## Original Article

Early Effects of the COVID-19 Pandemic on Patients in a Virtual Multicenter Spontaneous Coronary Artery Dissection (SCAD) Registry

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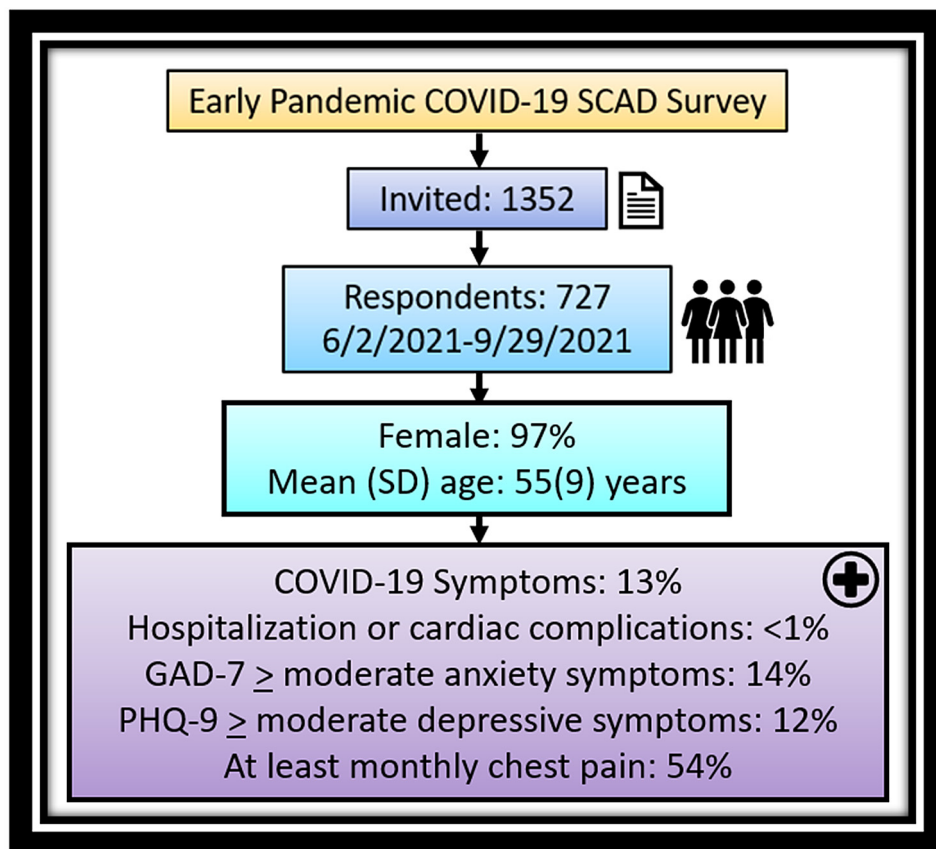
ABSTRACT

Background: The COVID-19 pandemic effects among patients with a history of spontaneous coronary artery dissection (SCAD), a cause of acute coronary syndrome associated with emotional and physical stress, are unknown.

RÉSUMÉ

Contexte : On ne connaît pas les effets de la pandémie de COVID-19 sur les personnes ayant des antécédents de dissection spontanée de l'artère coronaire (DSAC), une cause du syndrome coronarien aigu qui est une source de stress physique et émotionnel.

Methods: For this cross-sectional cohort study, participants of the Mayo Clinic "Virtual" Multicenter SCAD Registry were surveyed about the COVID-19 pandemic.

Results: Among 1352 participants, 727 (53.8%) completed surveys between June 2, 2021 and September 29, 2021. The majority of respondents (96.7%) were female, with a mean age of 54.9 ± 9.4 years. At the time of completing the survey, which was early in the pandemic, 91 respondents (12.6%) reported having prior COVID-19 symptoms, with < 1% experiencing hospitalization (n = 4) or cardiac complications (n = 6). A total of 14% had ≥ moderate anxiety symptoms, per the General Anxiety Disorder-7 item survey, and 11.8% had ≥ moderate depressive symptoms, per the Patient Health Questionnaire-9 item. Higher stress scores on the Likert scale were correlated with pandemic-related reduction in work hours and/or pay and/or unemployment (*P* = 0.013), remote work and/or change of job (*P* < 0.001), and loss of insurance and/or medical coverage (*P* = 0.025). A higher anxiety level, as measured on the Likert scale, was correlated with pandemic-related remote work and/or change of job (*P* = 0.007) and loss of insurance and/or medical coverage (*P* = 0.008). Since the start of the pandemic, 54% of respondents reported having at least monthly chest pain. Chest pain and COVID symptoms were each associated with higher scores on the General Anxiety Disorder-7 item survey and the Patient Health Questionnaire-9 item.

Conclusions: Early in the pandemic, COVID-19 symptoms, hospitalization, and cardiac complications were uncommon among SCAD patients. The burden of anxiety and depressive symptoms was minimal to mild, similar to that in prior reports. Likert-scale measures of stress and anxiety were higher among persons with work and/or pay reduction and/or unemployment, remote work and/or change of job, and loss of insurance and/or medical coverage. Over half of respondents reported experiencing chest pain, which was correlated with depressive and anxiety symptoms, highlighting an overarching clinical need.

Méthodologie : Pour les besoins de cette étude de cohorte transversale, les participants au registre « virtuel » multicentrique sur la DSAC de la clinique Mayo ont été interrogés dans le cadre d'une enquête sur la pandémie de COVID-19.

Résultats : Parmi les 1 352 participants au registre, 727 (53,8 %) ont répondu à l'enquête entre le 2 juin et le 29 septembre 2021. La majorité des répondants (96,7 %) étaient des femmes, et l'âge moyen était de 54,9 ± 9,4 ans. Au moment de l'enquête, réalisée au début de la pandémie, 91 répondants (12,6 %) avaient indiqué avoir déjà présenté des symptômes de COVID-19, et < 1 % avaient été hospitalisés (n = 4) ou avaient présenté des complications cardiaques (n = 6). Au total, 14 % des participants présentaient des symptômes d'anxiété à tout le moins modérés d'après le questionnaire GAD-7 (*General Anxiety Disorder*-7 item) et 11,8 %, des symptômes dépressifs à tout le moins modérés d'après le questionnaire PHQ-9 (*Patient Health Questionnaire*-9 item). Une corrélation a été établie entre un score de stress plus élevé sur une échelle de Likert et une réduction des heures de travail et/ou du salaire, une période de chômage (*p* = 0,013), le télétravail et/ou un changement d'emploi (*p* < 0,001) et la perte de l'assurance et/ou de la couverture médicale (*p* = 0,025) en lien avec la pandémie. Une corrélation a également été établie entre un niveau d'anxiété plus élevé mesuré sur une échelle de Likert et le télétravail et/ou un changement d'emploi (*p* = 0,007) et la perte de l'assurance et/ou de la couverture médicale (*p* = 0,008) en lien avec la pandémie. Depuis le début de la pandémie, 54 % des répondants ont indiqué ressentir une douleur thoracique au moins une fois par mois. La douleur thoracique et les symptômes de la COVID-19 ont par ailleurs été associés à des scores plus élevés aux questionnaires GAD-7 et PHQ-9.

Conclusions : Au début de la pandémie, les symptômes de la COVID-19, les hospitalisations et les complications cardiaques n'étaient pas fréquents chez les patients présentant une DSAC. Le fardeau des symptômes anxieux et dépressifs allait de minime à léger, comme en faisaient état les rapports précédents. L'anxiété et le stress mesurés sur une échelle de Likert ont été plus élevés chez les personnes ayant connu une réduction des heures de travail et/ou du salaire ou une période de chômage, ayant dû recourir au télétravail et/ou changer d'emploi, ou ayant perdu leur assurance et/ou couverture médicale. Plus de la moitié des répondants ont indiqué ressentir une douleur thoracique, laquelle a été mise en corrélation avec les symptômes d'anxiété et de dépression, ce qui souligne l'existence d'un besoin clinique important.

Spontaneous coronary artery dissection (SCAD) is a non-atherosclerotic, nontraumatic separation between layers of the coronary arterial wall due to an intimal tear and/or intramural hematoma leading to myocardial ischemia, infarction, or death. SCAD occurs most often in young and middle-aged women.[1] Factors associated with SCAD include fibromuscular dysplasia (FMD), hypertension, migraines, heritable connective tissue diseases, pregnancy, and other hormonal influences. The onset of SCAD symptoms can occur with physical or emotional stress, and SCAD is associated with substantial subsequent physical and psychological morbidity.[2-6] The etiology, optimal treatment, and long-term outcomes remain obscure, potentially adding to survivors' distress.

With the coronavirus disease of 2019 (COVID-19) pandemic and its potentially disproportionate impact on the well-being of women, economically, mentally, and emotionally, concern arose that the pandemic might negatively affect the health of SCAD patients. Isolated case reports have been made about SCAD occurring in patients with COVID-19, with proposed etiologies such as localized vascular inflammation secondary to the infection and/or precipitating pandemic-related stress in patients with vulnerable vasculature.[2,7-10] The aim of this study was to assess the effects of the COVID-19 pandemic on patients with SCAD.

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See page 697 for disclosure information.

Methods

This cross-sectional study was approved by the Mayo Clinic Institutional Review Board. Patients who had consented to the Mayo Clinic "Virtual" Multicenter SCAD Registry (NCT01429727)[11] from August 3, 2011 through June 1, 2021 were sent electronic surveys to describe their experiences, insights, and opinions related to the COVID-19 pandemic and COVID-19 vaccines on June 2, 2021. A total of 3 reminders were sent to those who had not completed the survey, with the last invitation sent out on August 2, 2021.

The Mayo Clinic "Virtual" Multicenter SCAD Registry is a patient-driven effort created in response to participants of an online community hosted by WomenHeart: the National Coalition for Women with Heart Disease in 2010. At that time, published research about nonatherosclerotic SCAD was limited to small case series of < 25 patients,[12,13] and SCAD was considered a very rare etiology of acute coronary syndrome. Our pilot study demonstrated that a virtual, multicenter registry of patients with nonatherosclerotic SCAD was feasible.[11] and patient recruitment began following institutional review board approval. Participants with SCAD were recruited from the Mayo Clinic and other healthcare systems. Recruitment was facilitated by disease-specific social media groups, physician referrals, and self-referrals. SCAD diagnosis was confirmed by the dedicated Mayo Clinic team's review of the coronary artery imaging and medical records prior to participant consent and enrollment. Data were abstracted from the medical records by trained research nurses and assistants. Surveys at enrollment and follow-up included questions regarding SCAD presentation, symptoms, medical history, medications, mental health, and current health status. The Mayo Clinic "Virtual" Multicenter SCAD Registry currently includes data from over 1580 participants.

For this cross-sectional study, questions about COVID-19 vaccine experiences and perceptions, COVID-19 exposures, diagnoses, and health effects were collected (Supplemental Appendix S1). Many of the questions asked respondents to reply for the period "since March 2020," as that is when the COVID-19 pandemic led to major event cancellations and stay-at-home orders in the US. The Patient Health Questionnaire-9 item (PHQ-9) and the General Anxiety Disorder-7 item (GAD-7) surveys were also collected. A PHQ-9 score of 0-4 was coded as "minimal"; a score of 5-9 was coded as "mild"; a score of 10-14 was coded as "moderate"; a score of 15-19 was coded as "moderately severe"; and a score of > 20 was coded as "severe" depressive symptoms.[14] A GAD-7 score of 0-4 was coded as "minimal"; a score of 5-10 was coded as "mild"; a score of 10-14 was coded as "moderate"; and a score of 15-21 was coded as "severe" anxiety symptoms.[15] PHQ-9 and GAD-7 scores also were analyzed on their original continuous scales. In addition to these instruments, participants were asked to rate their level of anxiety, stress, and depression on separate Likert scales, with scores ranging from 1 to 10.

Data were hosted on firewall-encrypted Mayo Clinic Research Electronic Data Capture (REDCap) and Mayo Clinic Big One Stop Shop (BOSS) programs. Data analysis was completed using R (R Foundation, Vienna, Austria), Microsoft Excel (Redmond, WA), and JMP software (SAS Institute Inc, Cary, NC). Continuous variables were recorded as mean (standard deviation) or median (interquartile range), and categorical variables were reported as count (percent). Group comparisons of continuous variables were conducted using the Student t test, the Wilcoxon rank-sum test, or the Kruskal-Wallis rank-sum test, and comparisons of categorical variables by group were made using Fisher's exact test. Simple linear regression was used to test whether age at survey or time since first SCAD was correlated with continuous GAD-7 or PHQ-9 scores. Two-sided P-values less than 0.05 were considered statistically significant. Responses of "unsure" to questions regarding employment and insurance were treated as missing. "Unsure" responses regarding COVID-19 symptoms are reported descriptively but are treated as missing for purposes of formal analysis.

Results

Of 1352 surveys sent to Mayo Clinic SCAD Registry participants with a confirmed SCAD history, 727 (53.8%) responded between June 2, 2021 and September 29, 2021. The majority (96.7%) of respondents were female, with an overall mean age of 54.9 + 9.4 years (Table 1). At the time of survey, which was early in the pandemic, 12.6% (N = 91) reported having experienced symptoms of COVID-19, with < 1% of total respondents requiring hospitalization (N = 4) or experiencing cardiac complications (N = 6). All of the patients requiring hospitalization were female, with an average age of 51.8 years (range: 42-61). All patients with cardiovascular complications were female, with an average age of 55.3 years (range: 42-70).

Participants reported a reduction in work hours and/or pay and/or unemployment (20.7%), remote work and/or change of job (40.3%), or loss of health insurance and/or medical coverage (1.4%); see Supplemental Appendix S1 for question verbiage. On average, respondents reported their stress, anxiety, and depression levels to be 5.4, 5.0, and 3.6, respectively, on a Likert scale of 1-10 (with 10 being the highest level of stress, anxiety, and depression). On the GAD-7 questionnaire, a moderate or higher level of anxiety symptoms was present among 13.9% of respondents. On the PHQ-9 survey, a moderate or higher level of depressive symptoms was present among 11.8% of participants. Time since first SCAD was not associated significantly with the continuous scores on the PHQ-9 ($P = 0.692$) or GAD-7 ($P = 0.805$). However, each decade increase in age at time of survey was associated with a 0.46-point decrease in PHQ-9 scores (95% confidence interval [CI] 0.11-0.80; $P = 0.009$) and a 0.77-point decrease in GAD-7 scores (95% CI 0.41-1.13; $P < 0.001$).

Over half (54%) of survey respondents reported having chest pain at least once monthly since the start of the pandemic in March 2020, with an average chest pain severity of around 3.3 of 10. Time since first SCAD was associated significantly with chest pain frequency ($P = 0.006$; Kruskal-Wallis) but not with chest pain severity in those that experienced it ($P = 0.91$; linear regression). However, the median time from first SCAD to survey was 6.3 years (interquartile range: 4.2, 9.5 years), so these results represent longer-term findings. Findings might differ if a cohort of patients who all experienced more recent SCAD were examined.

Table 1. Demographic and COVID-19-specific information for n = 727 respondents to the Mayo Clinic Spontaneous Coronary Artery Dissection (SCAD) Registry COVID-19 survey

Characteristic	Overall (n = 727)
Age at time of survey, y, mean (SD)	54.9 (9.4)
Age at first SCAD, y, mean (SD)	47.4 (9.2)
Years since first SCAD, mean (SD)	7.5 (4.9)
Female sex	703 (96.7)
Race (n = 621)	
Black or African American	7 (1.1)
Other race	7 (1.1)
Unknown	202 (32.5)
White	405 (65.2)
Marital status (n = 578)	
Married	392 (67.8)
Not married	70 (12.1)
Unknown	116 (20.1)
COVID symptoms (n = 725)	
Yes	91 (12.6)
No	593 (81.8)
Unsure	41 (5.7)
Required hospitalization (among those with symptoms; n = 90)*	
Yes	4 (4.4)
No	86 (95.6)
Cardiac complications (among those with symptoms; n = 90)*	
Yes	6 (6.7)
No	74 (82.2)
Unsure	10 (11.1)
Reduction in work hours and/or pay and/or unemployment (n = 716)	148 (20.7)
Remote work and/or change of job (n = 718)	289 (40.3)
Loss of health insurance and/or medical coverage (n = 718)	10 (1.4)
Stress score (max = 10; n = 725), mean (SD)	5.4 (2.5)
Anxiety score (max = 10; n = 724), mean (SD)	5.0 (2.6)
Depression score (max = 10; n = 723), mean (SD)	3.6 (2.5)
COVID-19 vaccine (n = 722)	
Yes	621 (86.0)
No	100 (13.9)
Unsure	1 (0.1)
Depressive symptoms as assessed by PHQ-9 (n = 722)	
Minimal	482 (66.8)
Mild	155 (21.5)
Moderate	56 (7.8)
Moderately severe	22 (3.0)
Severe	7 (1.0)
Anxiety symptoms as assessed by GAD-7 (n = 723)	
Minimal	432 (59.8)
Mild	191 (26.4)
Moderate	67 (9.3)
Severe	33 (4.6)
Chest pain frequency since March 2020 (n = 724)	
None	333 (46.0)
1−2 / mo	268 (37.0)
1 / wk	49 (6.8)
> 1 / wk	74 (10.2)
Mean severity of chest pain among those who indicated it (scale: 1−10)	3.3 (1.6)

Variables are reported as count (percent), unless otherwise indicated. Variable-specific sample sizes are reported for variables with at least one missing value.

GAD-7, General Anxiety Disorder-7 item survey; PHQ-9, Patient Health Questionnaire-9 item; SD, standard deviation.

*One patient who reported COVID-19 symptoms did not answer questions regarding hospitalization and cardiac complications.

Chest pain was significantly associated with higher levels of depressive and anxiety symptoms (Table 2), and having experienced COVID symptoms was also associated significantly with depressive and anxiety symptoms (Table 3). COVID vaccination was not associated with depression or anxiety.

Seven of the 10 patients (70%) who lost health insurance had experienced chest pain at least 1-2 times per month since March 2020, compared to 379 of 708 patients (53.6%) who reported not losing insurance coverage ($P = 0.355$; Fisher's exact test). In those who did experience chest pain, the median severity was rated at a 5 of 10 (quartile (Q)1, 4; Q3, 6) in the group who lost health insurance and at 3.0 (Q1, 2; Q3, 4) in the group who did not ($P = 0.022$; Wilcoxon rank-sum test). Time since first SCAD was not associated significantly with loss of health insurance.

Although most respondents did not describe financial difficulties, 40% of respondents found it more difficult to follow or were unable to follow a healthy lifestyle since the pandemic onset (Fig. 1). A majority of patients (86%) received COVID-19 vaccination, with government health resources being the most common reason for vaccine uptake, and "other" being the most common reason for vaccination declination. Supplemental Figure S1 shows rationales given for receiving vaccination. Given that the survey was conducted early in the pandemic, these data reflect uptake of the first vaccination and not subsequent doses.

Using the Likert scales, a small, but statistically significant, association of higher mean stress with reduction in work hours and/or pay and/or unemployment ($P = 0.013$) and remote work and/or change of job ($P < 0.001$). Stress level was also higher in those who experienced loss of insurance and/or medical coverage ($P = 0.025$; Tables 4-6; Fig. 2). Similarly, a trend occurred toward a higher mean Likert-scale score for level of anxiety with reduction in work hours and/or pay and/or unemployment ($P = 0.081$), and remote work and/or change of job ($P = 0.007$). Anxiety levels were also higher among those who lost insurance and/or medical coverage ($P = 0.008$). These associations were not as apparent when assessing according to the GAD-7 scores, with higher severity of symptoms according to the GAD-7 score being associated significantly with only loss of insurance and/or medical coverage (Tables 4-6; Fig. 3). The Likert scale score for depressive symptoms was higher with loss of insurance and/or medical coverage, and PHQ-9 scores did not demonstrate the same association (Table 6; Figs. 2 and 3). Overall, a moderate correlation occurred between the Likert anxiety scale score and the GAD-7 survey score (0.68), and between the Likert depression scale score and the PHQ-9 survey score (0.66).

Discussion

The primary findings of this cross-sectional study of SCAD patients are as follows: (i) very few (< 1%) of patients with prior SCAD required hospitalization or experienced cardiac complications early during the COVID-19 pandemic; (ii) the overall burden of anxiety and depression symptoms after SCAD was relatively low, and only 13.9% had ≥ moderate anxiety

Table 2. Depression and anxiety severity, stratified by whether individual experienced chest pain at least 1–2 times per month since March 2020

Measure	No chest pain (n = 333)	Chest pain (n = 391)	Total (n = 724)	P
PHQ-9 score (n = 721), mean (SD)	2.9 (3.5)	5.1 (4.9)	4.1 (4.4)	< 0.001*
Severity of depressive symptoms as assessed by PHQ-9 (n = 721)				< 0.001†
Minimal	254 (76.5)	227 (58.4)	481 (66.7)	
Mild	60 (18.1)	95 (24.4)	155 (21.5)	
Moderate	14 (4.2)	42 (10.8)	56 (7.8)	
Moderately severe	3 (0.9)	19 (4.9)	22 (3.1)	
Severe	1 (0.3)	6 (1.5)	7 (1.0)	
GAD-7 score (n = 722), mean (SD)	3.2 (3.7)	5.8 (5.0)	4.6 (4.6)	< 0.001*
Severity of anxiety symptoms as assessed by GAD-7 (n = 722)				< 0.001†
Minimal	238 (71.5)	193 (49.6)	431 (59.7)	
Mild	75 (22.5)	116 (29.8)	191 (26.5)	
Moderate	14 (4.2)	53 (13.6)	67 (9.3)	
Severe	6 (1.8)	27 (6.9)	33 (4.6)	

Data are reported as count (percent), unless otherwise indicated.

GAD-7, General Anxiety Disorder-7 item survey; PHQ-9, Patient Health Questionnaire-9 item; SD, standard deviation.

*Student t test.

†Fisher's exact test.

symptoms on the GAD-7 survey, and only 11.8% had ≥ moderate depression on the PHQ-9 survey; and (iii) using Likert-scale measurements, higher levels of stress and anxiety during the COVID-19 pandemic were associated with a reduction in work hours and/or pay and/or unemployment; remote work and/or change of job; and loss of insurance and/or medical coverage, but the effect sizes were relatively modest. These associations were not significant when using the GAD-7 and PHQ-9 scores, despite their moderate correlation with the Likert scale scores. However, the presence of chest pain and the presence of COVID symptoms were each associated with higher GAD-7 and PHQ-9 scores. The low rates of hospitalization and cardiac complications in the surveyed patients are reassuring, as cardiovascular disease was been considered a risk factor for a more severe disease course early in the pandemic.[16,17] Additionally, the existing literature about SCAD and COVID is limited to case reports hypothesizing that COVID-19 could contribute to the onset of SCAD among patients, due to pandemic stress or COVID-19-associated inflammation and vascular disruption. Although one possibility is that the participants who responded to the survey were those who felt well enough to do so, the overwhelming majority (98.6%) of the 727 Mayo Clinic SCAD respondents did not experience cardiac complications or hospitalization.

However, the prevalence of chronic chest pain was notable, with over half of patients experiencing chest pain in at least 1-2 episodes per month since March of 2020, with a mean severity score of 3.3 (range: 1-10, with 10 being most severe). A high prevalence of chest symptoms after SCAD was observed previously, prior to the COVID-19 pandemic,[1] although this was not reported as monthly frequency. Specifically, in the Canadian cohort of 750 patients, the prevalence of angina was 31.8%, with 20.8% of patients seeking care in the emergency room for chest pain symptoms within 3 years after SCAD hospitalization.[18] In a cross-sectional study of 1196 Mayo Clinic Registry patients, 40.2% of patients reported having chest pain after SCAD.[19]

Regardless of whether the chest pain frequency has increased as a result of it, the pandemic again highlights the symptom burden among patients post-SCAD. An interesting finding is that the presence of chest pain and the presence of COVID symptoms were each associated with higher GAD-7 and PHQ-9 scores. These findings are exploratory in nature and do not take into account potential confounding variables.

Table 3. Depression and anxiety severity, stratified by whether individual experienced COVID-19 symptoms ("unsure" responses are treated as missing)

| Measure	No symptoms (n = 593)	Symptoms (n = 91)	Total (n = 684)	P
PHQ-9 score (n = 682), mean (SD)	3.8 (4.3)	5.3 (5.1)	4.0 (4.4)	0.002*
Severity of depressive symptoms as assessed by PHQ-9 (n = 682)				0.003†
Minimal	417 (70.6)	47 (51.6)	464 (68.0)	
Mild	116 (19.6)	26 (28.6)	142 (20.8)	
Moderate	36 (6.1)	13 (14.3)	49 (7.2)	
Moderately severe	16 (2.7)	4 (4.4)	20 (2.9)	
Severe	6 (1.0)	1 (1.1)	7 (1.0)	
GAD-7 score (n = 683), mean (SD)	4.2 (4.4)	5.8 (5.5)	4.4 (4.6)	0.003*
Severity of anxiety symptoms as assessed by GAD-7 (n = 683)				0.018†
Minimal	371 (62.6)	43 (47.8)	414 (60.6)	
Mild	152 (25.6)	27 (30.0)	179 (26.2)	
Moderate	46 (7.8)	13 (14.4)	59 (8.6)	
Severe	24 (4.0)	7 (7.8)	31 (4.5)	

Data are reported as count (percent), unless otherwise indicated.

GAD-7, General Anxiety Disorder-7 item survey; PHQ-9, Patient Health Questionnaire-9 item; SD, standard deviation.

*Student t test.

†Fisher's exact test.
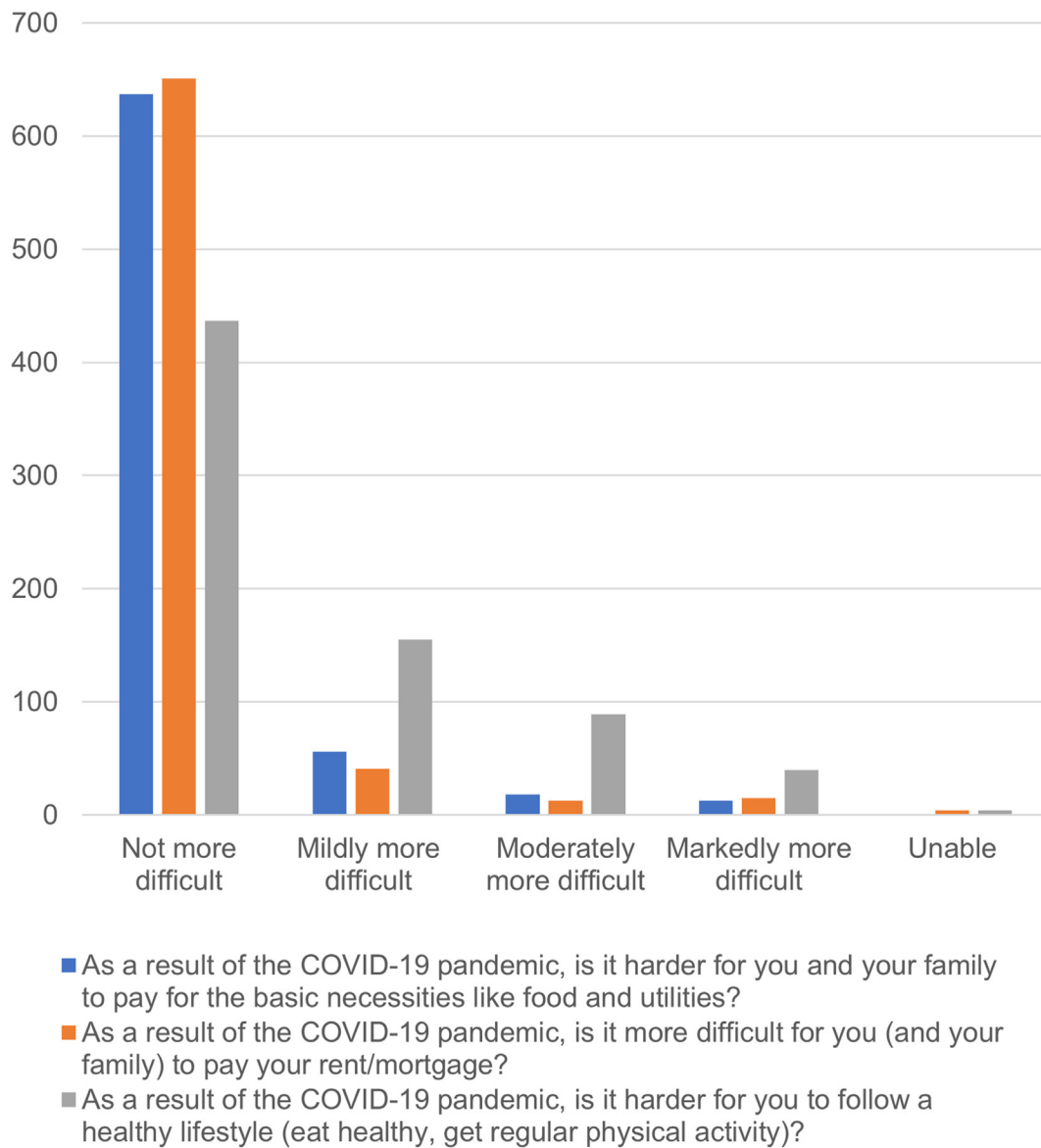
Figure 1. Reported pandemic effects since March 2020.

Furthermore, one cannot assess causality or association directionality from these data. One may hypothesize that chest pain and COVID symptoms contribute to increased anxiety and depressive symptoms. Conversely, patients with underlying anxiety and depression may be predisposed to experiencing a higher symptom burden and adverse effects on the body's response to illness.

In regard to chest pain after SCAD, the etiologies may be cardiac or noncardiac.[1] Cardiac etiologies include ischemia from persistent coronary obstruction post-SCAD or percutaneous intervention (eg, in-stent restenosis) and coronary vasospasm or microvascular dysfunction. These etiologies are best assessed with studies for ischemia (eg, a stress study with imaging) or coronary anatomy and function (eg, coronary computed tomography angiography or coronary angiography + functional testing). Patients also can have symptoms from myopericarditis and/or pericarditis, or uncommonly, pulmonary embolism and/or pulmonary hypertension. Noncardiac causes can include gastroesophageal reflux disease, chest wall pain, pleuritis, chronic pain syndrome, cardiac hypersensitivity, neurologic or psychosomatic and/or posttraumatic stress disorder symptoms. This finding emphasizes the importance of understanding the etiology among these patients, as that will affect treatment. And certainly, an important percentage of SCAD patients continue to have such symptoms, suggesting that room for improvement remains in the care of SCAD patients.

The incidences of a moderate or higher level of anxiety and depressive symptoms of 13.9% and 11.8%, according to the GAD-7 and PHQ-9 surveys, are comparable to the previously

Table 4. Depression, anxiety, and stress severity, stratified by whether individual experienced reduction in work hours and/or pay and/or unemployment

Measure	No (n = 568)	Yes (n = 148)	P
PHQ-9 score (n = 714), mean (SD)	4.1 (4.6)	4.0 (3.6)	0.814[*]
Severity of depressive symptoms, as assessed by PHQ-9 (n = 714)			0.168[†]
Minimal	381 (67.3)	97 (65.5)	
Mild	117 (20.7)	37 (25.0)	
Moderate	41 (7.2)	13 (8.8)	
Moderately severe	21 (3.7)	1 (0.7)	
Severe	6 (1.1)	0 (0.0)	
Depression score (of 10; n = 714), mean (SD)	3.5 (2.5)	3.9 (2.5)	0.135[*]
GAD-7 score (n = 714), mean (SD)	4.5 (4.7)	4.9 (4.3)	0.253[*]
Severity of anxiety symptoms, as assessed by GAD-7 (n = 714)			0.052[†]
Minimal	349 (61.7)	77 (52.0)	
Mild	140 (24.7)	51 (34.5)	
Moderate	49 (8.7)	16 (10.8)	
Severe	28 (4.9)	4 (2.7)	
Anxiety score (of 10; n = 716), mean (SD)	4.9 (2.6)	5.3 (2.7)	0.081[*]
Stress score (of 10), mean (SD)	5.2 (2.5)	5.8 (2.4)	0.013[*]

Data are reported as count (percent), unless otherwise indicated.

GAD-7, General Anxiety Disorder-7 item survey; PHQ-9, Patient Health Questionnaire-9 item; SD, standard deviation.

[*] Student t test.

[†] Fisher's exact test.

Table 6. Depression, anxiety, and stress severity, stratified by loss of insurance coverage

Measure	No (n = 708)	Yes (n = 10)	P
PHQ-9 score (n = 716)	3.0 (1.0, 6.0)	4.5 (4.0, 6.8)	0.062[*]
Severity of depressive symptoms as assessed by PHQ-9 (n = 716)			0.276[†]
Minimal	474 (67.1)	5 (50.0)	
Mild	148 (21.0)	5 (50.0)	
Moderate	55 (7.8)	0 (0.0)	
Moderately severe	22 (3.1)	0 (0.0)	
Severe	7 (1.0)	0 (0.0)	
Depression score (of 10; n = 717)	3.0 (1.0, 5.0)	6.0 (4.2, 7.0)	0.002[*]
GAD-7 score (n = 717)	3.0 (1.0, 7.0)	6.0 (5.0, 9.5)	0.034[*]
Severity of anxiety symptoms as assessed by GAD-7 (n = 717)			0.015[†]
Minimal	428 (60.5)	2 (20.0)	
Mild	183 (25.9)	5 (50.0)	
Moderate	63 (8.9)	3 (30.0)	
Severe	33 (4.7)	0 (0.0)	
Anxiety score (of 10; n = 717)	5.0 (3.0, 7.0)	7.0 (6.0, 9.0)	0.008[*]
Stress score (of 10; n = 717)	6.0 (3.0, 7.0)	7.0 (5.2, 9.0)	0.025[*]

Data are reported as median (interquartile range) or count (percent), unless otherwise indicated.

GAD-7, General Anxiety Disorder-7 item survey; PHQ-9, Patient Health Questionnaire-9 item.

[*] Wilcoxon rank-sum test.

[†] Fisher's exact test.

reported levels of 15% and 16%, from patients in the Mayo Clinic SCAD Registry, prior to the onset of the COVID-19 pandemic.[20] Presuming that similar biases affected the responses to that previous cross-sectional study, these data

Table 5. Depression, anxiety, and stress severity, stratified by "sought remote work accommodations and/or required to work remotely and/or change of job because of exposure concerns"

Measure	No (n = 429)	Yes (n = 289)	P
PHQ-9 score (n = 715), mean (SD)	3.9 (4.5)	4.3 (4.4)	0.190[*]
Level of depressive symptoms as assessed by PHQ-9 (n = 715)			0.034[†]
N-Missing	2	1	
Minimal	298 (69.8)	180 (62.5)	
Mild	76 (17.8)	77 (26.7)	
Moderate	34 (8.0)	21 (7.3)	
Moderately severe	16 (3.7)	6 (2.1)	
Severe	3 (0.7)	4 (1.4)	
Depression score (of 10; n = 716), mean (SD)	3.5 (2.5)	3.7 (2.6)	0.305[*]
GAD-7 score (n = 716), mean (SD)	4.4 (4.6)	4.8 (4.6)	0.251[*]
Severity of anxiety symptoms as assessed by GAD-7 (n = 716)			0.548[†]
Minimal	257 (60.2)	170 (58.8)	
Mild	115 (26.9)	75 (26.0)	
Moderate	34 (8.0)	32 (11.1)	
Severe	21 (4.9)	12 (4.2)	
Anxiety score (of 10; n = 717), mean (SD)	4.8 (2.6)	5.3 (2.6)	0.007[*]
Stress score (of 10), mean (SD)	5.0 (2.5)	5.8 (2.4)	< 0.001[*]

Data are reported as count (percent), unless otherwise indicated.

GAD-7, General Anxiety Disorder-7 item survey; PHQ-9, Patient Health Questionnaire-9 item; SD, standard deviation.

[*] Student t test.

[†] Fisher's exact test.

indicate that the prevalence of anxiety or depressive symptoms did not increase in the context of the COVID-19 pandemic. Incorporating the Likert-scale results, the degree of stress and anxiety among SCAD patients early in the pandemic was associated with socioeconomic parameters such as work and/or pay reduction, remote work, or loss of insurance and/or medical coverage. Although these associations were modest and were noted specifically with the Likert scales, this finding suggests that times of crisis, such as the COVID-19 pandemic, affected patients' financial and economic stability, which has been shown to be amplified by the sociocultural component of gendered inequalities in financial and economic stability.[21] The time since SCAD was not associated significantly with score severity, in contrast to a previous report.[18] Rather, older age was associated with lower PHQ-9 and GAD-7 scores, and this finding is consistent with data demonstrating age differences in mental health (ie, less anxiety and depression in older patients) during the COVID-19 pandemic.[22]

Limitations of this study include the inherent selection and referral bias of the Mayo Clinic "Virtual" Multicenter SCAD Registry. The COVID-19 survey required access to technology and motivation to complete the survey, which may introduce additional selection bias. Most respondents were White and female, which limits the generalizability of the results. In addition, the survey was completed during a single timepoint early during the COVID-19 pandemic, which has continued to evolve and affect individuals and society. The survey did not ask about emergency department visits, such as those for chest pain, which may have given additional insight regarding the effects of the pandemic and a possible confounding factor in regard to complications and medical attention early during the pandemic. Similarly, additional confounding variables may be present, and experiences of
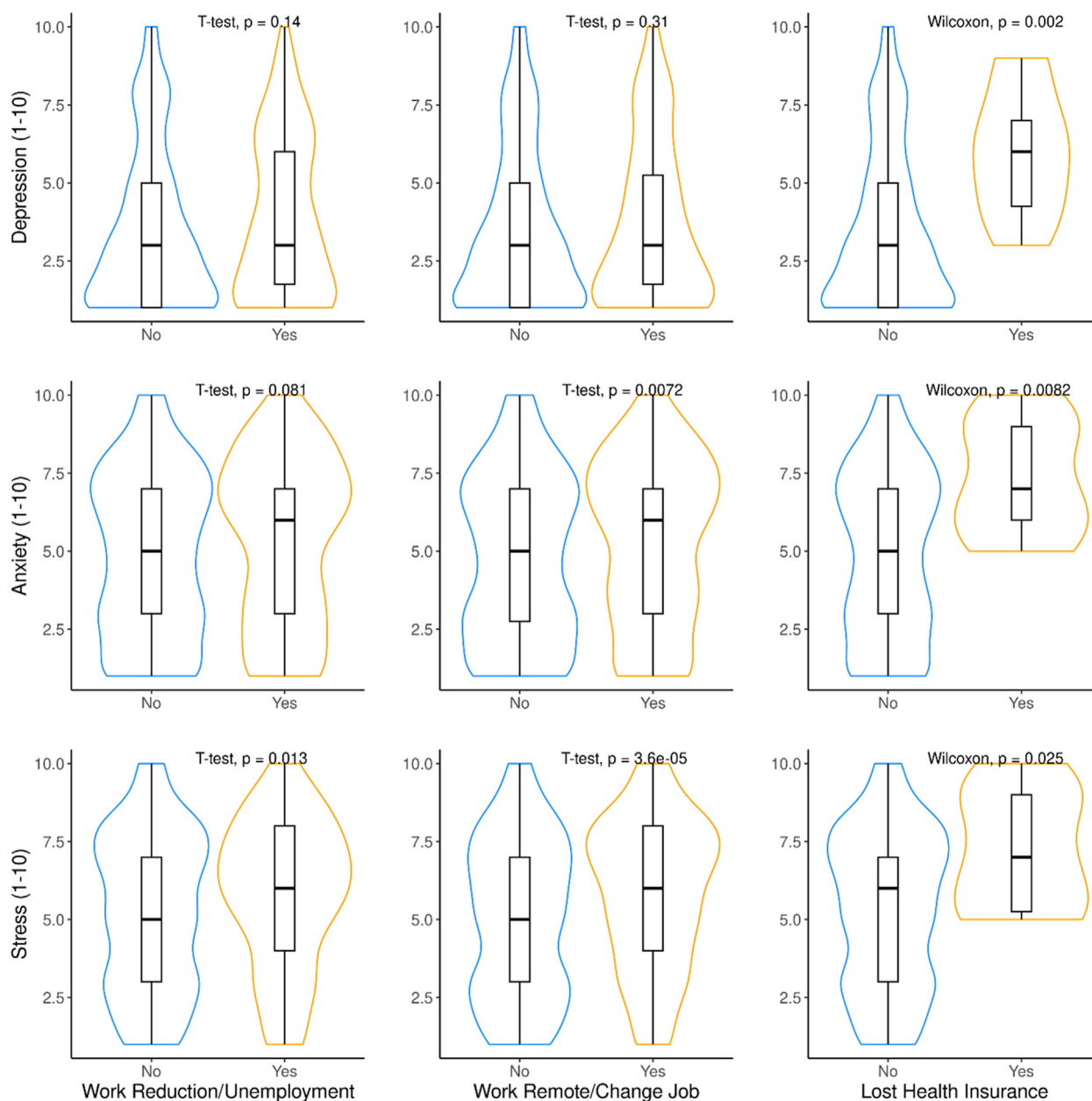
Figure 2. Violin plots (with embedded boxplots) of Likert-scale measurements (range: 1-10) of depression (row 1), anxiety (row 2), and stress (row 3), stratified by 3 variables of interest.

stress, anxiety, and depression are highly individualized, and many life circumstances may affect mental health other than job circumstances or insurance status. Due to the focused nature of the questions, further information regarding individual experiences, such as details regarding those who had cardiovascular complications, was limited to the comments section. For example, 2 participants volunteered information about their experience with "long COVID" in the comment box, but this was not asked of all respondents.

The difference in findings using the GAD-7 and PHQ-9 surveys, as compared to those using the Likert scales, is not fully understood but reflects inherent differences in assessing

anxiety and depressive symptoms (GAD-7 and PHQ-9 are validated and more objective, whereas the Likert scales are more subjective). Even though the Likert scales are simpler, some patients conceivably may have confused the value assignments for 0 and 10 on the scale. The findings regarding associations with loss of health insurance should be interpreted with caution, given that only a small number of patients lost insurance.

Despite these limitations, this study gives helpful insight regarding the impact of COVID-19 on patients with SCAD, a female-predominant condition. Future work includes understanding the long-term complications due to COVID-19
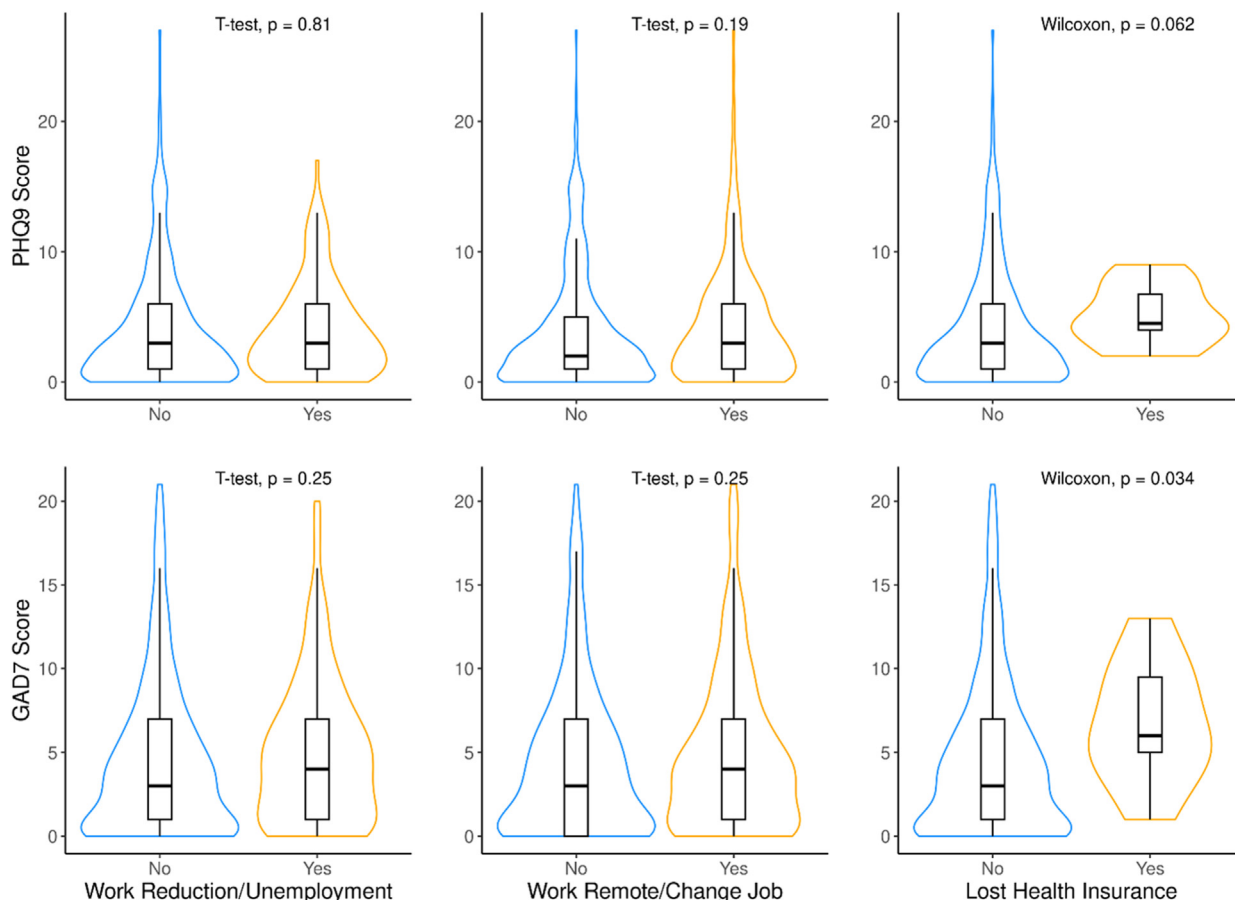
Figure 3. Violin plots (with embedded boxplots) of Patient Health Questionnaire-9 item (PHQ-9; row 1) and General Anxiety Disorder-7 item survey (GAD-7; row 2) scores, stratified by 3 variables of interest.

infection, including the impact of "long COVID" among this patient cohort.

Conclusions

Most Mayo Clinic SCAD Registry participants did not experience COVID-19 symptoms, hospitalization, or cardiac complications early in the pandemic. The prevalences of anxiety and depression symptoms were similar to those in prior reports, with most participants exhibiting minimal or mild anxiety and depressive symptoms, based on GAD-7 and PHQ-9 scores. However, Likert-scale scores of stress and anxiety were higher among participants with work and/or pay reduction and/or unemployment, remote work and/or change of job, and loss of insurance coverage as a result of the pandemic. Furthermore, over half of respondents reported persistent chest pain symptoms, highlighting a remaining clinical need among patients with a history of SCAD.

Acknowledgements

The authors sincerely thank the Mayo Clinic SCAD Registry participants, as this research would not have been possible without them. The authors also thank Nancy G. Acker, RN, and Susan K. Milbrandt, CCRC, for their assistance with the Mayo Clinic "Virtual" Multicenter SCAD Registry.

Ethics Statement

The research reported has adhered to the relevant ethical guidelines.

Patient Consent

The authors confirm that a patient consent form(s) has been obtained for this article.

Funding Sources

Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at https://www.cjcopen.ca/ and at https://doi.org/10.1016/j.cjco.2024.01.006.