comparison

with other acute myocardial infarction (the VIRGO experience). *Am J Cardiol*. 2022;173:33-38.
22. Murphy B, Le Grande M, Alvarenga M, Worcester M, Jackson A. Anxiety and depression after a cardiac event: prevalence and predictors. *Front Psych*. 2020;10:3010.
23. Murphy BM, Elliott PC, Ludeman D, et al. Red flags for anxiety and depression after an acute cardiac event: 6-month longitudinal study in regional and rural Victoria. *Eur J Prev Cardiol*. 2014;21(9):1079-1089.
24. Guan Y, Phillips L, Murphy B, et al. Impact of rumination on severity and persistence of anxiety and depression in cardiac patients. *Heart Mind*. 2021;5(1):9-16.
25. Bruyninx G, Grenier J, Greenman PS, Tassé V, Abdulnour J, Chomienne MH. Prevalence of symptoms of anxiety disorders and depression in cardiac rehabilitation patients in an academic hospital: a case study. *Psychiat Q*. 2021;92(1):273-287.
26. Olsen SJ, Schirmer H, Wilsgaard T, Bønaa KH, Hanssen TA. Cardiac rehabilitation and symptoms of anxiety and depression after percutaneous coronary intervention. *Eur J Prev Cardiol*. 2018;25(10):1017-1025.
27. Pogosova N, Boytsov S, De Bacquer D, et al. Factors associated with anxiety and depressive symptoms in 2775 patients with arterial hypertension and coronary heart disease: results from the COMETA multicenter study. *Glob Heart*. 2021;16(1):73.
28. Wu M, Shen L, Wang Q, et al. Anxiety and depression prevalence and risk factors among patients with cardiovascular diseases in post-COVID-19 China. *Front Pub Health*. 2021;9:758874.
29. Muggli EE, McCloskey D, Halliday JL. Health behaviour modelling for prenatal diagnosis in Australia: a geodemographic framework for health service utilisation and policy development. *BMC Health Serv Res*. 2006;6:109-118.
30. Khan Z, Musa K, Abumedian M, Ibekwe M. Prevalence of depression in patients with post-acute coronary syndrome and the role of cardiac rehabilitation in reducing the risk of depression: a systematic review. *Cureus*. 2021;13(12):e20851.
31. Rawashdeh SI, Ibdah R, Kheirallah KA, et al. Prevalence estimates, severity, and risk factors of depressive symptoms among coronary artery disease patients after ten days of percutaneous coronary intervention. *Clin Pract Epidemiol Ment Health*. 2021;17:103-113.
32. Edwards KS, Hekler AC, Baum J, et al. Psychological distress among female cardiac patients presenting to a women's heart health clinic. *Am J Cardiol*. 2019;123(12):2026-2030.
33. O'Neil A, Russell JD, Murphy B. How does mental health impact women's heart health? *Heart Lung Circ*. 2020;30(1):59-68.
34. Jackson A, Rogerson M, Le Grande M, et al. Protocol for the development and validation of a measure of persistent psychological and emotional distress in cardiac patients: the Cardiac Distress Inventory. *BMJ Open*. 2020;10(6):e034946.
35. Jackson AC, Le Grande MR, Rogerson MC, et al. The Cardiac Distress Inventory: a new measure of psychosocial distress associated with an acute cardiac event. *BMC Cardiovasc Disord*. 2022;22(1):460.
36. Jackson AC, Rogerson MC, Amerena J, et al. Unraveling the complexity of cardiac distress: a study of prevalence and severity. *Front Psychiatry*. 2022;13:808904.
37. Kroenke K, Spitzer RL, Williams JB, Monahan PO, Löwe B. Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Ann Intern Med*. 2007;146(5):317-325.
38. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: validity of a two-item depression screener. *Med Care*. 2003;41(11):1284-1292.
39. Tran HV, Gore JM, Darling CE, Ash AS, Kiefe CI, Goldberg RJ. Clinically significant ventricular arrhythmias and progression of depression and anxiety following an acute coronary syndrome. *J Psychosom Res*. 2019;117:54-62.
40. Suzuki T, Shiga T, Nishimura K, Omori H, Tatsumi F, Hagiwara N. Patient Health Questionnaire-2 screening for depressive symptoms in Japanese outpatients with heart failure. *Int Med*. 2019;58(12):1689-1694.
41. Furukawa TA, Kessler RC, Slade T, Andrews G. The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. *Psychol Med*. 2003;33(2):357-362.
42. Le Grande M, R., Murphy BM, Rogerson MC, et al. Development of a short form of the Cardiac Distress Inventory. *Eur Heart J Open*. In press.
43. Hanssen TA, Nordrehaug JE, Eide GE, Bjelland I, Rokne B. Anxiety and depression after acute myocardial infarction: an 18-month follow-up study with repeated measures and comparison with a reference population. *Eur J Cardiovasc Prev Rehabil*. 2009;16(6):651-659.
44. Kala P, Hudakova N, Jurajda M, et al. Depression and anxiety after acute myocardial infarction treated by primary PCI. *PLoS One*. 2016;11(4):e0152367.
45. Feng HP, Chien WC, Cheng WT, Chung CH, Cheng SM, Tzeng WC. Risk of anxiety and depressive disorders in patients with myocardial infarction: a nationwide population-based cohort study. *Medicine (Baltimore)*. 2016;95(34):e4464.
46. Thombs BD, Bass EB, Ford DE, et al. Prevalence of depression in survivors of acute myocardial infarction: review of the evidence. *J Gen Intern Med*. 2006;21(1):30-38.
47. Johnson AK, Hayes SN, Sawchuk C, et al. Analysis of posttraumatic stress disorder, depression, anxiety, and resiliency within the unique population of spontaneous coronary artery dissection survivors. *J Am Heart Assoc*. 2020;9(9):e014372.
48. Smaardijk VR, Mommersteeg PMC, Kop WJ, Pellegrini D, van Geuns R-J, Maas AHEM. Psychological and clinical characteristics of patients with spontaneous coronary artery dissection: a case-control study. *Int J Cardiol*. 2021;323:1-6.
49. Bouchard K, Coutinho T, Reed J, et al. Recovering from spontaneous coronary artery dissection: patient-reported challenges and rehabilitative intervention needs. *Health Psychol*. 2021;40(7):472-479.
50. Tarr I, Hesselson S, Iismaa SE, et al. Exploring the genetic architecture of spontaneous coronary artery dissection using whole-genome sequencing. *Cir Genom Precis Med*. 2022;15(4):267-277.
51. Chacin-Suarez AS, Bonikowske AR, Medina-Inojosa JR, et al. Physical activity and exercise patterns after spontaneous coronary artery dissection: insights from a large multinational registry. *Front Cardiovasc Med*. 2021;8:642739.
52. Australian Bureau of Statistics. National Health Survey: First Results. Canberra, Australia, 2017-18. https://www.abs.gov.au/statistics/health/health-conditions-and-risks/national-health-survey-first-results/latest-release
53. Hales CM, Carroll MD, Fryar CD, Ogden CL. *Prevalence of Obesity and Severe Obesity Among Adults: United States, 2017–2018. NCHS Data Brief, No 360*. Hyattsville, MD: National Center for Health Statistics; 2020.
54. Gilhofer TS, Saw J. Spontaneous coronary artery dissection: a review of complications and management strategies. *Expert Rev Cardiovasc Ther*. 2019;17(4):275-291.
55. Maas A, Bouatia-Naji N, Persu A, Adlam D. Spontaneous coronary artery dissections and fibromuscular dysplasia: current insights on pathophysiology, sex and gender. *Int J Cardiol*. 2019;286:220-225.