Psychological and clinical characteristics of patients with spontaneous coronary artery dissection: A case-control study☆

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A R T I C L E   I N F O

A B S T R A C T

Background: The relative frequency of psychological factors in patients with spontaneous coronary artery dissection (SCAD) compared to patients with traditional atherosclerosis-related type 1 acute coronary syndrome (ACS) is unknown. This study examines whether psychological factors and emotional or physical precipitants are more common in SCAD patients versus atherosclerosis-related ACS patients.
Methods: Participants with SCAD were recruited from a Dutch SCAD database. Given the predominance of SCAD in women (>90%), only female patients were included. The age- and sex-matched atherosclerosis-related ACS group was identified from a registry database. Online questionnaires and medical records were used to investigate psychological factors and clinical information. Univariate and multivariate logistic regression models were used to examine differences between 172 SCAD patients and 76 ACS patients on emotional and physical precipitants prior to the event and psychological factors after the event.
Results: Patients with SCAD were more likely to experience an emotional precipitant in the 24 h prior to the event (56%), compared with the ACS group (39%) (OR = 1.98, 95%CI 1.14–3.44). Multivariate analyses showed that this association remained significant after adjustment for covariates (OR = 2.17, 95%CI 1.08–4.36). At an average of 3.2 years post-hospitalization for the SCAD or atherosclerosis-related ACS event, both patient groups had similar high levels of perceived stress (50% vs. 45%, p = .471) and fatigue (56% vs. 53%, p = .643).
Conclusions: This study shows that risk profiles for SCAD differ from traditional atherosclerosis-related ACS. Our findings may help health professionals to recognize SCAD and offer tailored rehabilitation and prevention programs.

1. Introduction

Spontaneous coronary artery dissection (SCAD) is characterized by a separation within or between any of the three layers of the coronary artery wall, leading to the acute formation of an intramural hematoma and, eventually, a false lumen of the coronary artery, which may cause myocardial ischemia and myocardial infarction [1–3]. The disease is not related to coronary atherosclerosis or lipid accumulation as is the case with type 1 acute coronary syndrome (ACS) [2]. Approximately 1–4% of ACS patients present with SCAD and the disease affects women substantially more often than men (90% versus 10%) [2]. It is estimated that 35% of ACS in women younger than 50 years of age are caused by SCAD [2]. It is therefore important to identify specific risk factors for SCAD in female patients that expand beyond the typical cardiac risk factors for traditional, atherosclerosis-related type I ACS.

Standard cardiovascular risk factors are uncommon in patients with SCAD, except for hypertension [2]. However, fibromuscular dysplasia (FMD), a vasculopathy of the medium-sized arteries, is found to be present in more than 40% of SCAD patients [4]. Migraine is also common in patients with SCAD [5]. In addition to these unique risk factors for SCAD, evidence suggests that there may be differences between SCAD and atherosclerosis-related ACS with regard to the immediate precipitants of their acute clinical manifestations [6].

Evolving evidence indicates that SCAD is often preceded by emotional precipitants (40–56% of cases) or heavy physical exertion (18–24%) [1,2]. In atherosclerosis-related ACS samples, the occurrence of these precipitants is substantially lower, with estimates ranging from 8 to 17% for emotional precipitants and approximately 14% for physical triggers [6,7]. However, the range of prevalence estimates

varies because measurement tools and definitions of these potential triggers differ across studies. In addition, there are no case-control studies evaluating the differences between SCAD and atherosclerosis-related ACS with regard to emotional triggers and physical precipitants.

With regard to psychological factors such as depression and anxiety in patients with a history of SCAD versus ACS, studies have shown inconsistent results. Krittanawong et al. found that anxiety and depression were less often present in patients with SCAD compared to ACS patients [8], whereas other studies showed a higher prevalence of these psychological factors in SCAD patients [9,10]. These inconsistencies may in part be explained by retrospective reports of depression and anxiety at time points well after the clinical SCAD event.

The present case-control study examines whether psychological risk factors and emotional or physical precipitants are more common in SCAD than in atherosclerosis-related ACS. Because patients with SCAD are predominantly female, the present study focuses on women only. We will test the hypothesis that emotional and physical precipitants are more common in patients with SCAD than in ACS patients and that these associations will remain significant when adjusting for sociodemographic, clinical, women-specific, and personality factors. This study will add knowledge about the unique risk factors for SCAD which will be useful for the identification of high-risk patients and the development of treatment plans.

2. Methods

2.1. Study sample

This case-control study is part of a larger investigation identifying psychological and clinical characteristics associated with SCAD. Between March and May 2019, we searched the Radboud University Medical Center (Radboudumc) SCAD database (Nijmegen, The Netherlands) to recruit cases with a history of SCAD. This database involves registration from the local tertiary referral outpatient clinic, and self-registration by patients from other national hospitals. Inclusion criteria for the SCAD group were: diagnosis of SCAD based on coronary angiographic data [11], and sufficient knowledge of the Dutch language. Coronary dissections arising from coronary diagnostic or intervention procedures (iatrogenic), or as a consequence of trauma or atherosclerotic disease were ruled out.

For the control group, referred to as 'ACS group', we searched our local registry for all the female patients accessing the catheterization laboratory in the period 2013–2018, with a diagnosis of type 1 ACS; either (ST-elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI), or unstable angina (UA). Age-matched patients (according to the age at the time of the acute event) were recruited between August 2019 and October 2019.

The present study complies with the Declaration of Helsinki, and the research protocol was approved by the local research ethics board (#2018–5017). All participants provided informed consent prior to participating in the study.

2.2. Procedure

Eligible patients received an e-mail with information about the study and were asked to provide digital informed consent via an online data capture platform [www.castoredc.com]. Patients were asked to give permission to access their medical records and for filling-out online questionnaires. Patients with SCAD who were not seen by cardiologists from the Radboudumc received an additional questionnaire about medical data (e.g., hypertension, hypercholesterolemia, and medication use) that could not be derived from hospital records, and a request to send a letter from their cardiologist with confirmed SCAD diagnosis based on coronary angiography.

In total, 217 female patients with SCAD were approached, of whom 172 (79%) gave digital informed consent, completed filling out the

questionnaires, and for whom SCAD diagnoses could be verified. With regard to the ACS group, 153 fell within the range for age-based frequency matching. Of these 153 approached patients, 76 (50%) gave permission to participate and completed the questionnaires.

2.3. Measures

2.3.1. Study sample

Patient characteristics including demographic factors, traditional cardiovascular risk factors, and women-specific factors (e.g., pregnancy-related factors, hormonal therapy, and menopausal status) were measured with self-reported questionnaires and extracted from hospital records.

2.3.2. Comorbidities

The presence of comorbid conditions was self-reported. Medical comorbidities included common disorders of SCAD patients, e.g., migraine and tinnitus, pain conditions that were expected to be present in both the SCAD group and the ACS group, and a range of chronic symptoms that do not reflect ischemic or non-ischemic cardiovascular disease.

2.3.3. Emotional and physical precipitants prior to SCAD and atherosclerosis-related ACS

2.3.3.1. Emotional and physical precipitants. Emotional distress in the 24 h before the coronary event was defined as being upset about something, feeling tense or nervous, worried, and/or extreme or unusual emotional distress. The presence of either of these factors was recorded as 'emotional precipitant' versus 'absence'. Physical exertion in the 24 h before the ACS event was defined as extreme or unusual physical exertion. We also evaluated whether patients reported to be hurrying prior to the cardiac event, as this can comprise both emotional and physical challenges, and is often a precipitant of anginal chest pain.

2.3.3.2. Personality characteristics. The Type D Scale (DS14) was used to assess Type D personality. This instrument includes two seven-item subscales (negative affectivity; NA, and social inhibition; SI) [12]. A cut-off of 10 on both subscales was used to assess the prevalence of Type D in our sample. Neuroticism was investigated with the 8-item neurotic subscale from the Dutch version of the Big Five Inventory (BFI-NL) [13].

2.3.4. Psychological factors after SCAD and atherosclerosis-related ACS

In addition to the aforementioned emotional and physical precipitants that were present *before* the ACS event, we investigated the presence of psychological factors *after* the ACS event. The European Society of Cardiology (ESC) screening guidelines were used to determine psychological factors in this study [14], and included validated questionnaires for depression, anxiety, fatigue, and perceived stress. In addition to these psychological measurements, positive mental well-being, and sensitivity to physical symptoms were investigated.

The 7-item General Anxiety Disorder questionnaire (GAD-7) was used to measure anxiety symptoms [15]. This questionnaire investigated how often, during the past two weeks, patients were bothered by specific symptoms. Moderate or severe symptoms of anxiety were present when participants scored above the previously validated cutoff of 10.

Depressive symptoms were investigated with the Patient Health Questionnaire (PHQ-9) [16]. Participants could report if specific depressive symptoms had been present in the past two weeks. Moderate or severe symptoms of depression were present when participants scored above the previously validated cutoff of 10.

Symptoms of chronic fatigue were assessed with the Fatigue Assessment Scale (FAS-10) [17]. Patients could indicate on ten items how they usually feel. Substantial or extreme fatigue was determined by a cutoff of 22 [18].

Perceived stress was investigated with the Perceived Stress Scale (PSS) [19]. The 10-item version, which shows better psychometric characteristics compared to the original 14-item PSS, was used to identify participants with moderate or high perceived stress (cutoff ≥14) [20].

The Mental Health Continuum-Short Form (MHC-SF) was used to investigate positive mental well-being [21]. This 14-item instrument assesses emotional, psychological, and social well-being.

Attentional focus on body sensations was assessed with the Body Vigilance Scale (BVS-3) [22].

2.4. Statistical analyses

Characteristics of the study sample are reported as mean ± standard deviation (SD) for continuous variables, and frequencies and percentages for categorical variables. Univariate logistic regression analyses were used to investigate differences between patients with SCAD ("cases") versus atherosclerosis-related ACS ("controls") on sociodemographic factors, clinical factors, emotional and physical precipitants, and psychological factors. Data are presented as odds ratios (OR) with 95% confidence intervals (CI). Additional multivariate logistic regression models were used to examine whether the odds ratios remained significant when adjusting for sociodemographic (age, education level), lifestyle-related (physical inactivity), women-specific factors (gestational hypertension), and personality factors (neuroticism). Confidence intervals above or below 1.0 were considered statistically significant. Statistical analyses were performed using SPSS (version 24).

3. Results

3.1. Patient characteristics

Table 1 shows the characteristics of the 172 female patients with SCAD and the 76 patients with ACS due to atherosclerosis. Even after age-matching, patients with a history of SCAD were on average four years younger at the time of their event (49.4 ± 7.6 vs. 53.3 ± 7.3). Patients with SCAD were more often married, full-time or part-time employed, and had a higher education level compared to the ACS group. Standard cardiovascular risk factors were less frequent in SCAD patients (Table 1).

Patients with SCAD were more often on hormonal therapy (20% vs 7%; $p = .012$) and less often post-menopausal (37% vs. 63%; $p < .001$). Patients with SCAD also had more often a miscarriage (34% vs. 23%) but less often gestational hypertension (21% vs. 32%) than patients with ACS, but these difference were not significant (p values 0.102 and 0.072, respectively) (Supplemental Table S1).

Migraine (52% vs. 22%) and tinnitus (28% vs. 13%) were more often reported by SCAD patients than ACS patients (p-values <.001 and 0.013, respectively). The prevalence of other medical disorders and chronic pain conditions did not differ between the two groups. (Supplemental Table S1).

3.2. Emotional and physical precipitants prior to SCAD versus atherosclerosis-related ACS

Table 2 shows the prevalence of emotional and physical precipitants in the 24 h before the cardiac event in both groups. Patients with SCAD on average reported more often the presence of emotional distress (56% vs. 39%, $p = .015$). When examining specific emotional precipitants, SCAD patients reported more often to have been upset in the 24 h prior to the event, compared with ACS patients. The prevalence of other emotional precipitants did not differ between groups. Extreme or unusual physical exertion was reported by 20% of the ACS group and 18% of the SCAD group ($p = .749$). There were also no differences in the number of patients who reported hurrying prior to SCAD vs. ACS.

3.3. Personality characteristics and psychological factors after SCAD versus ACS

The patients with SCAD did not differ with regard to personality factors. The groups did not differ in levels of neuroticism ($p = .229$). In addition, the prevalence of Type D personality was 19% in the SCAD group, and 22% in the ACS group ($p = .493$). No significant differences between groups on psychological factors after the coronary event were found (Table 3). Moderate or severe anxiety symptoms (GAD-7 ≥ 10) were

Table 1
Demographic and cardiovascular risk factors: a comparison between traditional ACS patients and SCAD patients.

Characteristics			
Demographic factors	Traditional ACS ($n = 76$)	SCAD ($n = 172$)	Unadjusted OR
Age (years)	56.4 ± 7.1	52.0 ± 7.5	0.92 (0.89–0.96), $p < .001$
Age at (most recent) coronary event	49.4 ± 7.6	53.3 ± 7.3	0.93 (0.90–0.97), $p < .001$
European descent	75 (99%)	169 (98%)	1.33 (0.14–13.01), $p = .806$
Married or in a relationship	59 (78%)	154 (90%)	0.41 (0.20–0.84), $p = .015$
Employment status			0.75 (0.64–0.88), $p = .001$
- Employed, working full time	11 (15%)	31 (18%)	
- Employed, working part time	24 (32%)	98 (57%)	
- Other (e.g., unemployed, retired, homemaker)	41 (54%)	43 (25%)	
Education level			4.38 (2.36–8.13), $p < .001$
- High (University education or higher professional education)	17 (22%)	96 (56%)	
- Low (Secondary vocational education, secondary education, or primary education)	59 (78%)	76 (44%)	
Cardiovascular risk factors	Traditional ACS ($n = 76$)	SCAD ($n = 172$)	Unadjusted OR
Time between ACS event and survey completion	3.2 ± 2.1	3.1 ± 3.1	0.95 (0.87–1.04), $p = .294$
Hypertension	40 (53%)	54 (31%)	0.34 (0.20–0.58), $p < .001$
Hypercholesterolemia	38 (50%)	15 (9%)	0.09 (0.05–0.19), $p < .001$
Diabetes mellitus	14 (18%)	2 (1%)	0.05 (0.01–0.24), $p < .001$
Family history of coronary heart disease at age < 60 years	51 (67%)	80 (47%)	0.40 (0.21–0.78), $p = .007$
Current smoker	15 (20%)	4 (2%)	0.10 (0.03–0.31), $p < .001$
Ever-smoker (previous or current)	41 (54%)	31 (18%)	0.19 (0.10–0.34), $p < .001$
Body mass index (kg/m^2)	27.9 ± 4.7	24.9 ± 4.4	0.87 (0.82–0.93), $p < .001$
Physical inactivity[a]	20 (26%)	29 (17%)	0.57 (0.30–1.09), $p = .087$
Alcohol (>1 glass per day)	7 (9%)	16 (9%)	1.00 (0.38–2.67), $p = .997$

Values presented as mean ± SD or n (%).
[a] Not meeting the criterion of a minimum of 30 min of moderately intensive exercise per day.

Table 2
Emotional states and physical exertion prior to SCAD versus traditional ACS.

Emotional state and physical exertion in the 24 h prior to SCAD or traditional ACS	Traditional ACS (n = 76)	SCAD (n = 172)	Unadjusted OR	Adjusted OR[a]
Emotional distress				
Any emotional distress	30 (39%)	97 (56%)	1.98 (1.14–3.44), $p = .015$	2.17 (1.08–4.36), $p = .029$
- Upset about something	20 (26%)	69 (40%)	1.88 (1.04–3.40), $p = .038$	
- Feeling tense or nervous	22 (29%)	64 (37%)	1.46 (0.81–2.61), $p = .209$	
- Worried	26 (34%)	61 (36%)	1.07 (0.60–1.88), $p = .824$	
- Extreme or unusual emotional distress	19 (25%)	55 (32%)	1.41 (0.77–2.60), $p = .269$	
Physical exertion				
Extreme or unusual physical exertion	15 (20%)	31 (18%)	0.89 (0.45–1.78), $p = .749$	
Hurrying	18 (24%)	47 (27%)	1.21 (0.65–2.27), $p = .548$	

[a] Adjusted for age, education level, physical inactivity, gestational hypertension, and neuroticism.

Table 3
Psychological factors and personality characteristics in patients with SCAD and patients with traditional ACS.

Psychological factors	Traditional ACS (n = 76)	SCAD (n = 172)	Unadjusted OR
Psychological distress			
Moderate/severe anxiety [GAD7 cutoff ≥10]	10 (13%)	21 (12%)	0.97 (0.43–2.16), $p = .937$
Moderate/severe depressive symptoms [PHQ cutoff ≥10]	12 (16%)	16 (9%)	0.55 (0.25–1.24), $p = .150$
Substantial or extreme fatigue [FAS-10 cutoff ≥22]	40 (53%)	96 (56%)	1.14 (0.66–1.95), $p = .643$
Moderate or high perceived stress [PSS-10 cutoff≥14][a]	34 (45%)	85 (50%)	1.22 (0.71–2.10), $p = .471$
Positive mental well-being [MHC-SF, mean ± SD]	3.1 ± 0.9	3.2 ± 0.8	1.15 (0.84–1.57), $p = .398$
Sensitivity to physical symptoms [BVS-3, mean ± SD)]	15.7 ± 7.3	14.3 ± 6.3	0.97 (0.93–1.01), $p = .139$
Burnout	13 (17%)	43 (25%)	1.62 (0.81–3.22), $p = .173$
Personality characteristics			
Type D personality [DS14 ≥ 10 for both NA and SI]	17 (22%)	32 (19%)	0.79 (0.41–1.54), $p = .493$
Neuroticism [BFI-NL neuroticism scale, mean ± SD]	2.7 ± 0.7	2.8 ± 0.7	1.26 (0.87–1.83), $p = .229$

present in 12% of the SCAD sample and 13% of the ACS sample. Moderate or severe depressive symptoms (PHQ-9 ≥ 10) were present in 9% of the SCAD sample and 16% of the ACS sample. More than half of the participants in both groups experienced substantial or extreme fatigue (FAS-10 ≥ 22) (53% ACS vs. 56% SCAD). Moderate or high perceived stress (PSS-10 ≥ 14) was present in 45% of the ACS sample, and 50% of the SCAD sample (see Table 3; continuous questionnaire scores are presented in Supplemental Table S2).

3.4. Multivariate models

Table 2 (right columns) shows that SCAD patients were more likely to experience an emotional precipitant in the 24 h before their event, compared with ACS patients (OR = 1.98, 95%CI 1.14–3.44). Considering the difference in mean age between the groups, even after age-matching, age was used as an additional variable in for multivariate analysis. After adjustment for age, education level, physical inactivity, and gestational hypertension, the OR for reporting an emotional precipitant was 2.23 (95%CI 1.12–4.44) times higher for SCAD compared with ACS. Further adjustment for neuroticism did not influence this association (OR = 2.17, 95%CI 1.08–4.36).

4. Discussion

The present case-control study assessed whether emotional or physical precipitants prior to the coronary event, and psychological risk factors after the event are more common in female SCAD patients than in female patients with traditional, type 1, atherosclerosis-related ACS. Emotional distress in the 24 h prior to the ACS event was significantly more frequent in the SCAD group compared to the ACS group. The higher risk for experiencing an emotional precipitant in SCAD patients remained significant when adjusting for sociodemographic, clinical, women-specific, and personality factors. The presence of psychological factors after the cardiac event (SCAD or ACS) were substantially

elevated for perceived stress and fatigue, but did not differ between both groups.

4.1. Comparison with previous studies

More than half of the SCAD patients reported the presence of an emotional precipitant in the 24 h prior to the event. This finding is consistent with previous studies in which 41–55% of SCAD patients reported to have experienced unusual emotional distress preceding the event [23–25]. However, the percentage of ACS patients that reported the presence of an emotional precipitant (36%) is higher compared to percentages reported in previous studies (range 8–17%) [6,7]. Differences in percentages might be explained by the fact that the time between the precipitant and the onset of ACS differed across studies (ranging from several days until one hour), and different measurement tools and definitions of these precipitants were used. Physical precipitants were reported by approximately 20% in both patient groups, which is consistent with percentages in previous studies on type 1 ACS patients (14%) [6], and SCAD patients (range 13–29%) [24,25].

Regarding the psychological factors after SCAD, findings indicated high levels of perceived stress and fatigue. High levels of depression and anxiety were less often reported (9% and 12%, respectively). These percentages are slightly lower compared to the results of Johnson et al., who found that 15% of patients with SCAD had a score ≥ 10 for the PHQ, and 16% scored above the cutoff of ≥10 for the GAD7 [26]. The younger age of patients at the time of SCAD in their study might explain the higher depression and anxiety scores. However, they had a longer median follow-up duration, which should result in lower anxiety scores [26].

The percentages of people with moderate or severe depressive or anxiety symptoms did not differ between both groups. This finding differs from a previous case-control study, which found that 52% of SCAD patients and 2% of ACS patients reported a history of depression, anxiety or previous neuropsychiatric illness [9]. However, measurements in

their study included medical records and detailed medical interviews, which differs from the measures in the present study. Moreover, psychological measurements in their study were documented *prior to* the coronary event. With regard to depressive symptoms, Saw et al. found slightly higher mean scores on the PHQ-9 for SCAD patients (5.7 vs. 4.9) and lower mean PHQ-9 scores for ACS patients (4.1 vs. 5.5) compared to our study [10]. However, a large national database including more than 66,000 American patients with SCAD found that anxiety and depression based on ICD-9 CM codes were less common in patients with SCAD compared to ACS patients [8]. However, no other measurements to investigate psychological factors were used in their study, and there were difficulties regarding identifying diagnoses codes, such that patients with SCAD were possibly coded as having atherosclerosis-related ACS [27]. Findings on psychological factors in ACS and SCAD patients remain inconclusive and need further investigation.

Consistent with previous studies, traditional cardiovascular risk factors including a higher body mass index (BMI) [9,28], hypertension [10,28,29], diabetes [9,10,28,29], hypercholesterolemia [9,28,29], and smoking [10,29] were less often present in the SCAD group. The finding that migraine is more common in SCAD patients compared to atherosclerosis-related ACS, corresponds with the results of Krittanawong et al. [8]. However, in contrast to their study, we did not find that other comorbidities such as rheumatoid arthritis, Ehlers-Danlos syndrome, and Marfan syndrome were more frequent in SCAD patients compared to ACS patients. These data show that the present SCAD sample is comparable to other case series with coronary dissection.

4.2. Limitations

The present study has several limitations. Since the 'controls' in our study were matched based on age, and type I ACS more frequently occurs at a higher age compared to SCAD [2,3], only a relatively small number of ACS patients could be identified. Moreover, only half of the recruited ACS patients were willing to participate and completed the questionnaires. A reason for the relatively low participation rate compared to the high (76%) inclusion of recruited SCAD patients might be that SCAD patients experienced this study as more beneficial since risk factors in SCAD patients are less investigated [30]. Although differences in mean age of both groups were still statistically significant after matching, we were able to statistically adjust for these differences in our analyses.

With regard to the SCAD sample, the majority of participants were highly educated and registered themselves for the Radboudumc SCAD database, which may have led to referral bias and sampling bias since lower educated SCAD patients might be underrepresented in this study. Since other studies and reviews did not investigate the role of education level in SCAD patients, future research should include this factor.

The present cross-sectional comparison study only focused on the presence of psychological factors *after* the coronary event, which means we cannot comment on psychological factors as risk factors for the development of the event. Longitudinal studies are needed to identify the role of psychological risk factors for incident SCAD. However, we did find that emotional precipitants in the 24 h prior to SCAD contribute to the development of the disease, and were less often reported in the ACS group.

The median time between the coronary event and survey completion was approximately three years in both groups, which means that recall bias for emotional and physical precipitants might have influenced our results.

4.3. Implications for future research and clinical practice

The finding that traditional risk factors were less prominent in SCAD, but comorbidities including migraine and tinnitus were more frequent in the highly educated SCAD group, in addition to emotional precipitants in the 24 h before the event, adds to the creation of a profile that should be recognized by health care professionals when identifying SCAD and when offering therapeutic interventions. Providing education for both health care professionals and patients about these differences in risk factors may decrease misdiagnosing and underdiagnosing of SCAD. Some components of cardiac rehabilitation, including interventions on physical and emotional domains, may overlap for both SCAD and ACS patients. However, a high number of patients with SCAD feel that cardiac rehabilitation does not meet their needs since they feel that their condition is different compared to atherosclerosis-related ACS [31]. Therefore, cardiac rehabilitation should be tailored for SCAD patients with regard to medication counseling, physical activities, social support, and stress management. Early research indicates that adapted cardiac rehabilitation is beneficial for patients with SCAD in terms of resuming activities of daily life, addressing psychosocial needs, improving physical activities, and preventing recurrent cardiac events [32–34]. However, more research into the benefits of tailored cardiac rehabilitation including larger sample sizes is needed.

4.4. Conclusion

Patients with SCAD show different risk profiles compared with atherosclerotic coronary disease. Several comorbidities including tinnitus and migraine are frequent in SCAD patients, in addition to stress and fatigue. This study is unique because it is the first case-control study demonstrating that acute emotional distress precedes a SCAD event more frequently than an atherosclerosis-related ACS event. If confirmed by additional data, our findings may help health professionals to develop tailored rehabilitation and prevention programs.

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Declaration of Competing Interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijcard.2020.08.045.

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