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Health Status in Patients Treated with Cardiac Resynchronization Therapy: Modulating Effects of Personality

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Background: *Cardiac resynchronization therapy (CRT) is a promising treatment in chronic heart failure (CHF). However, a subgroup of patients still report impaired health status, cardiac symptoms, and feelings of disability following CRT. The aims of this study were to examine (1) whether CHF patients treated with CRT improved in patient-centered outcomes and functional capacity, and (2) whether personality traits exert a stable effect on these outcomes over two months.*

Methods: *Analyses are based on 31 patients (65% male; mean age 70 ± 8) with CHF treated with CRT. Two weeks before and two months after CRT, patients completed the Type-D Scale (negative affectivity, i.e., tendency to experience negative emotions, and social inhibition, i.e., tendency to inhibit self-expression), the Minnesota Living with Heart Failure Questionnaire (disease-specific health status), and the Health Complaints Scale (cardiac symptoms and perceived disability), and performed the six-minute walking test (functional capacity).*

Results: *There was an improvement in disease-specific health status ($P < 0.001$), cardiac symptoms ($P = 0.001$), perceived disability ($P < 0.001$), and functional capacity ($P = 0.007$) in all patients over two months. However, high negative affectivity patients reported significantly lower disease-specific health status ($P = 0.046$), and more cardiac symptoms ($P = 0.035$), and perceived disability ($P = 0.015$) as compared to low negative affectivity patients. There was no significant main effect for negative affectivity on functional capacity. High negative affectivity patients still reported lower disease-specific health status ($P = 0.06$) and significantly more perceived disability ($P = 0.04$) when adjusting for left ventricular ejection fraction, gender, and age. The effects of negative affectivity on patient-centered outcomes, as measured by Cohen's effect size index, were moderate to large.*

Conclusions: *Patient-centered outcomes improved over a two-month period in patients treated with CRT, but negative affectivity exerted a stable, negative effect on health status, cardiac symptoms, and perceived disability. Personality traits should be taken into account when evaluating effects of CRT. (PACE 2008; 31:28–37)*

Cardiac resynchronization therapy, personality traits, health status, patient-centered outcomes

Introduction

Cardiac resynchronization therapy (CRT) has been used extensively over the past years in patients with advanced systolic chronic heart failure (CHF) and a prolonged QRS interval. Such patients commonly have a delayed myocardial activation leading to a dyssynchronic contraction pattern of the left ventricle. This dyssynchrony results in hemodynamic alterations and ensures symptoms to the patients, such as dyspnea.[1,2] Large-scale clinical trials have shown that CRT exerts positive effects on mortality, morbidity, quality of life, functional status, and exercise capacity in CHF.[1–7] However, a subgroup of patients still report significant symptoms and high levels of disability following CRT, and are labeled as nonresponders.[8,9]

When evaluating the effects of CRT, New York Heart Association (NYHA) class and health status are most frequently used as indicators,[2,5,10] whereas the effects on a more broad range of patient-centered outcomes have not been reported. Little is also known about improvements in patient-centered outcomes following CRT. Patient-centered care refers to attending to patients' needs, improving or maintaining their quality of life, and giving them an opportunity to play an active role in medical decision making.[11] One key component of

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patient-centered care is the assessment of patient-centered outcomes. Examples of such outcomes are health-related quality of life and symptom burden.[11]

The *distressed*, or Type D, personality has been shown to influence a number of health outcomes in patients with heart disease, including mortality, morbidity, quality of life, and health status.[12–15] Type D personality is defined by two normal and stable personality traits, namely, negative affectivity (the tendency to experience a broad range of negative feelings) and social inhibition (the tendency not to share these feelings in social interaction).[16–19] Thus, patients with this disposition experience increased negative emotions, while not expressing these emotions in social interaction because of fear of rejection or disapproval.[16,17] Not only Type D personality, but also its two traits, negative affectivity and social inhibition, have been shown to be determinants of individual differences in health outcomes.[12–26] To date, no study has reported on the association between negative affectivity, social inhibition, and Type D personality, and patient-centered outcomes in patients treated with CRT.

Therefore, the aims of this study were to examine (1) whether CHF patients treated with CRT experience general improvements in patient-centered outcomes (disease-specific health status, cardiac symptoms, perceived disability) and functional capacity (six-minute walking test performance) over a two-month period, and (2) whether negative affectivity, social inhibition, or both (i.e., Type D personality) exert a stable negative effect on these outcomes.

Methods

Patient Population, Design, and Procedure

Between October 2003 and December 2006, all CHF patients who were eligible for CRT at the cardiology department of the TweeSteden teaching hospital in Tilburg, The Netherlands, were approached for participation in this study. All patients were treated according to the most recent guidelines for CHF.[27,28] These patients received either an Insync-III® (Medtronic Minneapolis, MN, USA) or Frontier-II® (St, Jude, Sylmar, CA, USA) device. These devices provide atrial-driven biventricular pacing with the use of a standard right ventricular lead and a left ventricular lead.

Inclusion criteria for CRT, and thereby for this study, were (1) diagnosis of systolic CHF, (2) being on optimal medical therapy, (3) NYHA functional class III or IV, with a QRS duration ≥120 ms, and (4) left ventricular ejection fraction (LVEF)≤40%. In addition, (5) at least one of the following echocardiographic criteria had to be fulfilled: an aortic preejection delay>140 ms, an interventricular mechanical delay>40 ms, or delayed activation of the posterolateral left ventricular wall.[3,29] For this study, patients who were unable to read, write, or understand Dutch, who had life-threatening comorbidities (e.g., cancer or a myocardial infarction one month preceding inclusion), severe cognitive impairments (e.g., dementia), or who participated in another study on psychological determinants of health outcomes in CHF, were excluded.

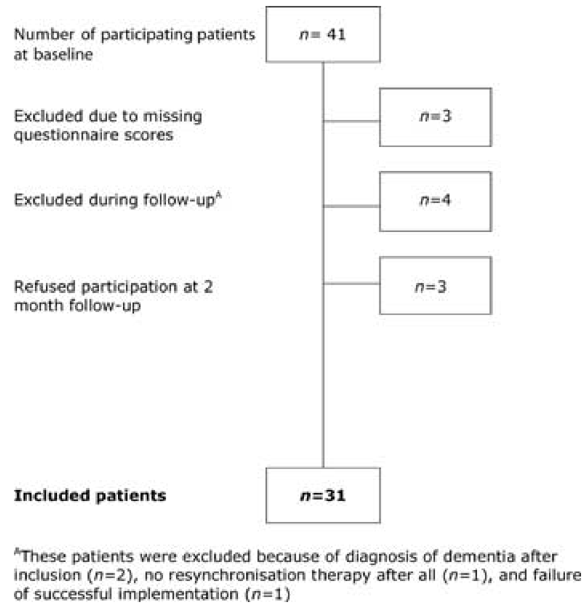

Figure 1. *Flow chart of patient selection.*

Of 91 patients, 55 fulfilled all criteria and were asked to participate in this study, of whom 41 (74.5%) agreed. However, since we used a prospective design, final analyses are based on 31 patients who had complete data at baseline and follow-up (Fig. 1).

The study was approved by the hospital medical ethics committee and carried out according to policies to protect human subjects formulated by the World Medical Association and described in the Helsinki Declaration. Every patient received verbal and written information about the study and provided written informed consent. Participation was voluntary and patients were free to withdraw at any time during the study without further explanation or consequences. The specialized heart failure nurse informed patients about the study and asked them to participate. If they agreed, they were called by the investigator in the same week to make an appointment for assessment (mean time between assessment and CRT = two weeks; SD = two weeks). During the first visit, patients were given additional information about the study and the CRT implantation procedure. They were asked to perform the six-minute walking test (6MWT) and complete a set of questionnaires at home. The questionnaires were returned in self-addressed envelopes. Two months following CRT (mean time between CRT and follow-up assessment = eight weeks; SD = three weeks), patients were asked to return to the hospital and the assessment procedure was repeated.

All questionnaires were checked for completeness, and patients who had left open several questions were called to obtain the answers. In case the questionnaires were not returned within one week after assessment, patients received a reminder telephone call or letter.

Instruments (Patient-Centered Outcomes)

The Minnesota Living with Heart Failure Questionnaire (MLWHFQ) was used to assess disease-specific health status from the patient's perspective.[30] The MLWHFQ is a subjective measure that is frequently used to measure disease-specific health status in CHF patients.[31] The 21 items are answered on a six-point scale, ranging from "no" (0) to "very much" (5), with a higher score on the MLWHFQ representing a poorer disease-specific health status.[30] The items ask about the impact of physical and psychological symptoms, and the effect of heart failure on physical and social functioning. Also, medication side-effects are captured.[32] The MLWHFQ has solid psychometric properties, with Cronbach's α ranging from 0.91 to 0.96.[30–32] The total score is the best measure of the patient's health status.[32]

Cardiac symptoms and perceived disability were measured by the Health Complaints Scale (HCS). Originally, the scale was developed to create a sensitive outcome measure in the context of coronary heart disease.[33] This questionnaire consists of two 12-item subscales, measuring cardiac symptoms that frequently occur in patients with heart disease, and perceived disability, respectively. The cardiac symptom subscale contains items measuring cardiac and pulmonary symptoms, fatigue, and sleep problems, whereas the perceived disability subscale contains items focusing on health worry (anxious concerns about ones health) and illness disruption (concerns about the extent to which illness interferes with one's life). The items are answered on a 5-point Likert scale ranging from "not at all" (0) to "extremely" (4).[33] The HCS is a valid, internally consistent (Cronbach's $\alpha \geq 0.89$), and stable (test-retest reliability $\geq$ 0.69) measure, and has good construct validity.[33,34] Furthermore, it has been shown that the HCS is sensitive to detect treatment effects.[33] A higher score on the subscales of the HCS means more symptoms and more perceived disability.

Disease-specific health status and health complaints were measured at baseline and two months following CRT.

Functional Capacity

We used the 6MWT as a measure of the patient's functional capacity. The 6MWT has good intrasubject reproducibility and reliability.[35,36] Patients were asked to walk six minutes at their own pace, without talking to the investigator. The investigator encouraged patients with standardized statements such as "You are doing well." Other conversation was not allowed. The walking test was interrupted when patients were too tired or reported too many symptoms to walk any further. The patients were permitted to stop and rest when necessary during the test.[35,37]

Functional capacity was measured at baseline and two months following CRT.

Personality Traits

Negative affectivity, social inhibition, and Type D personality were assessed with the Type D Scale (DS14).[17] The questionnaire consists of two subscales of seven items each, measuring the two normal and stable personality traits negative affectivity and social inhibition.[17] The 14 items are answered on a 5-point Likert Scale ranging from "false" (0) to "true" (4). Examples of items measuring negative affectivity are: "I often feel unhappy" and "I am often irritated." Examples of items measuring social inhibition are: "I often feel inhibited in social interactions" and "I am a closed kind of person." Type D personality is defined as a standardized cutoff $\geq$10 on both subscales of the DS14, that is, the negative affectivity as well as the social inhibition subscale. High negative affectivity and high social inhibition are defined as a score of $\geq$10 on the negative affectivity or social inhibition subscale, while scoring low on the other scale.[17] Recently, it was shown that the items of the DS14 had highest measurement precision around the mentioned cutoff.[38] The negative affectivity and social inhibition subscales have good internal consistency (Cronbach's $\alpha = 0.88/0.86$) and good three-month test-retest reliability ($r = 0.72/0.82$).[17] The construct validity of negative affectivity and social inhibition has been confirmed against the Big-Five personality traits neuroticism and extraversion, respectively.[17] Furthermore, a recent study in 475 patients with myocardial infarction indicated that Type D personality was a stable construct over an 18-month period.[39] The DS14 was administered at baseline.

Clinical Variables and Sociodemographic Characteristics

Information on sociodemographic and clinical variables (etiology, LVEF, NYHA, comorbidities, current medication, height, and weight) was collected at baseline and obtained from the medical records or the treating cardiologist/heart failure nurse. Sociodemographic variables included gender, age, marital status, educational level, and work status, and were measured by purpose-designed questions in the questionnaire. Lifestyle variables (i.e., smoking and exercising) were also measured by means of a self-report.

Statistical Analyses

Discrete variables were compared with the χ^2 test and continuous variables with Student's t-test for independent samples. In order to adjust for multiple comparisons, multivariate analyses of variance (MANOVA) for repeated measures were performed to examine whether there were differences in (a) patient-centered outcomes, that is, disease-specific health status (MLWHFQ), cardiac symptoms, and perceived disability (HCS), and (b) between low/high negative affectivity (cutoff $\geq$10), low/high social inhibition (cutoff $\geq$10), and Type D personality (yes/no)[17] on these outcomes over time. Differences on 6MWT performance over time were evaluated with an analysis of variance (ANOVA). *Post hoc* ANOVAs for repeated measures were performed to evaluate differences in mean scores on the patient-centered outcomes at baseline and two months following CRT. Personality traits were entered into the ANOVAs to examine between-group differences on all outcome measures. Analyses of covariance (ANCOVA) were used to examine whether negative affectivity exerted a stable effect on disease-specific health status, cardiac symptoms, perceived disability, and functional capacity, adjusting for baseline LVEF, gender, and age.

Finally, Cohen's effect size index (d) was used to evaluate the influence of negative affectivity and gender on all outcome measures.[40] Gender is an individual difference variable that is often included in cardiovascular research.[41] An effect size (ES) of 0.20 is considered small, of 0.50 moderate, and of $\geq$0.80 large.[40] All analyses were performed using SPSS 14.0 for Windows (Chicago, IL, USA).

Results

Baseline Characteristics

Of 31 patients, 11 (36%) patients had elevated scores on negative affectivity and 18 patients (58%) were significantly socially inhibited. The prevalence of Type D personality in this sample was 26% (8/31).

Baseline characteristics for the complete sample and stratified by negative affectivity are shown in Table I. High negative affectivity patients differed from low negative affectivity patients on educational level in that patients high on negative affectivity were more often on lower educational level.

CRT and Patient-Centered Outcomes

The results of the MANOVA for repeated measures indicated a significant overall improvement in disease-specific health status, cardiac symptoms, and perceived disability $F(1,30 = 25.15$; $P < 0.001)$.

ANOVA for repeated measures showed a significant general improvement in disease-specific health status as measured with the MLWHFQ over two months in patients treated with CRT ($F(1,30) = 25.665$; $P < 0.001$). There was also a main effect for time on both subscales of the HCS, indicating an improvement in cardiac symptoms ($F(1,30) = 13.789$; $P = 0.001$) and perceived disability $F(1,30) = 15.685$; $P < 0.001$) over time.

In Table II, mean scores on the patient-centered outcomes at baseline and two months following CRT are shown.

Personality and Patient-Centered Outcomes in CRT

When including personality traits (that is, negative affectivity, social inhibition, and Type D personality) as between-subjects factors in the MANOVAs for repeated measures, we found a main effect for negative affectivity on disease-specific health status, cardiac symptoms, and perceived disability ($F(1,29 = 6.81$; $P = 0.01$). This effect of negative affectivity was (a) stable over time, given the fact that the negative affectivity by time interaction effect was nonsignificant ($P = 0.70$), and (b) the same for all patient-centered outcome measures used, that is, the negative affectivity by scale interaction was also nonsignificant ($P = 0.85$). Neither social inhibition nor Type D personality was significantly associated with any of the outcome measures.

In the ANOVA for repeated measures, we found that high negative affectivity patients treated with CRT reported significantly lower disease-specific health status compared to low negative affectivity patients ($F(1,29) = 4.363$; $P = 0.046$) (Fig. 2). The interaction effect negative affectivity by time was not significant ($F(1,29) = 0.050$; $P = 0.82$), indicating that negative affectivity exerted a stable effect on disease-specific health status over a two-month period. Compared to low negative affectivity patients, high negative affectivity patients also reported more cardiac symptoms ($F(1,29) = 4.879$; $P = .035$) and more

Table I.

Baseline Characteristics Stratified by Negative Affectivity

	Total sample (n = 31)	High NA[1] (n = 11)	Low NA (n = 20)	P
Demographics				
Age, mean (SD)	70 (8)	70 (8)	70 (9)	0.95
Male sex	20 (65)	6 (55)	14 (70)	0.39
Living with a partner	23 (74)	8 (73)	15 (75)	0.89
Lower education	9 (29)	6 (55)	3 (15)	0.02
Retired	23 (74)	9 (82)	14 (70)	0.47
Working	3 (10)	1 (9)	2 (10)	0.94
Clinical measures				
NYHA[2] class III	28 (90)	9 (82)	19 (95)	0.23
LVEF[3] (%), mean (SD)	27 (8)	28 (11)	26 (6)	0.71
Ischemic etiology	20 (65)	9 (82)	11 (55)	0.14
Lifestyle				
Smoking	7 (23)	3 (27)	4 (20)	0.64
Physical activity	12 (39)	3 (27)	9 (45)	0.33
BMI,[4] mean (SD)	28 (4)	30 (5)	27 (3)	0.55
Comorbidities				
COPD[5]	11 (36)	5 (46)	6 (30)	0.39
Diabetes mellitus	7 (23)	4 (36)	3 (15)	0.17
Renal insufficiency	6 (19)	2 (18)	4 (20)	0.90
Hypertension	19 (61)	6 (55)	13 (65)	0.57
Hyperlipidemia	17 (55)	8 (73)	9 (45)	0.14
PAD[6]	6 (19)	3 (27)	3 (15)	0.41
Medication				
ACE-inhibitors	24 (77)	7 (64)	17 (85)	0.17
ARBs	12 (39)	6 (55)	6 (30)	0.18
Diuretics	23 (74)	9 (82)	14 (70)	0.47
Spironolactone	5 (16)	1 (9)	4 (20)	0.43
Digitalis	8 (26)	4 (36)	4 (20)	0.32
β-Blockers	18 (58)	6 (55)	12 (60)	0.77
Long-acting nitrates	11 (36)	4 (36)	7 (35)	0.94
Aspirin	20 (65)	6 (55)	14 (70)	0.39
Statins	14 (45)	5 (46)	9 (45)	0.98
Psychopharmacology	9 (29)	4 (36)	5 (25)	0.51

Data are presented as n (%), unless otherwise indicated.
[1]Negative affectivity.
[2]New York Heart Association functional class.
[3]Left ventricular ejection fraction.
[4]Body Mass Index.
[5]Chronic obstructive pulmonary disease.
[6]Peripheral artery disease.

perceived disability ($F(1,29) = 6.715$;P = 0.015), as measured with the HCS over two months (Fig. 2). The nonsignificant interaction effects for negative affectivity by time for both cardiac symptoms ($F(1,29) = 0.97$; P = 0.33) and perceived disability ($F(1,29) = 0.022$; P = 0.88) indicated a stable negative effect of negative affectivity on cardiac symptoms as well as on perceived disability over the follow-up period.

Effects on Functional Capacity

Functional capacity, as measured with the 6MWT, improved significantly during the course of two months ($F(1,30) = 8.538$; P = 0.007) (Table 2). However, there was no significant between-subjects difference between high and low negative affectivity patients on the 6MWT (P = 0.33) (Fig 2); neither was there an interaction effect for

Table II.

Mean Scores on Patient-Centered Outcomes and Functional Capacity at Baseline and Two Months Following CRT

	Mean (SD) Baseline	Mean (SD) Two months	F	P
Health status[1]	47.5 (16.4)	32.2 (17.7)	25.665	<0.001
Cardiac symptoms[2]	21.0 (12.6)	13.9 (12.7)	13.789	0.001
Perceived disability[2]	23.8 (11.6)	17.0 (13.7)	15.685	<0.001
Functional capacity[3]	120.0 (95.2)	200.0 (160.0)	8.538	0.007

[1]Minnesota Living with Heart Failure Questionnaire.
[2]Health Complaints Scale.
[3]Six-minute walking test (in meters).

negative affectivity by time (P = 0.36). There were also no main effects for social inhibition or Type D personality on functional capacity.

Effect of Negative Affectivity on Outcomes (Adjusted Analyses)

When adjusting for LVEF, gender, and age (ANCOVA), high negative affectivity patients still reported lower disease-specific health status ($F(1,1) = 3.813$; P = 0.06) and significantly more perceived disability ($F(1,1) = 4.894$; P = 0.04) as compared to low negative affectivity patients. There were no main between-subjects effects for negative affectivity on cardiac symptoms (P = 0.11) nor on functional capacity (P = 0.37), when adjusting for disease severity, gender, and age. There were no between-subjects effects for LVEF, gender, and age, but male patients had near significant better functional capacity as compared to female patients ($F(1,1) = 3.833$; P = 0.06) (Table III).

Effects of Negative Affectivity Versus Gender

Negative affectivity had moderate-to-large effects on the patient-centered outcomes at baseline and two-month follow-up, but a small effect on functional capacity is measured by Cohen's effect size index. The effect of negative affectivity on disease-specific health status, cardiac symptoms, and perceived disability was larger than the effect of gender on these outcomes (Fig. 3).

Discussion

To our knowledge, this is the first study to examine the influence of personality traits on a broad range of patient-centered outcomes in patients treated with CRT. We found a general improvement in patient-centered outcomes, that is, disease-specific health status, level of cardiac symptoms, perceived disability, and in functional capacity over a 2-month period in these patients. However, negative affectivity had a stable, negative effect on patient-centered outcomes, with patients high on negative affectivity reporting lower disease-specific health status, more cardiac symptoms, and more perceived disability as compared to low negative affectivity patients. There was no difference between high and low negative affectivity patients on functional capacity. When adjusting for disease severity (LVEF) and sociodemographics, negative affectivity still exerted a substantial negative effect on disease-specific health status and perceived disability. The effects of negative affectivity on the patient-centered outcomes were moderate to large, as indicated by Cohen's effect size index.[40] Type D personality (concurrent high negative affectivity and social inhibition) and social inhibition were not associated with the patient-centered outcomes and functional capacity.

CRT is a promising treatment option for patients with advanced CHF, as it has been shown in prospective clinical trials to reduce mortality and morbidity, and to improve quality of life and functional status.[1–7,42–45] However, not all patients experience improvement following CRT.[44] In this context, it is important to identify which clinical parameters predict poor treatment response,[45,46] but it might be of equal importance to gain knowledge about those patients that still report cardiac symptoms and perceived disability following CRT. Furthermore, it has been shown in previous research in patients with an implantable cardioverter defibrillator that psychological variables are at least as important as disease characteristics in predicting quality of life.[47]

Some authors stress that soft endpoints (such as measures of complaints and 6MWT performance) are less appropriate for measuring effects of CRT,[44] whereas others emphasize that there is an urgent need to focus on patient-centered outcomes in cardiovascular research, such as health status and symptoms.[11] Negative affectivity is a

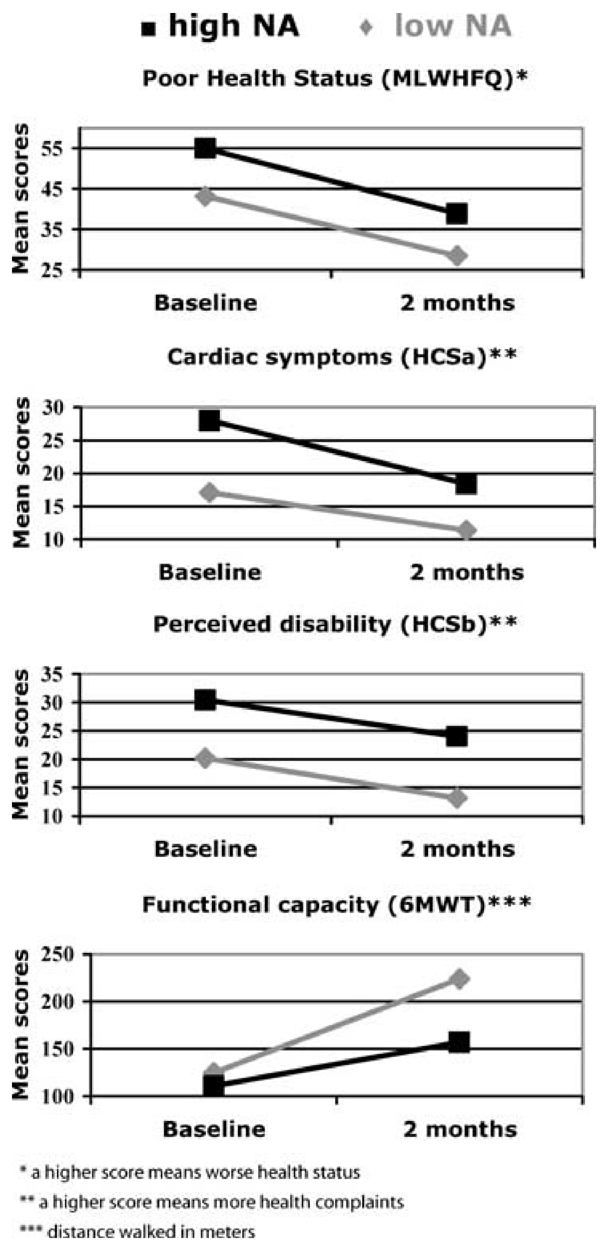

Figure 2. *Mean health status, symptom, and functional capacity scores at baseline and two-month follow-up stratified by negative affectivity*.

stable personality trait that is defined as the tendency to experience a broad range of negative feelings even in the absence of overt stress. High negative affectivity persons focus on the negative side of others and the world, and have a negative self-view.[18] Research has shown that persons high on negative affectivity report more symptoms, although the relationship between negative affectivity and actual morbidity or mortality is not clear.[17,48,49] As Kroenke points out, subjective symptoms may guide diagnosing and treatment in medical settings.[50] Therefore, the subgroup of high negative affectivity post-CRT patients, who report more impaired disease-specific health status and more health complaints as compared to low negative affectivity patients, may incorrectly be labeled as "nonresponder" or "having no benefit from CRT." However, these patients do improve on outcome following CRT, although they do not reach the same level as low negative affectivity patients, as they report more health complaints. Furthermore, there were no differences between high and low negative affectivity patients on functional capacity, whereas high negative affectivity patients do perceive more disability as compared to low negative affectivity patients. Therefore, it may be that persons high on negative affectivity are sensitive for the encouraging statements that the investigator is allowed to give during 6MWT performance, but in general feel more disabled. An alternative may be that these patients report more impaired disease-specific health status, more symptoms, and feel more disabled both before and after CRT, but are not different from low negative affectivity patients on more objective measures, such as 6MWT performance. In a recent study, in patients with atrial fibrillation (AF), it was shown that negative emotions-influenced patients' AF symptoms report more than objective indicators of AF.[51] Taken together, it is possible that high negative affectivity patients report more health complaints, although they do not differ on clinical measures of disease severity. Further research is warranted to explore this.

In previous research, Type D personality has been shown to predict negative outcome.[12–15,20–22,52,53] In this study, no differences between Type D and non Type D patients on any of the outcome measures over a two-month period was found. This may be due to the relatively small sample size, with only eight patients being identified as Type D, and the relatively short follow-up period of two months.

Limitations and Strengths

This study is exploratory and has several limitations. First, there was no control group and it is not possible to attribute the general improvements in disease-specific health status, cardiac symptoms, perceived disability, and functional capacity to CRT. Second, the sample size was small, which may be a reason for not finding an effect of negative

Table III.

Effect of Negative Affectivity on Patient-Centered Outcomes and Functional Capacity (Adjusted Analyses)

	Health Status[a]		Cardiac Symptoms[b]		Perceived Disability[b]		Functional Capacity[c]	
	F	P	F	P	F	P	*F*	P
NA[1]	3.813	0.06	2.802	0.11	4.894	0.04	0.839	0.37
LVEF[2]	1.319	0.26	0.053	0.82	0.151	0.70	1.005	0.32
Gender	0.129	0.72	1.314	0.26	0.809	0.38	3.833	0.06
Age	0.039	0.85	0.755	0.39	0.003	0.96	0.259	0.62

[1] Negative affectivity.
[2] Left ventricular ejection fraction.
[a] Minnesota Living with Heart Failure Questionnaire.
[b] Health Complaints Scale.
[c] 6-minute walking test.

affectivity on cardiac symptoms in adjusted analyses. Third, the follow-up period was relatively short. Fourth, we had only information on LVEF and NYHA class at baseline and were therefore not able to study the influence of personality traits on LVEF and other echo parameters over time. We were therefore also not able to assess whether CRT had resulted in changes in echo parameters. However, the focus of the study was on patient-centered outcomes.

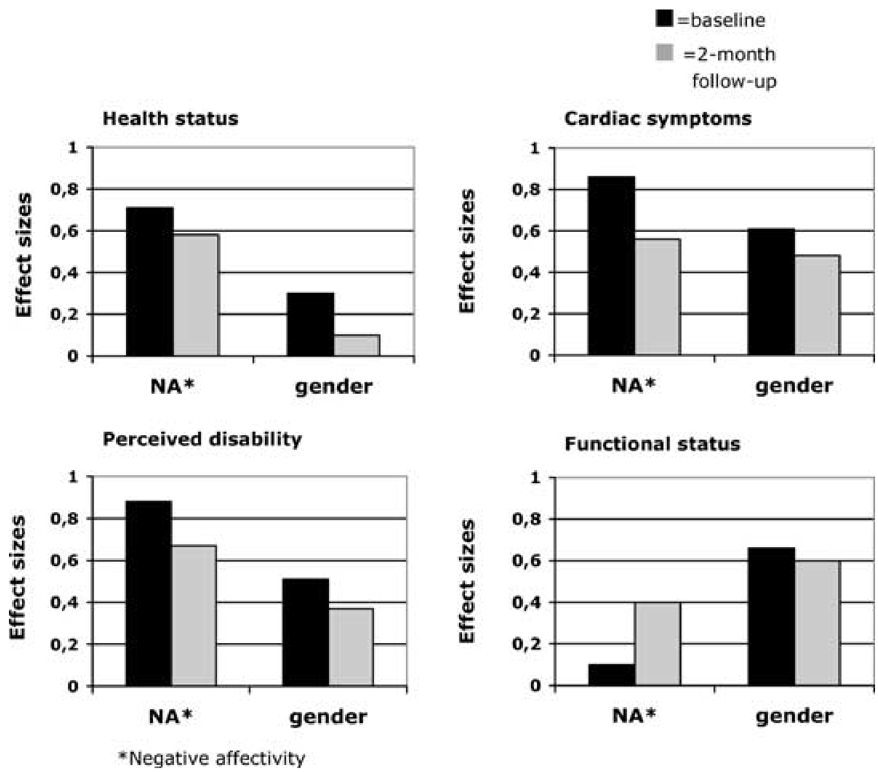

Figure 3. *Effect sizes of negative affectivity and gender on patient-centered outcomes and functional capacity.*

Despite these limitations, this is the first study examining the effect of personality traits on patient-centered outcomes in patients treated with CRT. Furthermore, the study focuses on patient-centered outcomes and their determinants, which may help to close the gap between research and clinical practice.[11]

Conclusions

In conclusion, we found general improvements in disease-specific health status, cardiac symptoms, perceived disability, and functional capacity over a two-month period in patients treated with CRT. However, patients high on negative affectivity reported lower disease-specific health status, and more cardiac symptoms and perceived disability as compared to patients low on negative affectivity. Large-scale studies with a longer follow-up period are needed to further explore the relationship between personality traits and outcomes in patients treated with CRT.

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References

1. Abraham WT. Cardiac resynchronization therapy. Prog Cardiovasc Dis 2006;48:232–238.
2. Young JB, Abraham WT, Smith AL, Leon AR, Lieberman R, Wilkoff B, Canby RC, et al. [For the Multicenter InSync ICD Randomized Clinical Evaluation (MIRACLE ICD) Trial Investigators]. Combined cardiac resynchronization and implantable cardioversion defibrillation in advanced chronic heart failure: The MIRACLE ICD trial. JAMA 2003;289:2685–2694.
3. Cleland JG, Daubert JC, Erdmann E, Freemantle N, Gras D, Kappenberger L, Tavazzi L. (on behalf of The CARE-HF Study Investigators). Longer-term effects of cardiac resynchronization therapy on mortality in heart failure. [the Cardiac Resynchronization-Heart Failure (CARE-HF) trial extension phase]. Eur Heart J 2006;27:1928–1932.
4. Cleland JG, Daubert JC, Erdmann E, Freemantle N, Gras D, Kappenberger L, Tavazzi L. [For the Cardiac Resynchronization – Heart Failure (CARE-HF) Study Investigators]. The effect of cardiac resynchronization on morbidity and mortality in heart failure. N Eng J Med 2005;352:1539–1549.
5. Cazeau S, Leclercq C, Lavergne T, Walker S, Varma C, Linde C, Garrigue S, et al. [For the Multisite Stimulation in Cardiomyopathies (MUSTIC) Study Investigators]. Effects of multisite biventricular pacing in patients with heart failure and intraventricular conduction delay. N Eng J Med 2001;344:873–880.
6. Linde C, Braunschweig F, Gadler F, Bailleul C, Daubet JC. Long-term improvements in quality of life by biventricular pacing in patients with chronic heart failure: Results from the Multisite Stimulation In Cardiomyopathy Study (MUSTIC). Am J Cardiol 2003;91:1090–1095.
7. Freemantle N, Tharmanathan P, Calvert MJ, Abraham WT, Ghosh J, Cleland JG. Cardiac resynchronisation for patients with heart failure due to left ventricular systolic dysfunction – a systemic review and meta-analysis. Eur J Heart Fail 2006;8:433–440.
8. Haywood G. Biventricular pacing in heart failure: Update on results of clinical trials. Curr Control Trials Cardiovasc Med 2001;2:292–297.
9. Bax JJ, Van Der Wall EE, Schalij MJ. Cardiac resynchronization therapy for heart failure. N Engl J Med 2002;347:1803–1804.
10. Najem B, Unger P, Preumont N, Jansens JL, Houssière A, Pathak A, Xhaet O, et al. Sympathetic control after cardiac resynchronization therapy: Responders versus nonresponders. Am J Physiol Heart Circ Physiol 2006;291:2647–2652.
11. Krumholz HM, Peterson ED, Ayanian JZ, Chin MH, DeBusk RF, Goldman L, Kiefe CI, et al. Report of the National Heart, Lung, and Blood Institute Working Group on outcomes research in cardiovascular disease. Circulation 2005;111:3158–3166.
12. Denollet J, Holmes RV, Vrints CJ, Conraads VM. Unfavorable outcome of heart transplantation in recipients with Type D personality. J Heart Lung Transplant 2007;26:152–158.
13. Denollet J, Vaes J, Brutsaert DL. Inadequate response to treatment in coronary heart disease: Adverse effects of Type D personality and younger age on 5-year prognosis and quality of life. Circulation 2000;102:630–635.
14. Al-Ruzzeh S, Athanasiou T, Mangoush O, Wray J, Modine T, George S, Amrani M. Predictors of poor mid-term health related quality of life after primary isolated coronary artery bypass grafting surgery. Heart 2005;91:1557–1562.
15. Schiffer AA, Pedersen SS, Widdershoven JW, Hendriks EH, Winter JB, Denollet J. The distressed (Type D) personality is independently associated with impaired health status and increased depressive symptoms in chronic heart failure. Eur J Cardiovasc Prev Rehabil 2005;12:341–346.
16. Denollet J. Type D personality a potential risk factor refined. J Psychosom Res 2000;49:255–266.
17. Denollet J. DS14: Standard assessment of negative affectivity, social inhibition, and Type D personality. Psychosom Med 2005;67:89–97.
18. Watson D, Pennebaker JW. Health complaints, stress, and distress: Exploring the central role of negative affectivity. Psychol Rev 1989;96:234–254.
19. Asendorpf JB. Social inhibition: A general developmental perspective. In: Traue HC, Pennebaker JW (eds.): Emotion, Inhibition and Health. Seattle, WA: Hogrefe and Huber Publishers, 1993:80–99.
20. Pedersen SS, Lemos PA, van Vooren PR, Liu TK, Daemen J, Erdman RA, Smits PC, et al. Type D personality predicts death or myocardial infarction after bare metal stent or sirolimus-eluting stent implantation. A Rapamycin-Eluting Stent Evaluation at Rotterdam Cardiology Hospital (RESEARCH) registry substudy. J Am Coll Cardiol 2004;44:997–1001.
21. Pedersen SS, Ong AT, Sonnenschein K, Serruys PW, Erdman RA, van Domburg RT. Type D personality and diabetes predict the onset of depressive symptoms in patients after percutaneous coronary intervention. Am Heart J 2006;151:367e1–367e6.
22. Appels A, Golombeck B, Gorgels A, de Vreede J, van Breukelen G. Behavioral risk factors of sudden cardiac arrest. J Psychosom Res 2000;48:463–469.
23. Put C, Van Den Bergh O, Van Ongeval E, De Peuter S, Demedts M, Verleden G. Negative affectivity and the influence of suggestion on asthma symptoms. J Psychosom Res 2004;57:249–255.
24. Kahn JH, Hessling RM, Russell DW. Social support, health, and well-being among the elderly: What is the role of negative affectivity? Pers Individ Diff 2003;35:5–17.
25. Eisenberg N, Fabes RA, Murphy BC. Relations of shyness and low sociability to regulation and emotionality. J Pers Soc Psychol 1995;68:505–517.
26. Rapee RM. The development and modification of temperamental risk for anxiety disorders: Prevention of a lifetime of anxiety? Biol Psychiatry 2002;52:947–957.
27. Hunt SA, Abraham WT, Chin MH, Feldman AM, Francis GS, Ganiats TG, Jessup M, et al. ACC/AHA 2005 Guideline update for the diagnosis and management of chronic heart failure in the adult: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (writing committee to update the 2001 guidelines for the evaluation and management of heart failure). J Am Coll Cardiol 2005;46:e1–e82.
28. Krum H. The Task Force for the Diagnosis and Treatment of Chronic Heart Failure of the European Society of Cardiology. Guidelines for the diagnosis and treatment of chronic heart failure (update 2005). Eur Heart J 2005;26:2472–2477.
29. Hayes DL, Wang JW, Sackner-Bernstein J, Asirvatham SJ. Resynchronization and Defibrillation for Heart Failure, a Practical Approach. 1st Ed. Oxford: Blackwell Futura 2004.

30. Rector TS, Kubo SH, Cohn JN. Patients' self-assessment of their congestive heart failure (Part 2). Content, reliability, and validity of a new measure: The Minnesota living with heart failure questionnaire. Heart Failure 1987;10:198–209.
31. Middel B, Bouma J, de Jongste M, van Sonderen E, Niemeijer MG, Crijns H, Van Den Heuvel W. Psychometric properties of the Minnesota Living with Heart Failure Questionnaire (MLWF-Q). Clin Rehabil 2001;15:489–500.
32. Rector TS. Overview of the Minnesota Living with Heart Failure® questionnaire. www.mlhfq.org, 2005.
33. Denollet J. Health complaints and outcome assessment in coronary heart disease. Psychosom Med 1994;56:463–474.
34. Lowe R, Norman P, Bennett P. Coping, emotion and perceived health following myocardial infarction: Concurrent and predictive associations. Brit J Health Psychol 2000;5:337–350.
35. Miyamoto S, Nagaya N, Satoh T, Kyotani S, Sakamaki F, Fujita M, Nakanishi N, et al. Clinical correlates and prognostic significance of six-minute walk test in patients with primary pulmonary hypertension. Comparison with cardiopulmonary exercise testing. Am J Respir Crit Care Med 2000;161:487–492.
36. Pinna GD, Opasich C, Mazza A, Tangenti A, Maestri R, Sanarico M. Reproducibility of the six-minute walking test in chronic heart failure patients. Statist Med 2000;19:3087–3094.
37. American Thoracic Society. ATS statement: Guidelines for the six-minute walk test. Am J Respir Crit Care Med 2002;166:111–117.
38. Emons WH, Meijer RR, Denollet J. Negative affectivity and social inhibition in cardiovascular disease: Evaluating type-D personality and its assessment using item response theory. J Psychosom Res 2007;63:27–39.
39. Martens EJ, Kupper HM, Pedersen SS, Aquarius AE, Denollet J. Type-D personality is a stable taxonomy in post-MI patients over an 18-month period. J Psychosom Res 2007;63:545–50.
40. Cohen J. Statistical Power Analysis for the Behavioural Sciences. Mahwah (NJ): Lawrence Erlbaum Associates Publishers, 1988.
41. Pedersen SS, Denollet J, Daemen J, van de Sande M, de Jaegere PT, Serruys PW, Erdman RA, et al. Fatigue, depressive symptoms, and hopelessness as predictors of adverse clinical events following percutaneous coronary intervention with paclitaxel-eluting stents. J Psychosom Res 2007;62:455–461.
42. Gurevitz O, Glikson M. Cardiac resynchronization therapy: A new frontier in the management of heart failure. Isr Med Assoc J 2003;5:571–575.
43. Luck JC, Wolbrette DL, Boehmer JP, Ulsh PJ, Silber D, Naccarelli GV. Biventricular pacing in congestive heart failure: A boost toward finer living. Curr Opin Cardiol 2002;17:96–101.
44. Auricchio A, Abraham WT. Cardiac resynchronization therapy: Current state of the art: Cost versus benefit. Circulation 2004;109:300–307.
45. McAlister FA, Ezekowitz J, Hooton N, Vandermeer B, Spooner C, Dryden DM, Page RL, et al. Cardiac resynchronization therapy for patients with left ventricular systolic dysfunction. JAMA 2007;297:2502–2514.
46. Trupp RJ. Cardiac resynchronization therapy: A practical guide for device optimization, Part I. Congest Heart Fail 2006;12:169–173.
47. Sears SF, Saia Lewis T, Kuyl EA, Conti JB. Predictors of quality of life in patients with implantable cardioverter defibrillators. Psychosomatics 2005;46:451–457.
48. Watten RG, Vassend O, Myhrer T, Syversen J. Personality factors and somatic symptoms. Eur J Pers 1997;11:57–68.
49. Denollet J, De Potter B. Coping subtypes for men with coronary heart disease: Relationship to well-being, stress and type A behaviour. Psychol Med 1992;22:667–684.
50. Kroenke K. Studying symptoms: Sampling and measurement issues. Ann Intern Med 2001;134:844–853.
51. Sears SF, Serber ER, Alvarez LG, Schwartzman DS, Hoyt RH, Ujhely MR. Understanding atrial symptom reports: Objective versus subjective predictors. Pacing Clin Electrophysiol 2005;28:801–807.
52. Pedersen SS, Denollet J. Type D personality, cardiac events, and impaired quality of life: A review. Eur J Cardiovasc Prev Rehabil 2003;10:241–248.
53. Pedersen SS, Denollet J. Is Type D personality here to stay? Emerging evidence across cardio-vascular disease patient groups. Curr Cardiol Rev 2006;2:205–213.