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Valued Life Activities, Smoking Cessation, and Mood in Post-Acute Coronary Syndrome Patients

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Abstract

Purpose—Continued engagement in valued life activities is a protective factor for depression and has been linked to readiness to quit smoking in medical populations, but has never been examined among Acute Coronary Syndrome (ACS) patients. The purpose of this study is to investigate relationships among valued life activities, mood, and smoking post-ACS.

Methods—Participants were 54 post-ACS patients who were smoking before ACS hospitalization. Data on mood, smoking status, engagement in valued activities, restriction of valued activities, and satisfactory replacement of restricted activities was collected 1-12 months post-ACS.

Results—Depressive symptoms were associated with both less valued activity engagement and greater valued activity restriction. Positive affect was associated with greater valued activity engagement and negative affect was associated with greater valued activity restriction. Satisfactory replacement of restricted activities was associated with greater positive affect, fewer depressive symptoms, and quitting smoking post-ACS. The majority of these relationships remained significant after controlling for relevant covariates, including physical functioning.

Conclusions—Valued activity restriction and engagement may contribute to depressed mood and failure to quit smoking in ACS patients. Psychotherapies that target greater engagement in valued life activities deserve further investigation in ACS patients.

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Conflict of Interest Statement

Andrew M. Busch declares that he has no conflict of interest regarding this manuscript.

John Fani Srour declares that he has no conflict of interest regarding this manuscript.

James A. Arrighi declares that he has no conflict of interest regarding this manuscript.

Christopher W. Kahler declares that he has no conflict of interest regarding this manuscript.

Belinda Borrelli declares that she has no conflict of interest regarding this manuscript.

Human Subjects Statement

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

Keywords

Depression; Coronary Heart Disease; Smoking; Activity Restriction; Acute Coronary Syndrome

Thirty-seven percent of Acute Coronary Syndrome (ACS) patients smoke cigarettes [1] and up to one third of patients experience clinically significant depression symptoms post ACS [2]. Depression at the time of ACS predicts failure to quit smoking following ACS [3] and smoking at the time of ACS predicts depression status following ACS [4]. Most importantly, depressed mood and continued smoking post-ACS are both strong independent predictors of future mortality [5, 6].

One variable that has been associated with both fewer depressive symptoms and greater readiness to quit smoking in those with chronic illness is the restriction of valued life activities due to physical limitations [7-9]. There is also evidence that generating satisfactory replacements for restricted activities can mitigate the negative effects of activity restriction [10, 7]. New physical limitations are common post-ACS. Published case reports [11] and patient authored accounts [12] indicate that valued activity restriction is an important quality of life consideration in this population; however, this issue has not been studied empirically in ACS patients. Purely physical limitations sometimes resolve over the months post-ACS, but patients often continue to restrict valued activities due to psychological barriers or misunderstanding of physical limitations by the patient or caregivers.

We hypothesize that restriction of valued activities contributes to mood disruption and is a barrier to smoking cessation in post-ACS patients. This hypothesis is consistent with the well supported behavioral model of depression which posits that depression is a) a function of losses of or chronically low levels of environmental positive reinforcement (with the ACS acting as a trigger for a sudden loss of access to positive reinforcement) and b) often associated with unhealthy avoidance behaviors (such as smoking; [13-16]).

As a first step in exploring this hypothesis, we tested whether valued activity engagement, valued activity restriction, and the ability to find satisfactory replacements for restricted activities were associated with depressive symptoms, positive and negative affect, and smoking status 1-12 months post-ACS hospitalization.

Methods

This sample consisted of 54 participants who had been hospitalized for ACS in the past 1-12 months and were smokers at the time of this index ACS event. All data was collected at one time-point. Inclusion criteria were 1) diagnosis of unstable angina (UA), ST segment elevation myocardial infarction (STEMI) or non-ST segment elevation myocardial infarction (NSTEMI), 2) smoked ≥ 3 cigarettes/day pre-hospitalization and smoked ≥ 100 cigarettes in lifetime, 3) age between 18-75 years, and 4) fluency in English. Exclusion criteria were 1) limited mental competency, 2) current psychosis, serious mental illness, or suicidality, 3) terminal illness, and 4) pregnancy at time of MI. Participants completed self-report measures and an interview (either in-person or by phone) during a single interaction with staff (i.e., data are cross sectional). No treatment was provided as part of this study. Participants were

recruited from outpatient cardiac rehabilitation and cardiology clinics, and from completers of a separate observational research study.

Self-report measures were:

1) The Center for Epidemiologic Studies Depression Scale – Short Form (CESD-10; [17]). The CESD-10 is a 10-item measure of depressive symptoms that has shown good reliability ($\alpha = 0.88$) and validity in medically ill patients [18]. The CESD-10 showed good reliability in the current sample ($\alpha = 0.89$). Items are rated on a 4 point scale indicating how many days that symptom was experienced over the past week. Scores range from 0-30 with higher scores indicating greater depression symptoms.

2) The Positive and Negative Affect Scales (PANAS; [19]). The PANAS is a 20-item measure that produces separate scores for positive affect (PA) and negative affect (NA) over the past month. Both PANAS scales have shown good internal consistency across a variety of time intervals (α s .84-.90; [19]). The PANAS showed good reliability for both PA ($\alpha = 0.89$) and NA ($\alpha = 0.86$) in the current sample. Items consist of positive and negative emotions that are rated on a 5-point Likert scale. Scale scores range from 10-50 with higher scores indicating greater affect. PA and NA were measured along with depressive symptoms in this study because recent research suggests that PA and NA may be differentially predictive of future cardiac disease [20].

3) Duke Activity Status Index (DASI; [21]). The DASI is a 12-item measure of functional exercise capacity designed for and validated with cardiac patients. It has demonstrated good reliability ($\alpha = 0.86$) and validity in cardiac patients [22]. The DASI showed good reliability ($\alpha = 0.83$) in the current sample. The DASI items ask yes/no questions about *ability* to engage in physical activities with a range of difficulty (e.g., “*Can you run a short distance?*”). DASI scores range from 0 to 58.2 with higher scores representing higher physical functional capacity.

The interview included medical history (e.g., type of ACS, cardiac rehabilitation attendance), smoking status (ex-smokers reported “No smoking, not even a puff” in the past 7 days; a standard definition of smoking abstinence [23]) and the Valued Activity Restriction and Replacement Interview (VARRI). The VARRI has been used successfully and linked to important health behavior variables in patients with physical disabilities [7]. The VARRI produces the following variables:

a) *Valued activity engagement*: Participants were asked, “What activities do you currently engage in that bring you meaning, pleasure, or a sense of accomplishment?” and were allowed to list up to six activities (examples from this sample include exercise, adult education classes, political campaigning, playing music, caring for pets, cooking, and crafts). Activity engagement was measured as a count of these responses. Valued activity engagement (in addition to activity restriction) was included in the current study because similar activity engagement variables (i.e., engagement in pleasant activities) have recently been linked to depression in post-ACS patients [24].

b) *Valued activity restriction*: Participants were asked to list “social, work related, pleasurable, or otherwise meaningful activities” that they “had to give up or severely restrict due to their cardiac condition” (examples from this sample include antiquing, employment, travel, hunting, fishing, and home maintenance). Activity restriction is measured as a count of these responses (0-6). Note that activity restriction questions were specific to limitations caused the participant’s cardiac condition.

c) *Satisfactory replacement of restricted activities*. Participants were also asked which restricted activity was the most important to them, if they had found a replacement for it (yes/no), and to rate their degree of satisfaction (0-10 scale; 0 = “not at all satisfied” to 10 = “extremely satisfied”) with any such replacement. Participants who rated satisfaction with a replacement as ≥ 5 were considered to have found a satisfactory replacement. Examples of satisfactory replacements reported by participants in the current sample included: a participant who could no longer play sports with his children that now takes them to sporting events instead and a participant who could no longer do a physically demanding job that now runs a business out of her home instead.

Analytic plan

Bivariate relations between all independent variables (valued activity engagement, valued activity restriction, and satisfactory replacement of restricted activities) and dependent variables (depressive symptoms, PA, NA, and post-ACS smoking status) are presented. Next, multivariate regressions controlling for a priori and emergent covariates are presented. DASI score was included as an a priori covariate in all models as we wanted to determine if restriction of *personally valued* activities restricted due to cardiac disease (e.g., individual can no longer engage in a specific hobby) are important, when controlling for physical functional limitations (e.g., individual can no longer walk up a flight of stairs). Number of cigarettes smoked per day prior to the index ACS event was included as an a priori covariate in models predicting post-ACS smoking status. Demographic and medical history variables significantly associated with dependent variables after controlling for DASI score were entered as emergent covariates (see table 1 for full list of variables considered for entry as emergent covariates).

Results

Seventy-nine individuals were screened. Fourteen were ineligible. Eleven were eligible, but did not participate (two declined; nine could not attend appointment times). Fifty-four participants completed the study. Twenty-nine participants were interviewed in-person and 25 were interviewed by phone (these groups did not differ significantly on any of the variables below).

Data was collected an average of 23.9 (SD = 11.0) weeks after the index event (range 5-44 weeks; median = 22 weeks). The average CESD-10 score was 10.5 (SD = 7.6; range 0-27) indicating clinically significant depressive symptoms (i.e., CESD-10 scores ≥ 10 [17]) in this sample. The mean PA score was 31.0 (SD = 7.8; range 16-47) and the mean NA score was 21.4 (SD = 7.8; range 10-37). The mean DASI score was 38.7 (SD=16.1, range = 7.2-58.2. Additional sample characteristics are reported in Table 1.

Activity engagement averaged 2.3 activities (SD = 1.2, range 0-6). Activity restriction was positively skewed (20 reported zero restricted activities), so it was treated as ordinal (median = 1, range 0-5). Bivariate correlations showed that more activity engagement was associated with higher PA ($r = .35; p = .01$) and fewer depressive symptoms ($r = -.41; p = .01$), but was not associated with NA ($r = -.16; p = .26$). More activity restriction was significantly associated with more depressive symptoms ($r_s = .38; p = .01$) and NA ($r_s = .37; p = .01$), but was not associated with PA ($r_s = -.11; p = .43$). Neither valued activity engagement nor restriction were related to post-ACS smoking status.

As expected, higher DASI score was significantly related to greater valued activity engagement ($r = .40, p = .01$) and less valued activity restriction ($r_s = -.45; p = .001$). Higher DASI score was also significantly related to fewer depressive symptoms ($r = -.37, p = .01$) and greater PA ($r = .30, p < .05$). These findings support our conservative, a priori decision to include DASI score as a step 1 covariate in all multivariate analyses described below.

Thirty-four of the 54 participants (63.0%) reported 1 restricted activity. Of these 34, 12 (35.3%) reported having a satisfactory replacement for their most important restricted activity and 22 (64.7%) reported no such satisfactory replacement. Those with a satisfactory replacement had significantly fewer depressive symptoms (CESD 7.3 (SD = 5.8) vs. 15.3 (SD = 7.4); $t(32) = 3.22, p = .01$), higher PA (35.0 (SD = 5.6) vs. 27.9 (SD = 7.2); $t(32) = 2.93, p = .01$), and a lower smoking rate (16.7% vs. 59.1%; $\chi^2 = 5.67, p = .05$), but there were no differences in NA (21.0 (SD = 7.2) vs. 25.0 (SD = 8.8)).

Multivariate findings. All linear regression models are shown in Table 2. Valued activity restriction was trichotomized for regressions due to significant skewness and unbalanced residuals when used as a continuous variable. Resulting categories were zero restricted activities ($n = 20$), one or two restricted activities ($n = 26$), and three or more restricted activities ($n = 8$). Contrast codes were utilized to enter trichotomized activity restriction as an independent variable in regression models.

Valued activity engagement, having any activity restriction (no restricted activities vs. 1 or more), and extent of activity restriction (1-2 vs. 3+ restricted activities) were all significantly related to depressive symptoms after controlling for DASI score and prior ACS. Together, valued activity engagement and restriction explained an additional 15.0% of the variance in fewer depressive symptoms on top of covariates (See Table 2, Depressive Symptoms Model 1).

Valued activity engagement was not significantly associated with PA after controlling for DASI score and being married or co-habituating in a committed relationship ($p = .08$; See Table 2, PA Model 1). Having any restricted activities was significantly related to NA controlling for DASI and heart failure ($p = .05$), while extent of activity restriction (1-2 vs. 3+ restricted activities) was not associated with NA in this model. Overall, valued activity restriction explained an additional 7.1% of variance in NA (See Table 2, NA Model 1).

Among those with at least one restricted activity ($n = 34$), having a satisfactory replacement for one's most important restricted activity was significantly associated with fewer depressive symptoms ($p = .02$; controlling for DASI score and prior ACS) and greater PA (p

= .02; controlling for DASI score and being married or co-habituating in a committed relationship). Having a satisfactory replacement explained 13.8% additional variance in depressive symptoms and 13.8% additional variance in PA (See Table 2, Depressive Symptoms Model 2 and PA Model 2).

In a two step hierarchical logistic regression predicting post-ACS smoking status among those with at least one restricted activity, having a satisfactory replacement was significantly associated with quitting smoking (Wald = 4.30; OR = 6.53, 95% confidence interval 1.11-38.50; $p = .04$) after controlling for DASI score and number of cigarettes smoked per day prior to the index ACS (heart failure was also associated with smoking in bivariate analyses, but could not be used as a covariate due to a lack of variability). Adding satisfactory replacement to the model explained an additional 13.4% of the variance in smoking status (change in Cox & Snell's pseudo R^2).

Discussion

We found that valued activity engagement and restriction were both associated with mood in the year post-ACS. Interestingly, both were associated with depressive symptoms, but there were differential relationships with specific aspects of mood: valued activity restriction was associated with NA, but not PA, and valued activity engagement was associated with PA, but not NA. Finding a satisfactory replacement for one's most important restricted activity was significantly related to fewer depressive symptoms, greater PA, and being an ex-smoker post-ACS. Most of these relationships remained significant even when relevant covariates (including physical functional capacity) were controlled.

To our knowledge these are the first data linking activity restriction variables to concurrent mood in post-ACS patients. This study also extends on previous work by linking activity restriction and engagement to mood variables after controlling for physical limitations. Furthermore, data are consistent with previous findings suggesting the importance of measuring *both* activity engagement and activity restriction [25], b) that PA and NA variables can be function differentially in post-ACS patients [20], and c) problem-solving satisfactory replacements for restricted activities can mitigate the negative effects of activity restriction [7, 10].

The current cross-sectional data does not allow for direct causal inferences and it is possible that the relationship between activity engagement/restriction and mood in ACS patients is bidirectional. In terms of causality, these results should be viewed as primarily hypotheses generating. However, there is evidence from other studies with medically ill populations showing that activity engagement/restriction predicts depression onset [26] and that targeting activity restriction/engagement with counseling improves future mood and promotes health behavior change [27]. Thus, counseling interventions that target engagement in valued life activities and replacement of restricted activities such as Behavioral Activation and Acceptance and Commitment Therapy [28, 29, 14], may deserve further study in cardiac patients. Notably, both of these treatments have been supported for improving mood [30, 31] and facilitating smoking cessation in non-ACS populations [32, 33].

The sample size in this study was small (particularly for the subsample of those with restricted activities), thus while many findings are significant, confidence intervals are wide. Further research (including longitudinal designs and larger samples) investigating valued activity engagement and restriction in cardiac patients is warranted. Such studies should test whether mood mediates the relationship between activity restriction and smoking and examine within patient trajectories of post-ACS activity restriction and engagement over time. Future work could also investigate the relationship between instructions from medical personal (and patient understanding of these instructions) related to post-ACS activity restriction and engagement.

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Table 1

Participant Characteristics

| | Mean (SD) or % |
|---|--------------------|
| <u>Demographics</u> | |
| Age (years) | 54.7 (8.8) |
| Married or living with committed partner | 44.4% ^a |
| Gender | 64.8% Male |
| Race | |
| Non-Hispanic Caucasian | 77.8% |
| African American | 11.1% |
| Hispanic | 1.9% |
| American Indian | 1.9% |
| Multiracial | 7.4% |
| Employed at least part-time | 37.0% |
| Yearly Household income \geq \$40,000 | 50.0% |
| Some college education | 48.1% |
| Years smoking before index event | 33.9 (11.9) |
| <u>Medical history</u> | |
| Weeks since index ACS event | 23.9 (11.0) |
| Type of index ACS event | |
| STEMI | 50.0% |
| NSTEMI | 13.0% |
| Unstable Angina | 37.0% |
| Prior ACS event | 27.8% ^b |
| Attended \geq 1 Session of cardiac rehabilitation | 87.0% |
| Subsequent ACS event | 13.0% |
| Co-morbidities | |
| Heart Failure | 9.3% ^{cd} |
| Diabetes | 35.2% |
| COPD | 18.5% |
| Stroke history | 5.6% |
| Orthopedic limitations | 16.7% |
| Other major (e.g., HIV, cancer) | 9.3% |
| <u>A priori covariates</u> | |
| DASI | 38.7 (16.1) |
| Cigarettes/day before index ACS | 20.7 (11.9) |
| <u>Dependent Variables</u> | |
| Depressive Symptoms (CESD-10) | 10.5 (7.6) |
| Positive Affect (PANAS) | 31.0 (7.8) |
| Negative Affect (PANAS) | 21.4 (7.8) |
| Post-ACS smoker | 46.3% |

Note. ACS = Acute Coronary Syndrome. STEMI = ST segment elevation myocardial infarction. NSTEMI = non-ST segment elevation myocardial infarction. COPD = Chronic Obstructive Pulmonary Disease. DASI = Duke Activity Status Index. CESD-10 = Center for Epidemiologic Studies Depression Scale – Short Form. PANAS = Positive Affect Negative Affect Scales

^aPredicts higher positive affect after controlling for DASI score at $p < .05$.

^bPredicts more depressive symptoms after controlling for DASI score at $p < .05$

^cPredicts higher negative affect after controlling for DASI score affect at $p < .05$

^dPredicts post-ACS smoking status after controlling for DASI score at $p < .05$

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Table 2

Valued Activity Variables predicting Depressive Symptoms, Positive Affect, and Negative Affect after controlling for relevant covariates.

| | R² Change | B | SE of B | P |
|--|---------------------------------|----------|----------------|----------|
| Depressive Symptoms model 1^a | | | | |
| Valued activity engagement | | -1.817 | .829 | .033 |
| Valued activity restriction | | | | |
| No activity restriction vs. any restriction | | 4.568 | 2.251 | .048 |
| 1-2 vs. 3 or more restricted activities | | -5.557 | 2.716 | .046 |
| Depressive Symptoms model 2^{ab} | | | | |
| Satisfactory replacement of most important restricted activity | .138 | -6.507 | 2.694 | .022 |
| Positive Affect Model 1^c | | | | |
| Valued activity engagement | .050 | 1.588 | .882 | .078 |
| Positive Affect Model 2^{bc} | | | | |
| Satisfactory replacement of most important restricted activity | .138 | 5.924 | 2.372 | .018 |
| Negative Affect Model 1^d | | | | |
| Valued activity restriction | .071 | | | |
| No restriction vs. Any restriction | | 5.059 | 2.484 | .046 |
| 1-2 vs. 3 or more restricted activities | | -1.027 | 2.991 | NS |

^aControlling for functional capacity (DASI score) and prior ACS event

^bIncludes only those with > 1 restricted activity (n = 34)

^cControlling for functional capacity (DASI score) and married/living together in committed relationship

^dControlling for functional capacity (DASI score) and heart failure status