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Anxiety sensitivity and fear of exercise in patients attending cardiac rehabilitation

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ABSTRACT

Background: Habitual engagement in aerobic exercise is critically important for the secondary prevention of cardiovascular disease. Anxiety sensitivity, the fear of anxiety and arousal sensations, is a cognitive factor associated with risk and persistence of anxiety and stress disorders. Anxiety sensitivity has also been linked to various problematic health behaviors, including low levels of physical activity. Thus, anxiety sensitivity may undermine aerobic exercise participation in patients enrolled in cardiac rehabilitation (CR).
Purpose: This is the first study to evaluate anxiety sensitivity in patients enrolled in CR, and examine the association between anxiety sensitivity and fears about the negative consequences of exercise.
Methods: Patients (n = 69, 68.1% male) were enrolled in an outpatient, medically-supervised, multi-component 12-week CR program. Anxiety sensitivity was assessed with the Anxiety Sensitivity Index-3 (ASI-3).
Results: On average, patients had completed 5.3 (SD = 3.5) weeks of CR. Scores on the ASI-3 indicated moderate levels of anxiety sensitivity (M = 17.2, SD = 12.3). Moderate and high levels of anxiety sensitivity were present in 43.5% and 31.9% of patients. Anxiety sensitivity was significantly moderately correlated with fear of negative consequences from exercise. After adjusting for relevant covariates, anxiety sensitivity accounted for significant incremental variance in fears of negative consequences from exercise, which was a medium-sized effect.
Conclusions: Elevated anxiety sensitivity is common in patients enrolled in CR and is associated with greater fears of negative consequences from exercise. Anxiety sensitivity may be an important clinical target in CR to decrease patients' fears about bodily sensations to promote exercise engagement, and in turn, enhance CR outcomes.

1. Introduction

Cardiovascular disease (CVD) accounts for approximately 1 in every 3 deaths annually in the United States (Centers for Disease Control and Prevention, 2014; Go et al., 2013) and costs more than any other medical condition (Go et al., 2013). Habitual physical activity, especially aerobic exercise, is critical for secondary prevention of CVD to facilitate stabilization, slowing, or reversing of the atherosclerosis process (Anderson & Taylor, 2014). However, exercise levels are low in patients with CVD, even after acute coronary events, revascularization or surgical procedures (Mons, Hahmann, & Brenner, 2014). Although structured aerobic exercise through cardiac rehabilitation (CR) is a critical part of post-hospital care in patients with CVD (Anderson & Taylor, 2014), less than one-third of patients utilize CR services (Fang, Ayala, Luncheon, Ritchey, & Loustalot, 2017; Pack et al., 2014) and maintenance of habitual physical activity is low regardless of attendance to exercise-based CR (ter Hoeve et al., 2015).

One understudied barrier to aerobic exercise in CVD patients is anxiety, which is among the earliest and most intense psychological reactions following cardiac events (Moser & Dracup, 1996). Clinically-

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elevated anxiety is associated with including three-fold increased risk for all-cause mortality following acute coronary event and an almost two-fold increased likelihood of reinfarction (e.g., Edmondson et al., 2012; Januzzi, Stern, Pasternak, & DeSanctis, 2000; Tully, Cosh, & Baumeister, 2014; Tully, Cosh, & Baune, 2013). Although anxiety and fear is a normative response to a life-threatening event, increased worry and fear about cardiac sensations potentiates subjective experience of cardiac pain (Zvolensky, Eifert, Feldner, & Leen-Feldner, 2003) and can maintain anxiety (Telch et al., 2010). Such anxiety and fear may subsequently promote avoidance of activities that elicit physical sensations (e.g., aerobic exercise). Indeed, elevated anxiety following an acute coronary event is associated with elevated physical symptoms and low levels of physical activity one year later (Mayou et al., 2000).

Anxiety sensitivity is a cognitive vulnerability defined as the tendency to be fearful of, or catastrophically interpret the meaning of, anxiety and related physical sensations (Reiss, 1991). Simply put, anxiety sensitivity can be conceptualized as the fear of anxiety. Anxiety sensitivity is primarily implicated in the development and maintenance of anxiety and stress disorders (Olatunji & Wolitzky-Taylor, 2009). Limited work has examined the nature of anxiety sensitivity in patients with CVD. Theoretically, following an acute cardiac event or procedure or in the presence of cardiac threat, individuals may be fearful and overestimate the danger and risk associated with experiencing bodily sensations potentially due to cognitive biases to prominent physical and cardiac symptoms (Aikens, Zvolensky, & Eifert, 2001; Telch et al., 2010; Zvolensky et al., 2003). Initial data indicate that anxiety sensitivity is significantly higher in cigarette smokers with a self-reported history of CVD relative to smokers with no CVD history (Farris & Abrantes, 2017). Additionally, clinically-elevated levels of anxiety sensitivity were documented in a small sample of patients with coronary artery disease (Schroeder, Gerlach, Achenbach, & Martin, 2015). Further, anxiety sensitivity is associated with increased carotid plaques and arterial stiffness in those without CVD (Seldenrijk et al., 2013), suggesting its link to risk for CVD.

A growing literature, not specific to CVD, supports the link between anxiety sensitivity and various problematic health behaviors, including physical inactivity (Otto et al., 2016). Anxiety sensitivity is associated with lower levels of physical activity (Moshier, Szuhany, Hearon, Smits, & Otto, 2016), potentially due to the fear of the distressing bodily sensations evoked during exercise. Indeed, individuals with elevated anxiety sensitivity experience greater fear when engaging in structured bouts of aerobic exercise, particularly if they have a higher body mass index (Smits, Tart, Presnell, Rosenfield, & Otto, 2010), and perceive prolonged bouts of exercise as more effortful (Farris et al., 2017), relative to individuals with lower levels of anxiety sensitivity. Theoretically, anxiety sensitivity may be particularly important for patients enrolled in CR, for whom the presence of various physical symptoms and medical comorbidities can amplify anxiety and the salience and fear of body sensations (Farris & Abrantes, 2017; Zvolensky et al., 2003), especially during exercise.

Therefore, we aimed to characterize the nature of anxiety sensitivity in patients with CVD enrolled in CR, and examine the association between anxiety sensitivity and fears of potential negative health consequences of exercise. It was hypothesized that anxiety sensitivity would be (a) clinically elevated in the sample and (b) associated with more severe fears about the negative consequences of exercise.

2. Method

2.1. Participants and procedures

Patients ($n = 69$) were enrolled in an outpatient, medically-supervised, multi-component 12-week CR program. Patients were eligible for the CR program if they had a diagnosis of unstable angina, myocardial infarction, heart failure, had a left ventricular assist device, or had recent percutaneous coronary intervention, heart valve repair or replacement, heart bypass or transplant surgery. The CR program included three-times weekly structured supervised aerobic exercise, educational classes that addressed a range of topics including modifiable lifestyle factors and mental health, case management by exercise physiologist, nurse or physical therapist, peer-support programming, and, when indicated, the option for individual treatment sessions (e.g., psychologist, dietitian, pharmacist). At admission to the program, patients completed a standardized battery of self-report assessments, including measures of anxiety and depression. Anxiety sensitivity and fear of exercise were assessed at a single CR session for all patients, regardless of their current CR treatment week. Thus, all data presented are cross-sectional.

2.2. Measures

Demographic Characteristics and Medical History. Demographic factors, CR admission diagnosis, and cardiac risk status were extracted from clinic medical database. The American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) protocol was used to determine cardiac risk during exercise, which is stratified as low, moderate, or high risk, numerically coded in these data as 0, 1, and 2 (respectively). Risk stratification is used to provide instruction to clinicians regarding the amount and type of exercise supervision provided to patients during CR (Warburton, Bredin, Jamnik, Shephard, & Gledhill, 2016), and patients were not informed of their AACVPR risk stratification.

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007). The ASI-3 is an 18-item self-report measure in which respondents indicate the extent to which they are concerned about possible negative consequences of anxiety and related physical sensations (e.g., "It scares me when my heart beats rapidly"). Responses are rated on a five-point Likert scale ranging from 0 (*very little*) to 4 (*very much*) and summed to create a total score (possible range 0–72) and three subscale scores (possible range 0–24) reflecting physical, cognitive, and social consequences. The ASI-3 measure has strong psychometric properties (Taylor et al., 2007). Internal consistency of ASI-3 total and subscales scores in the current sample was good: Cronbach's $\alpha = 0.78$ (total), $\alpha = 0.82$ (physical), $\alpha = 0.90$ (cognitive), and $\alpha = 0.74$ (social). Clinical cut-scores ≥ 17 and ≥ 23 indicate moderate and high levels of anxiety sensitivity, respectively, which have been documented in undergraduate students (Allan, Korte, Capron, Raines, & Schmidt, 2014) and daily cigarette smokers (Allan et al., 2014).

Fear of Exercise Questionnaire. We developed items that assess fearful beliefs about the negative consequences of exercise (e.g., belief that something might suddenly happen physically during exercise, not being able to breathe properly during exercise, fear that a cardiac event will occur during exercise), low exercise confidence, and related avoidance behaviors (e.g., slowing down/stopping exercise when feeling physical discomfort, avoiding exercise alone because it is medically unsafe). Six items are rated on scale from a 0 (*very little*) to 4 (*very much*) and summed to create a total score (possible range 0–24). An exploratory factor analysis (EFA) using principal components analysis was conducted to examine the underlying structure of the items. The factor structure was determined by examination of the scree plot for clear discontinuities of eigenvalues and eigenvalues > 1 (Goldberg & Velicer, 2006) and factor loadings ≥ 0.40 was used to determine significant item loading (Tabachnick & Fidell, 2000). Examination of scree plot indicated that a one-factor structure was the best solution (eigenvalue = 3.15), which explained 52.5% of the total variance. The minimum average partial (MAP; Velicer, 1976) and parallel analysis with 1000 random sample datasets (O'Connor, 2000) confirmed the single component solution. All factor loadings were ≥ 0.52. Internal consistency of items was good (Cronbach's $\alpha = 0.81$).

Generalized Anxiety Disorder-7 (GAD-7 Spitzer, Kroenke, Williams, & Löwe, 2006) and Patient Health Questionnaire-9 (PHQ-9 Kroenke, Spitzer, & Williams, 2001). The GAD-7 and PHQ-9 are validated self-report assessments DSM-IV symptoms of generalized anxiety and major depression, respectively. Frequency of symptoms in the past two weeks is rated from 0 (*none*) to 3 (*nearly every day*). Scores are summed to create and higher scores reflect more severe anxiety and depressive symptoms. Internal consistency was good for the GAD-7 items (Cronbach's $\alpha = 0.87$) and PHQ-9 items (Cronbach's $\alpha = 0.81$).

2.3. Data analytic procedures

Three cases were missing data on self-reported measures from medical record data (PHQ-9, GAD-7), thus mean scores were imputed. Descriptive inferential statistics and bivariate correlations were conducted. A hierarchical regression analysis was used to examine the incremental association between anxiety sensitivity and fears of negative consequences from exercise. Cohen's f^2 was used to index effect size from the multiple regression, where values of 0.02, 0.15, and 0.35 can be considered small, medium, and large, respectively (Cohen, 1988).

3. Results

Patients (n = 69, $M_{age} = 65.6$, $SD = 10.9$; 68.1% male) identified their race as white (89.9%), black (4.3%) or other (5.8%). Marital status was reported as married (63.8%), single (24.6%), divorced (5.8%) or widowed (5.8%). CR admission diagnoses were as follows: Coronary artery bypass graft (29.0%), ST-elevation myocardial infarction (20.3%), non-ST elevation myocardial infarction (18.8%), percutaneous coronary intervention (13.0%), valve replacement/repair (10.1%), heart failure (5.8%), unstable angina (1.4%), and cardiomyopathy (1.4%). AACVPR risk status was determined as low (11.6%), intermediate (60.9%) and high (27.5%). On average, patients had completed 5.3 weeks ($SD = 3.5$, Mode = 1, 2) of CR at the time of the study.

3.1. Anxiety sensitivity

Scores on the ASI-3 indicated that patients had, on average, moderate levels of anxiety sensitivity ($M = 17.2$, $SD = 12.3$; observed range = 1–57). Descriptive information and correlations are presented in Table 1. Examination of subscale scores indicated that patients reported highest concern about the *physical* consequences of bodily sensations. Based on the validated cut-offs, 43.5% of patients had at least moderate anxiety sensitivity ($M = 28.7$, $SD = 9.2$) and 31.9% of patients had high anxiety sensitivity ($M = 31.7$, $SD = 8.9$). Anxiety sensitivity, particularly physical concerns was significantly associated with younger age, and anxiety sensitivity was not significantly associated with current program week or number of sessions attended. Anxiety sensitivity was significantly correlated with severity of anxiety symptoms and to a smaller extent with depression severity. Anxiety sensitivity did not significantly differ by patient sex, CVD diagnosis, or AACVPR risk status.

3.2. Anxiety sensitivity and fear of exercise

There was a significant moderate sized correlation of anxiety sensitivity with fears of negative consequences from exercise. A hierarchical linear regression was conducted to examine the extent to which anxiety sensitivity was incrementally associated with of fears of exercise. In the first step of the model, patient sex (1 = female, 0 = male), age, current week of CR and AACVPR status were entered as covariates. In the second step, anxiety and depressive sypmtom severity were entered. In the last step, anxiety sensitivity was entered. Model diagnostics indicated no evidence of multicollinearity (VIF < 1.8, Tolerance > 0.55). The full model was significant ($F[7,61] = 4.65$, $p < .001$) and accounted for 27.3% of variance (Adj R^2) in fears of negative consequences from exercise ($f^2 = 0.38$). The first step of the model accounted for a significant 14.0% variance ($F[4,64] = 2.61$, $p = .044$; $f^2 = 0.16$). The predictors in second step of the model accounted for an additional non-significant incremental variance 2.5% of variance ($f^2 = 0.03$). The addition of anxiety sensitivity accounted for an incremental 18.3% of variance in fears of negative consequences from exercise ($b = 0.17$, $b_{CI95\%} = 0.09\text{-}0.25$, $t = 4.14$, $p < .001$; $f^2 = 0.22$).

4. Discussion

The current study provides a novel evaluation of anxiety sensitivity (the fear of anxiety and related bodily sensations) and relationship with fears of negative consequences from exercise in patients enrolled in exercise-based CR. Moderate levels of anxiety sensitivity were reported in this sample of patients with various forms of CVD enrolled in CR. Approximately one in four patients (43.5%) had moderate levels of anxiety sensitivity, and one-third (33.3%) had high anxiety sensitivity. Physical consequences of bodily sensations (e.g., *"It scares me when my heart beats rapidly")* appear to be primary concern in these patients. Somatic aspects of CVD and diminished functional capacity likely heighten concern about the physical implication of experiencing various bodily sensations. Importantly, while anxiety sensitivity was associated with severity of anxiety symptoms and to a smaller extent depressive symptoms, anxiety sensitivity shared only 5–13% of variance with these factors. Collectively, elevated anxiety sensitivity is common in patients attending CR and is related to, but distinct, from broad negative affect symptoms, suggesting that it may warrant

Table 1
Descriptive overview and correlations between anxiety sensitivity and related characteristics.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. ASI-3 Total score	–	.84**	.89**	.85**	-.22	.12	-.03	.10	.51**	.36**	.23
2. ASI-3 Physical Concerns		–	.61**	.55**	-.31*	.19	-.04	.10	.65**	.33**	.18
3. ASI-3 Cognitive Concerns			–	.65**	-.05	.09	-.01	.08	.40**	.35**	.25*
4. ASI-3 Social Concerns				–	-.23	.02	-.03	.08	.28*	.26*	.17
5. Age					–	-.03	.17	.11	-.25*	-.17	.04
6. AACVPR Risk status						–	-.08	.04	.25*	.08	.04
7. Current week of CR							–	.83**	-.19	-.08	.10
8. Sessions attended								–	-.23	-.11	.10
9. Fear of Exercise									–	.22	.11
10. Anxiety (GAD-7)										–	.59**
11. Depression (PHQ-9)											–
Mean	17.2	7.1	4.2	5.9	65.5	1.2	5.3	7.8	5.2	4.9	4.0
SD	12.3	4.8	5.1	4.4	10.9	0.6	3.5	4.2	4.5	4.7	3.9
Observed Min-Max	1–57	0–21	0–22	0–16	39–91	0–2	1–15	1–18	0–18	0–21	0–16

$^*p < .05$; $^{**}p < .01$.

separate clinical attention.

Findings also provide novel evidence linking anxiety sensitivity to elevated fears of negative consequences from exercise. Specifically, patients with elevated levels of anxiety sensitivity hold stronger beliefs that exercise will cause harmful physical outcomes, like sudden bodily changes, impaired breathing, and cardiac events, and avoid exercise as a result. These findings build upon prior work that have documented the association between anxiety sensitivity and general emotional distress experienced during bouts of exercise (Smits et al., 2010). Anxiety sensitivity was also uniquely (incrementally) associated with fears of exercise, above and beyond the effects of demographic factors, CR treatment week, AACVPR risk status, and anxiety and depressive symptoms. Of note, prior research has found that elevated anxiety sensitivity is associated with higher levels of subjective exertion during prolonged bouts of exercise (Farris et al., 2017), which may cause individuals to limit the intensity of exercise or avoid it altogether. Although beyond the scope of this initial study, it is important to carefully evaluate the extent to which patients titrate the intensity of exercise (i.e., slow down) or discontinue in the presence of fears about bodily sensations, and the degree to which exercise adjustments are medically indicated (true alarm) versus fear-driven (false alarm). Patients with elevated anxiety sensitivity enrolled in CR may also be at increased risk for dropout from CR or non-compliance with their exercise prescription, including home-based exercise activities, due to fears about exercise. Given the importance of habitual moderate-to-vigorous intensity aerobic exercise for the efficacy of CR, future work is needed to understand how anxiety sensitivity and fears of exercise influence actual exercise engagement in patients in CR.

Interestingly, anxiety sensitivity was not significantly associated with week of CR treatment or number of sessions attended. These data suggest that mere exposure to CR may be insufficient for addressing anxiety sensitivity. Although aerobic exercise is an effective intervention for reducing anxiety sensitivity through its effect as an interoceptive exposure - repeated exposure to feared bodily sensations (Asmundson et al., 2013; Smits, Berry, Rosenfield, et al., 2008), exercise alone in the absence of other cognitive-behavioral intervention components (Smits, Berry, Tart, & Powers, 2008) is likely insufficient for reducing anxiety sensitivity in patients enrolled in CR. For example, to decrease anxiety sensitivity, patients with CVD may need an intervention that includes psychoeducation about anxiety sensitivity and the role of exercise as interoceptive exposure, in addition to disease-specific psychoeducation including exercise limits, warning signs for medical risk and guidelines for distinguishing between normal versus catastrophic fear and worry about bodily sensations. In addition, although high-intensity aerobic exercise is ideal for interoceptive exposure (Broman-Fulks, Berman, Rabian, & Webster, 2004), many patients with CVD have limited functional capacity and medical comorbidities that impact exercise prescription. Therefore, the use of high-intensity aerobic exercise *exclusively* as interoceptive exposure is likely not be feasible for all patients with CVD. Finally, there may be certain features of the CR environment that result in a context-specific vulnerability for fear of bodily sensations and exercise. It is possible that patients may perceive presence of routine safety monitoring devices during CR exercise sessions (e.g., heart rate, blood pressure, electrocardiography monitors) as indicative of threat (Telch et al., 2010), which may inadvertently potentiate and maintain patients' fears of exercise. The alternative may also be true – that in the context of elevated anxiety sensitivity and exercise fear, the presence of these devices may be perceived as "safe" and "live-saving" whereby provided reassurance to patients.

It is also worth noting that this sample of patients were generally older in age ($M = 65.5$, $SD = 10.9$) and anxiety sensitivity was associated with younger age. Prior research has found that older adults, relative to younger adults, have lower levels of anxiety sensitivity and health anxiety (Gerolimatos & Edelstein, 2012; Mahoney, Segal, & Coolidge, 2015), potentially due to more effective use of emotion regulation strategies (e.g., more accurate appraisal of bodily sensations; Gerolimatos & Edelstein, 2012) or age-related reductions in distress about physical symptoms or death given health decline is anticipated in later life (Chopik, 2017). Thus, it is possible that younger patients enrolled in CR may be at greater risk for having elevated anxiety sensitivity, and in turn, fearful beliefs about the negative consequences of exercise.

Our findings should be viewed in the context of certain limitations. The data were cross-sectional and self-report in nature. Larger studies are needed to examine the replicability of the current evidence. Additionally, although the psychometrics properties of measures of anxiety sensitivity are comparable between younger and older adults (Mahoney et al., 2015; Mohlman & Zinbarg, 2000), we are not aware of any studies that have validated ASI-3 cut points in older adults thus this work relied on existing cut points consistently documented from samples comparatively younger samples (Allan et al., 2014; Allan et al., 2014). Moreover, the study did not examine link between anxiety sensitivity and CVD risk factors (e.g., obese BMI, poor diet, cigarette smoking, hypertension, functional capacity), which is an important area for future research inquiry. While anxiety sensitivity was not significantly associated with AACVPR risk stratification, patients were not informed of their risk status thus is it unknown how awareness of risk may contribute to elevated acutely increase anxiety, catastrophic thoughts about bodily sensations and promote greater fears about the negative consequences of exercise. Finally, the study did not examine exercise engagement or clinical CR outcomes, which is a next logical step in this line of research to understand the prospective link between anxiety sensitivity and exercise compliance (at home and during CR), attendance and dropout, and CR outcomes.

Despite these limitations, the current study has several points of innovation. It provides descriptive information on the prevalence and nature of anxiety sensitivity in a clinical sample of patients in CR. This study also documented the convergent validity of the ASI-3 with measures of negative affect. Perhaps more importantly, this study presents novel evidence of the link between anxiety sensitivity and fears of negative consequences from exercise in patients attending CR. Laboratory and intervention development research in this arena has the potential to elucidate a novel, relatively unexplored psychological risk factor for exercise avoidance in patients with CVD and those enrolled in CR.

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