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Anhedonia is associated with poor health status and more somatic and cognitive symptoms in patients with coronary artery disease

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Abstract

Purpose The effectiveness of cardiac rehabilitation (CR) in patients with coronary artery disease (CAD) is moderated by negative emotions and clinical factors, but no studies evaluated the role of positive emotions. This study examined whether anhedonia (i.e. the lack of positive affect) moderated the effectiveness of CR on health status and somatic and cognitive symptoms.

Methods CAD patients ($n = 368$) filled out the Hospital Anxiety and Depression Scale (HADS) to assess anhedonia at the start of CR, and the Short-Form Health Survey (SF-36) and the Health Complaints Scale (HCS) at the start of CR and at 3 months to assess health status and somatic and cognitive symptoms, respectively.

Results Adjusting for clinical and demographic factors, health status improved significantly during the follow-up ($F(1,357) = 10.84$, $P = .001$). Anhedonic patients reported poorer health status compared with non-anhedonic patients, with anhedonia exerting a stable effect over time ($F(1,358) = 34.80$, $P < .001$). Somatic and cognitive symptoms decreased over time ($F(1,358) = 3.85$, $P = .05$). Anhedonics experienced more benefits in terms of somatic and cognitive symptoms over time ($F(1,358) = 13.00$, $P < .001$).

Conclusion Anhedonic patients reported poorer health status and higher levels of somatic and cognitive symptoms prior to and after CR. Somatic and cognitive symptoms differed as a function of anhedonia over time, but health status did not. Anhedonia might provide a new avenue for secondary prevention in CAD.

Keywords Anhedonia · Cardiac rehabilitation · Health complaints · Health status · Positive affect

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Introduction

Cardiac rehabilitation (CR) has shown to be effective in improving clinical outcome [1] and health status [2], and in reducing mortality [3] in patients with established coronary artery disease (CAD). However, the effectiveness of CR seems to be moderated by both clinical and psychological factors [4, 5]. Regarding psychological factors, most attention has been paid to the detrimental effects of negative affect, such as depression [6], anxiety [7], and general distress [8], thereby neglecting the role of positive affect. Positive affect can be described in terms of joy, cheerfulness, and happiness [9]. Importantly, positive and negative affect are not merely opposite ends of a continuum [10], with the possibility that both types of affect can be present simultaneously.

In the general cardiovascular literature, there is an increased interest in the role of positive affect on clinical outcomes. In a recent study, emotional vitality, a concept that is closely related to positive affect, was protective against incident CAD [11]. In patients with established CAD, a positive relation was found between happiness and a decrease in the number of hospital readmissions after 90 days [12]. To date, studies on the relationship between positive affect–related constructs and survival have shown inconsistent results [13–17]. Anhedonia (i.e. the lack of positive affect) has been shown to independently predict the combined endpoint of adverse clinical events and mortality 1 year after an acute coronary syndrome [17] and in patients following implantation of coronary-artery stents [18], even after controlling for clinical depression and severity of depressive symptoms [17].

Apart from clinical outcomes, studies on patient-centered outcomes have been advocated, as these may help bridge the gap between research and clinical outcome [19]. To date, no studies have focused on anhedonia and patient-centered outcomes in cardiac patients. Hence, the objective of the current study was to prospectively examine the associations between anhedonia and patient-centered outcomes, defined as health status and somatic and cognitive symptoms, in CAD patients attending CR.

Method

Study design and participants

Consecutive patients with CAD ($n = 368$; response rate = 71.2%) referred to CAPRI (cardiac rehabilitation program at the Rotterdam Organization for Cardiac Rehabilitation, Rotterdam, The Netherlands) between March 2004 and October 2005, participating in the identification of subgroups of HEART patients that may not benefit optimally from CArdiac Rehabilitation (HEARTCARE) study, comprised the sample for the current study. Patients diagnosed with chronic heart failure by their treating cardiologist (due to participation in another study within the institution) and those with insufficient knowledge of the Dutch language to be able to complete questionnaires were excluded from participation. A flow-chart of the patient selection is provided in Fig. 1. Patients were asked to complete a set of psychological questionnaires at baseline and at 3-month follow-up (i.e. prior to and after completion of the rehabilitation program). The present study was set up as a between-subjects design, and not as a randomized controlled trial, given that CR has been shown to decrease mortality. Hence, it would be unethical to withhold CR from patients [6].

The study protocol was approved by the medical ethics committee of the Erasmus Medical Center, Rotterdam. The study was conducted according to the Helsinki Declaration and every patient provided written informed consent.

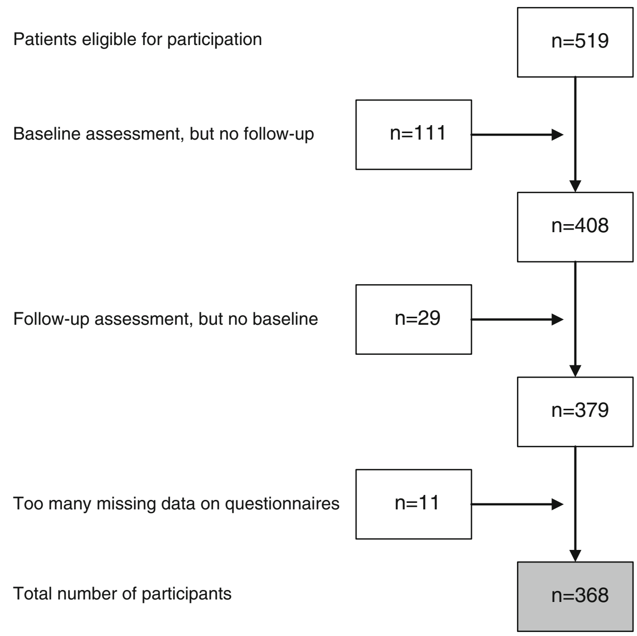

Fig. 1 Flow chart of patient selection

Contents of the rehabilitation program

The program was multi-factorial comprising an introduction module, a physical exercise component, modules on risk factors, stress management, diet, medication, weight loss, and smoking cessation, with the possibility of having individual counseling by a psychiatrist, psychologist, or social worker if necessary.

Materials

Demographic and clinical variables

Demographic variables included gender, age, educational level, marital status, and employment status. Clinical variables, obtained from the patients' medical records, included initial diagnosis, cardiac history prior to the referral event (i.e. previous myocardial infarction (MI), coronary artery bypass graft surgery (CABG), or percutaneous coronary intervention (PCI)), prescribed medications, smoking, and risk factors (i.e. hypercholesterolemia, hypertension, diabetes, family history, renal insufficiency, chronic obstructive pulmonary disease (COPD), and liver insufficiency).

Anhedonia

Anhedonia (i.e. the lack of positive affect) was assessed with the Hospital Anxiety and Depression Scale (HADS) at baseline [20, 21]. Items are scored on a 4-point Likert scale ranging from 0 to 3. Previous research using factor analysis of the HADS has identified a psychometrically sound positive subscale in patients with CAD [18]. In line with this study, the Positive Affect scale was computed by summing up four items (i.e. items 2, 4, 12, and 6) (range [0–12], mean = 9.79 ± 2.54) [18]. Anhedonia was defined as a score ≤ 7 on the Positive Affect scale (i.e. one SD below the mean). The mean scores on the Negative Affect (range [0–12], mean = 3.08 ± 2.56) and the Relaxed Affect scale (range [0–9], mean = 6.03 ± 2.30) were in line with this study as well [18].

In order to cross-validate the three subscales derived from the HADS, patients also filled out the Global Mood Scale (GMS) to assess Positive and Negative Affect [22–24]. The 20 items are answered on a 5-point Likert scale ranging from 0 ('not at all') to 4 ('extremely'). Both subscales have good internal consistency ($\alpha = .94$ and $\alpha = .93$, respectively) [24], and test–retest reliability over a 3-month period for both subscales is adequate (Negative Affect = 0.66 and Positive Affect = 0.57) [22].

Health status

The Dutch version of the Short-Form Health Survey (SF-36) was administered both at baseline and at 3 months to assess generic health status [25, 26]. All 36 items are answered according to standardized response choices and contribute to eight subscales: Physical Functioning, Social Functioning, Role Limitations due to Physical Functioning, Role Limitations due to Emotional Functioning, Mental Health, Vitality, Bodily Pain, and General Health. Raw scores were transformed to summary scores according to standard scoring procedures. Subscale scores range from 0 to 100, with higher scores indicating better levels of functioning. In addition, by using scoring algorithms, these eight scales can be summarized in two component scores: the Mental Component Score (MCS) and the Physical Component Score (PCS) [27]. The validity and reliability of the SF-36 are good [26].

Somatic and cognitive symptoms

The 24-item Health Complaints Scale (HCS), a disease-specific measure, was administered to assess somatic and cognitive symptoms at baseline and at 3-month follow-up [28]. Both the somatic and the cognitive complaints scale consist of 12 items that are scored on a 4-point Likert scale ranging from 0 ('not at all') to 4 ('extremely'), with a score range from 0 to 48. A high score on both subscales indicates more symptoms. Internal consistency is good ($.89 < \alpha < .91$) and test–retest reliability has proven to be adequate ($r = .69$) in patients with established CAD [28, 29]. This instrument has been shown to be responsive to tap treatment-related changes following CR [30].

Statistical analyses

Principal Component Analysis (PCA) with varimax rotation was used to explore the factorial structure of the HADS. The scree plot was used as a criterion for the number of factors to be extracted. KMO and Bartlett's test of sphericity were used as fit-indices. KMO (.92) and Bartlett's test of sphericity ($\chi^2(91) = 1966$, $P < .001$) indicated that the data were appropriate for carrying out a PCA. The construct validity of the HADS scales (i.e. Positive Affect, Negative Affect, and Relaxed Affect) was determined by computing Pearsons' product-moment correlations between the GMS Positive and Negative Affect scales. Discrete variables were compared with the Chi-square test and continuous variables with Student's t-test for independent samples. Analyses were adjusted for multiple comparisons by means of Bonferroni corrections (α/number of comparisons). To examine differences in health status between anhedonic and non-anhedonic patients prior to and after CR, we used multivariable analysis of variance (MANOVA) in order to adjust for multiple comparisons, given that the SF-36 comprises two summary scores (PCS and MCS) and the HCS comprises two subscales (somatic and cognitive symptoms). Multivariable analysis of covariance (MANCOVA) was performed to adjust for the effect of potential confounders on the relationship between anhedonia and health status and somatic and cognitive symptoms. A priori [31], we decided to include age, gender, comorbidity (COPD, diabetes, or renal insufficiency), the use of nitrates, antidepressant and anxiolytic medications, and receiving individual counseling as covariates in the analyses based on the literature [7, 32, 33]. In addition, we added the derived HADS Negative Affect scale in order to control statistically for a measure of negative affect, also to investigate whether negative and positive affect are merely the opposites of two ends of a continuum [10], or whether they can be present at the same time. This approach is in line with previous studies on the effects of anhedonia in cardiac patients [17, 18]. Post hoc paired samples t-tests were conducted to determine differences in summary scores for the SF-36 and scale scores of the HCS for anhedonic and non-anhedonic patients separately.

A post hoc power analysis showed that with an assumed effect-size of .20, $\alpha = .05$, and a power of 95%, a sample size of 327 patients was required to detect statistically significant differences in SF-36 component scores and HCS scores pre- and post-CR (repeated measures design, within-between interaction). This assumption was met, since analyses were performed on 368 patients. All statistical tests were two-tailed, and $P < .05$ was used to indicate statistical significance. Statistical analyses were performed using SPSS 17.0 for Windows (SPSS Inc., Chicago, Illinois, USA).

Results

Patient characteristics

Completers ($n = 368$) and non-completers ($n = 151$) of the CR program did not differ on baseline demographic and clinical characteristics.

The prevalence of anhedonia was 20.1% in the current sample. Patient baseline characteristics stratified by anhedonia are presented in Table 1. Differences emerged between anhedonic and non-anhedonic patients on baseline demographic and clinical characteristics, with anhedonic patients more frequently smoking ($P = .002$) and taking more often anti-depressant and anxiolytic medications ($P < .001$ and $P = .007$, respectively) compared with non-anhedonic patients. In addition, trends were found for non-anhedonic patients being more likely to have a partner and less likely to have individual counseling as part of CR.

Characteristics of the HADS Positive Affect scale

PCA confirmed the previously identified three-factor structure [18], comprising Positive Affect (4 items), Negative Affect (4 items), and Relaxed Affect (3 items) (Table 2). The items 8 (*"I feel as if I am slowed down"*), 9 (*"I get a sort of frightened feeling like 'butterflies' in the stomach"*), and 10 (*"I have lost interest in my appearance"*) were excluded from further analyses, because these items loaded diffusely on the three factors (high cross-loadings), had relatively low item-correlations, and did not contribute to the internal consistency of any of the scales.

The derived HADS Positive Affect subscale showed a significant correlation with the GMS Positive Affect subscale ($r = .53$, $P < .001$) and a significant negative correlation with the GMS Negative Affect subscale ($r = -.47$, $P < .001$), confirming the construct validity of this derived HADS subscale. In addition, the derived HADS Negative Affect subscale was significantly positively correlated with the GMS Negative Affect scale ($r = .50$, $P < .001$) and negatively correlated with the GMS Positive Affect subscale ($r = -.38$, $P < .001$). The HADS Relaxed Affect subscale showed significant correlations with both of the GMS Positive Affect and Negative Affect scales ($r = .36$ and $r = -38$, both Ps $< .001$, respectively).

Anhedonia as a determinant of health status

MANOVA with repeated measures demonstrated a significant within-subjects effect for time ($F(1,366) = 222.63$, $P < .001$), indicating that health status improved following CR. The time *by* Anhedonia interaction effect was not significant, indicating that Anhedonia had a stable effect on health status over time ($F(1,366) = 1.33$, $P = .25$). However, anhedonic patients reported significantly poorer health status than non-anhedonic patients ($F(1,366) = 64.53$, $P < .001$). Mean scores on health status pre- and post-CR stratified by anhedonia are presented in Fig. 2.

MANCOVA showed a main effect for time ($F(1,357) = 10.84$, $P = .001$), indicating that the overall improvement in health status after CR as seen in unadjusted analysis remained when correcting for potential confounders. Furthermore, a trend was found for the interaction effect for time *by* anxiolytic medications, denoting that patients using anxiolytic medications reported impaired health status pre- and post-CR compared with patients not using anxiolytic medications ($F(1,357) = 3.45$, $P = .06$). Comorbidity, age, gender, smoking, nitrate use, use of antidepressants, individual counseling, and the HADS Negative Affect scale did not interact with CR (all Ps $> .05$). The time *by* anhedonia interaction effect was not significant, indicating that anhedonia had a stable effect on health status over time ($F(1,357) = .23$, $P = .63$). The between-subjects effect for anhedonia remained significant, showing that anhedonic and non-anhedonic patients differed on self-reported health status ($F(1,357) = 34.80$, $P < .001$). The main effects for age ($F(1.357) = 3.85$, $P = .05$), comorbidity ($F(1,357) = 4.82$, $P = .03$), the HADS Negative Affectivity scale ($F(1,357) = 98.24$, $P < .001$), and individual counseling ($F(1,357) = 3.90$, $P = .05$) were significant.

Paired samples t-tests showed that anhedonic patients reported improvements on both the MCS and the PCS ($t(73) = -5.51$ and $t(73) = -5.21$, both Ps $< .001$). Likewise, non-anhedonic patients reported improvements on the MCS and the PCS ($t(293) = -7.52$ and $t(293) = -12.48$, both Ps $< .001$).

Anhedonia as a determinant of somatic and cognitive symptoms

MANOVA with repeated measures yielded a significant main within-subjects effect for time, indicating a decrease in somatic and cognitive symptoms following CR ($F(1,366) = 96.11$, $P < .001$). The interaction effect for time *by* anhedonia was significant, showing that anhedonia did not exert a stable effect over time on somatic and cognitive symptoms ($F(1,366) = 11.79$, $P < .001$). Finally, the between-subjects main effect for anhedonia was significant, denoting that anhedonic and non-anhedonic patients reported different levels of somatic and cognitive symptoms ($F(1,366) = 94.59$, $P < .001$). Mean scores on somatic and cognitive symptoms pre- and post-CR, stratified by anhedonia, are presented in Fig. 3.

In repeated measures MANCOVA, the main effect for time was significant, indicating that after controlling for

Table 1 Demographic and clinical data stratified by anhedonia[a]

	Total sample ($n = 368$)	Anhedonia ($n = 74$)	No anhedonia ($n = 294$)	P
Socio-demographics				
Males	290 (78.8)	58 (78.4)	232 (78.9)	.92
Age, mean (SD)	58.0 (10.2)	57.7 (10.1)	58.1 (10.3)	.77
Having a partner	330 (89.7)	62 (83.8)	268 (91.2)	.06
Clinical variables				
Cardiac event prior to index event[b]	299 (81.3)	60 (81.1)	239 (81.3)	.97
Diabetes Mellitus	54 (14.7)	13 (17.6)	41 (13.9)	.43
Dyslipidemia	185 (50.3)	42 (56.8)	143 (48.6)	.21
Hypertension	122 (33.2)	27 (36.5)	95 (32.3)	.50
COPD[c]	28 (7.6)	6 (8.1)	22 (7.5)	.86
Currently smoking	32 (8.7)	13 (17.6)	19 (6.5)	.002[d]
Medication				
ACE-inhibitors	215 (58.4)	47 (63.5)	168 (57.1)	.32
Calcium-antagonists	42 (11.4)	5 (6.8)	37 (12.6)	.16
Nitrates	118 (32.1)	15 (20.3)	103 (35.0)	.02*
Statins	298 (81.0)	62 (83.8)	236 (80.3)	.49
Aspirin	277 (75.3)	57 (77.0)	220 (74.8)	.70
Diuretics	66 (17.9)	10 (13.5)	56 (19.0)	.27
Anti-depressants	15 (4.1)	10 (13.5)	5 (1.7)	<.001[d]
Anxiolytics	31 (8.4)	12 (16.2)	19 (6.5)	.007[d]
Cardiac rehabilitation components[e]				
Introduction	144 (44.4)	29 (45.3)	115 (44.2)	.88
Risk factors	251 (77.0)	46 (70.8)	205 (78.5)	.18
Nutrition/Dietary advice	238 (73.0)	43 (66.2)	195 (74.7)	.16
Medication	196 (59.0)	38 (57.6)	158 (59.4)	.79
Physical exercise	327 (98.5)	64 (97.0)	263 (98.9)	.26
Stress management	61 (18.4)	8 (1214)	53 (20.0)	.14
Smoking cessation	26 (7.8)	4 (6.1)	22 (8.3)	.55
Weight loss	53 (16.0)	11 (16.7)	42 (15.8)	.86
Individual counseling	48 (14.5)	14 (21.2)	34 (12.8)	.08

[a] Results are presented as n(%) unless otherwise stated

[b] CABG, MI, or PCI

[c] COPD = Chronic obstructive pulmonary disease

[d] $P < .05$

[e] Due to missing data for 36–44 patients, analyses were conducted on available data

covariates, somatic and cognitive symptoms decreased during the 3-month follow-up period ($F(1{,}357) = 3.75$, $P = .05$). The interaction effect for time *by* anhedonia remained significant after controlling for covariates ($F(1{,}357) = 3.86$, $P = .05$). Likewise, the main between-subjects effect for anhedonia remained significant ($F(1{,}357) = 13.00$, $P < .001$). The main between-subjects effects for the HADS Negative Affect scale ($F(1{,}357) = 123.46$, $P < .001$) were significant.

Post hoc analyses showed that anhedonic patients reported a decrease in somatic as well as cognitive symptoms following CR ($t(73) = 5.48$ and $t(293) = 5.22$, both Ps $< .001$). Likewise, non-anhedonic patients also reported a decrease in somatic and cognitive symptoms after attending the CR program ($t(293) = 7.07$ and $t(293) = 6.54$), both Ps $< .001$).

Discussion

Studies on the role of psychological factors in CR programs have merely focused on the role of negative affect. In contrast, little is known about the effects of positive affect in CAD. To the best of our knowledge, this is the

Table 2 Factor structure of the HADS[a]

	HADS Items	Factor I[b] Positive affect	Factor II[b] Negative affect	Factor III[b] Relaxed affect
6	I feel cheerful	**.73**	−.20	.27
2	I still enjoy the things I used to enjoy	**.69**		.24
4	I can laugh and see the funny side of things	**.72**	−.24	.30
12	I look forward with enjoyment to things	**.73**		
3	I get a sort of frightened feeling as if something awful is about to happen		**.81**	
13	I get sudden feelings of panic		**.75**	
5	Worrying thoughts go through my mind	−.37	**.69**	−.25
1	I feel tense or wound up	−.42	**.54**	−.30
7	I can sit at ease and feel relaxed	−.33	−.38	**.64**
14	I can enjoy a good book or TV program	.31		**.66**
11	I feel restless as if I have to be on the move			**.81**
	Internal consistency (Cronbach's α)	.83	.81	.67

HADS = Hospital Anxiety Depression Scale

[a] Loadings < .20 are not displayed

[b] Items assigned to a factor are presented in bold-face

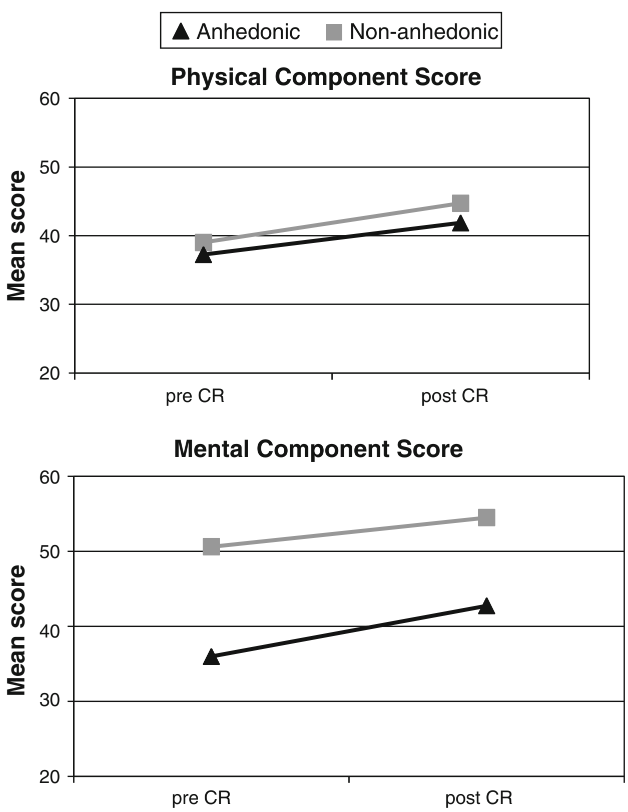

Fig. 2 Mean health status scores pre- and post-CR stratified by anhedonia. MANOVA with repeated measures. A high score represents better health status. *Note*: SDs range from 6.94 to 11.24. Main effect for Time $F(1,357) = 10.84$, $P = .001$; Main effect for Anhedonia $F(1,357) = 34.80$, $P < .001$; Interaction for Time*Anhedonia $F(1,357) = .23$, $P = .63$. *CR* Cardiac rehabilitation

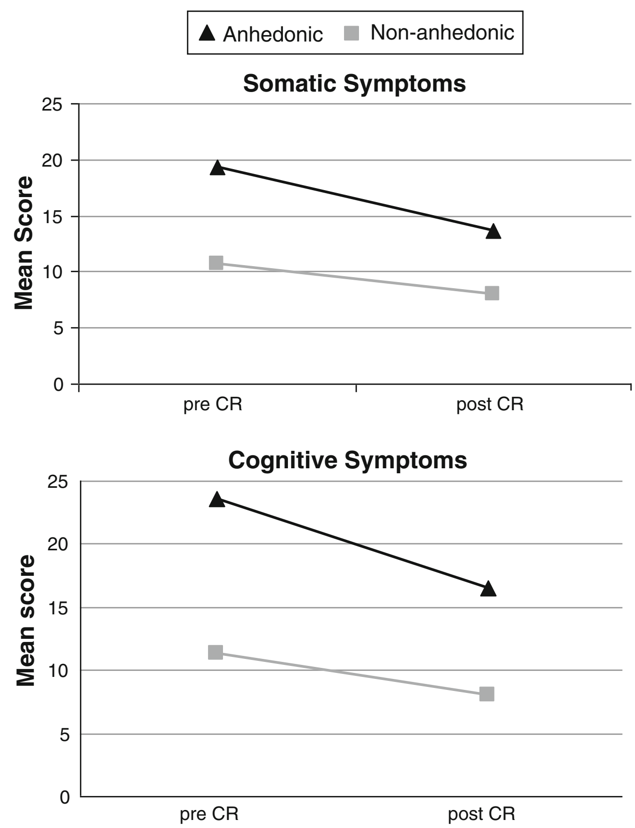

Fig. 3 Mean somatic and cognitive symptoms pre- and post-CR stratified by anhedonia. MANOVA with repeated measures. *Note*: SDs range from 7.40 to 12.73. Main effect for Time $F(1,357) = 3.75$, $P = .05$; Main effect for Anhedonia $F(1,357) = 13.00$, $P < .001$; Interaction for Time*Anhedonia $F(1,357) = 3.86$, $P = .05$. *CR* Cardiac rehabilitation

first study to demonstrate that anhedonic patients, i.e. the lack of positive affect, reported more impaired health status and higher levels of health complaints prior to and after CR attendance compared with non-anhedonic patients. Furthermore, the current study pointed out that patients' health status improved and somatic and cognitive symptoms decreased in both anhedonic as well as non-anhedonic patients over time. In addition, we found an interaction effect for anhedonia by time for somatic and cognitive symptoms, indicating that anhedonic patients reported more benefit from CR in terms of reduction in somatic and cognitive symptoms. The interaction effect for time by health status was not significant.

Our study was in line with previous findings, showing that CR may improve health status [2] and diminish somatic and cognitive symptoms [28]. However, in the present study, we were also able to identify a specific subgroup of patients—namely anhedonic patients—who consistently reported impaired health status and higher levels of somatic and cognitive symptoms despite CR attendance. The importance of anhedonia has been demonstrated previously in CAD, with anhedonia being a risk factor for major clinical adverse events following implantation of coronary-artery stents [18], and the combined endpoint of adverse clinical events and all-cause mortality [17]. The present study elaborates on these findings by showing that in a large sample of CR patients, patient-centered outcomes vary as a function of the level of anhedonia as well.

In addition, in this study, we replicated findings on the underlying factorial structure of the HADS. Originally, this instrument was developed to assess depressive and anxious symptomatology in hospitalized patients [20, 21]. However, two recent studies suggest that it is also possible to derive a measure of anhedonia from the HADS [18, 34]. Hence, with the HADS, it is possible to tap into several psychological constructs that have been shown to impact on patient well-being and prognosis in CAD without increasing patient burden, making it an opportune instrument to use in clinical practice. In line with these two other studies, we found that HADS assesses Negative Affect, Relaxed Affect, and Positive Affect. The construct validity of these subscales was confirmed by the significant medium to large correlations with the GMS, an instrument that previously has been shown to valid and reliably assess positive and negative affect [22–24]. Furthermore, the three derived HADS scales were shown to be internally consistent ($.83 < \alpha < .67$).

The notion of positive and negative affect not just merely being the opposite two ends of a continuum [10], and the possibility that both types of affect can be present simultaneously, broadens the scope. The present study supports this notion, as the effects of anhedonia remained significant after controlling for the confounding effects of negative affect. The combined effects of negative and positive affect, i.e. the interaction between those two types of affect, might refine findings and contribute to a fuller understanding of the role of affect in the context of CAD.

Limitations of the current study must be acknowledged. First, we were not able to control for markers of disease severity, (e.g. left ventricular ejection fraction) as these were not consistently collected in the current study. Moreover, in the present study, we only evaluated the effect of anhedonia on short-term patient-centered outcomes. Whether these improvements remain over time is unknown, but it has been shown that the effects of CR on health status remain over time [35, 36]. Further, patients diagnosed with chronic heart failure were excluded in the current study, due to participation in another study. Results from the current study can therefore not be generalized to this specific patient group. Fourth, information on psychiatric diagnoses and objective outcomes, such as exercise capacity, are lacking. Finally, the present study was based on a between-subjects design and improvements in health outcomes cannot be attributed to CR, due to the lack of a control-group. Strengths of the study comprise the large sample size and the use of valid and reliable instruments to assess patient-centered outcomes. In addition, both generic as well as disease-specific questionnaires were administered to evaluate CR in CAD patients.

From a clinical point of view, studies on anhedonia pave the way for the development of new interventions for secondary prevention. Positive affect has been shown to be associated with biological indices of cardiac disease in healthy individuals, like salivary cortisol, systolic blood pressure, and inflammatory markers [37–39]. However, up to now, most studies have focused on the detrimental effects of negative affective states, like distress [8] and depressive symptoms [6] on CR outcome. Our results indicate that anhedonia is also of importance in the context of CR. Consequently, incorporating and encouraging the development of skills to experience more positive affect might contribute to increased benefits from CR programs. Cognitive-behavioral therapy and mindfulness-based stress reduction have been shown to improve positive affect in medically ill patients [40, 41], and in older depressed patients at increased cardiovascular risk [42], and might be effective in enhancing positive affect in patients attending CR.

Future studies are warranted to further determine the role of anhedonia on hard outcomes like (re-)hospitalization, major clinical adverse events (MACE), and survival. Anhedonia, or the lack of positive affect, independently predicted major clinical adverse events following implantation of coronary-artery stents [18], and the combined endpoint of MACE and all-cause mortality in post-MI patients [17] in previous studies. However, the current study is of importance as health status has been shown to predict mortality in CAD patients [43], and patient-centered outcomes and the identification of its determinants have been advocated to bridge the gap between research and clinical practice [19].

In conclusion, the present study showed that anhedonic CAD patients reported poorer health status and higher levels of somatic and cognitive symptoms prior to and after CR in comparison with non-anhedonic patients. Furthermore, health status improved and somatic and cognitive symptoms decreased in both anhedonic and non-anhedonic patients. Somatic and cognitive symptoms pre- and post-CR changed differentially for anhedonic and non-anhedonic patients, with anhedonic patients reporting more changes in somatic and cognitive symptoms. These findings underscore the importance of studying positive affect within the context of CR.

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Conflicts of interest None.

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