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Type D personality and depressive symptoms are independent predictors of impaired health status in chronic heart failure ☆

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Abstract

Objective: To examine whether Type D personality exerts a stable, independent effect on health status in CHF over time, adjusted for depressive symptoms.
Subjects: CHF outpatients ($n=166$; 75% men; mean age 66 years) completed the Type D Scale and Beck Depression Inventory (baseline) and the Minnesota Living with Heart Failure Questionnaire and Short-Form Health Survey (baseline and 12 months).
Results: There was a general improvement in disease-specific physical ($p=.029$) and mental ($p<.001$) health over time, but Type D patients scored significantly lower on both outcomes ($p\leq.001$). The interaction effects Type D × time were not significant, indicating stability of the personality effect. Type D patients also scored significantly lower on all generic physical (p values between .001 and .04) and mental (all p values <.001) health status subdomains; these effects were also stable over time. Type D was an independent predictor of disease-specific mental health ($p<.001$), social functioning ($p=.04$), role emotional functioning ($p<.001$), bodily pain ($p=.05$), and general health ($p=.04$), adjusted for depressive symptoms, baseline health status and clinical characteristics. Depressive symptom was an independent predictor of role physical functioning and bodily pain.
Conclusions: Type D personality and depressive symptoms were independent predictors of impaired health status in CHF.

Keywords: Health status; Type D personality; Depression; Chronic heart failure

1. Introduction

Chronic heart failure (CHF) is a serious condition, with increasing incidence and prevalence, and deleterious effects on prognosis and health status [1–4]. Impaired health status is a predictor of poor prognosis in CHF [5], but it is also emphasised by patients as an important treatment goal on its own, with patients generally preferring better health status over prolonged survival [6]. Hence, the study of health status, representing a patient-centred outcome, and its determinants is important for secondary prevention in order to identify high-risk patients. The study of patient-centred outcomes has also been advocated by others, as a means by which to bridge the gap between research and clinical practice [7].

Several studies have focused on functional status, as indicated by (self-rated) New York Heart Association (NYHA) class [8,9], age [8,10,11], sex [8,11,12], and somatic comorbidity [8] as important determinants of health status in patients with CHF. Depression has also been identified as a potential determinant (e.g. [13,14]). By contrast, a paucity of

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studies has investigated personality in the context of health status and CHF, probably because of the inconsistencies in findings in research on the Type A Behaviour Pattern (TABP) [15]. However, personality factors may explain individual differences in health outcomes above and beyond demographic and clinical risk factors [16].

Type D personality is an emerging risk factor that has been associated with poor prognosis and health status across different cardiovascular patient groups [17,18]. Type D personality is defined by a high score on the two stable personality traits, negative affectivity and social inhibition [16]. Patients with a Type D personality tend to experience increased levels of anxiety, irritation, and depressed mood across situations and time, while not sharing these emotions with others because of fear of rejection or disapproval [16]. Type D personality has been associated with impaired health status in patients with coronary artery disease (CAD), and in heart transplant recipients (e.g. [15,19,20]). Preliminary findings from a cross-sectional study suggested that Type D may also affect health status in CHF patients [21], but no prospective studies have examined whether this effect remains stable over time. Furthermore, it is unknown whether Type D personality predicts disease-specific and generic physical and mental health status in CHF above and beyond depressive symptoms.

Therefore, the aims of this study were to examine (1) whether Type D personality has a stable effect on disease-specific and generic physical and mental health status in CHF over a 12-month period, and (2) whether Type D personality is an independent determinant of health status at 12-month follow-up, when adjusting for depressive symptoms and baseline health status.

2. Methods

2.1. Patient population, design and procedure

Between October 2003 and October 2005, consecutive CHF patients from the cardiology unit of the TweeSteden teaching hospital in Tilburg, the Netherlands, were recruited for the current study. Of 287 patients asked to participate, 228 (79.4%) agreed. Since we used a prospective design and patients died and left the study during follow-up, final analyses are based on 166 of these 228 patients (Fig. 1).

Inclusion criteria were: (1) diagnosis of systolic CHF with a left ventricular ejection fraction (LVEF) ≤40%, (2) ≤80 years of age, and (3) stable on medication for at least 1 month prior to inclusion. We excluded patients with (1) a diagnosis of diastolic heart failure, (2) who were unable to read, write or understand Dutch, and (3) who had life-threatening comorbidities (e.g. cancer or a myocardial infarction (MI) 1 month preceding inclusion), or (4) severe cognitive impairment (e.g. dementia). All patients were treated following the most recent guidelines for CHF [1,2,22].

The study was approved by the hospital medical ethics committee and carried out in accordance with the Helsinki Declaration. All patients received oral 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.

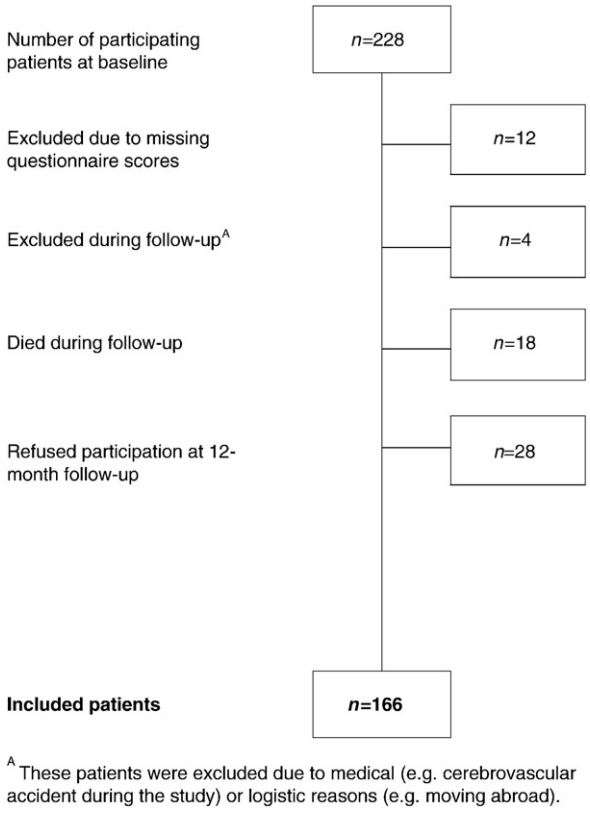

Fig. 1. Flow chart of patient selection.

The treating cardiologist or CHF nurse informed patients about the study and asked them to participate. If they agreed, they were contacted by the investigator in the same week to make an appointment for assessment. During the first visit, patients were given additional information about the study and were asked to complete a set of questionnaires at home and return them in a pre-addressed envelope. For the 12-month follow-up, patients were invited to the hospital again and were given a set of questionnaires again to complete at home as before. All questionnaires were checked for completeness. Patients who did not complete all of the questions were contacted in an attempt to obtain the answers or they were mailed a copy of the unanswered questions and were asked to complete them. If questionnaires were not returned within two weeks, patients received a reminder telephone call or letter.

2.2. Measures

2.2.1. Disease-specific health status

In the current study, both physical and mental health status were assessed with a disease-specific and a generic measure at baseline and at 12-month follow-up.

We used the Minnesota Living with Heart Failure Questionnaire (MLWHFQ) to assess disease-specific physical and mental health status [23–26]. The MLWHFQ is a 21-item measure of health status that is specifically designed for CHF patients [23,24]. The 21 items are answered on a 6-point Likert scale, ranging from "no" (0) to "very much" (5). A higher score on the MLWHFQ represents a poorer health status [23]. The MLWHFQ consists of two dimensions, i.e., a physical and an emotional/mental dimension [25,26]. The questionnaire has solid psychometric properties, with good internal consistency (Cronbach's $\alpha = .91–.96$ for the total scale [23,24], and .94 and .88 for the physical and mental dimension, respectively [25]). In this study, the mean score was 14.7 ± 9.7 (range 0–37) for the physical dimension and 6.0 ± 5.5 (range 0–23) for the mental dimension at baseline.

2.2.2. Generic health status

The Short-Form Health Survey (SF-36) is a 36-item measure of generic health status, with higher scores indicating better generic health status, except for the bodily pain subscale where a higher score indicates the absence of pain [27–29]. The SF-36 can be divided into eight subscales, measuring the following subdomains of health status: (1) physical functioning, (2) role limitations due to physical functioning, (3) role limitations due to emotional functioning, (4) mental health, (5) vitality, (6) social functioning, (7) bodily pain, and (8) general health. Subscale scores can be obtained by summing the items together, dividing the outcome by the range of scores, and finally transforming the raw scores to *Z*-scores, ranging from 0 to 100. The subscales can be summarised into a physical component score (PCS) and a mental component score (MCS) [29,30]. Two recent studies which examined the effect of Type D personality on health status in patients treated with percutaneous coronary intervention (PCI) [15] or an implantable cardioverter-defibrillator (ICD) [31], used the eight subdomains of the SF-36. To make the results of the current study comparable to these two studies, we also used the subdomains as indicators of generic physical and mental health status. The Dutch version of the SF-36 is a reliable and valid instrument for use in chronic disease populations, with a mean Cronbach's α of .84 across the eight subscales [28].

2.2.3. Type D personality

Type D personality was measured with the Type D Scale (DS14) [16]. This questionnaire consists of 14 items that are divided into two subscales, namely negative affectivity and social inhibition. Items are answered on a 5-point Likert scale from "false" (0) to "true" (4). A standardised cut-off ≥ 10 on both subscales indicates Type D caseness [16]. Emons et al. showed recently that the items of the DS14 had the highest measurement precision around this cut-off of 10 [32]. The two DS14 subscales have good psychometric qualities, with Cronbach's $\alpha = .88/.86$ and 3-month test–retest reliability $r = .72/.82$ for the negative affectivity and social inhibition subscale, respectively [16]. Recently, the stability of Type D personality over 18 months was shown in post-MI patients [33]. The DS14 was administered at baseline.

2.2.4. Depressive symptoms

The presence of depressive symptoms was assessed at baseline with the Beck Depression Inventory (BDI), a commonly used questionnaire to measure depressive symptoms in clinical research and in patients with cardiovascular disease (CVD) [34,35]. The 21 items are answered on a 4-point scale, ranging from "0" to "3". A higher total score on the BDI indicates more depressive symptoms. A standardised cut-off ≥ 10 denotes those with likely depressive symptomatology [34]. The BDI is a valid and reliable measure of depressive symptoms, with Cronbach's $\alpha = .81$ in non-psychiatric samples [35].

2.3. Socio-demographic and clinical characteristics

Socio-demographic variables, including sex, age, marital status, and educational level, were obtained through four purpose-designed questions in the questionnaire. Information on clinical variables, including LVEF, NYHA functional class, aetiology of CHF (ischaemic/non-ischaemic), comorbidities (diabetes mellitus, renal insufficiency, hypertension and hyperlipidaemia), and medication (ACE inhibitors, ARBs, diuretics, spironolactone, digitalis, beta-blockers, long-acting nitrates, aspirin, statins, and psychotropic agents) were obtained from the medical records or the treating cardiologist/CHF nurse. Smoking status was assessed by self-report.

2.4. Statistical analyses

Discrete variables were compared with the chi-square 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 disease-specific (MWLHFQ) and generic (SF-36) health status as a function of Type D personality and depressive symptoms over a 12-month period. Post-hoc ANOVAs for repeated measures were performed to evaluate differences in mean scores on health status at baseline and at 12-month follow-up. Type D personality and depressive symptoms were entered (separately) into the ANOVAs to compare patients with and without a Type D personality, and depressed and non-depressed patients on all measures of health status over a 12-month period. Univariable and multivariable linear regression analyses were used to examine predictors of health status at 12 months. Prior to regression analyses, independent continuous variables were recoded into dichotomous variables. In the multivariable linear regression analyses, we entered Type D personality (e.g. [15,19–21]), depressive symptoms (e.g. [13,14]), sex [8,11,12], age [8,10,11], educational level, NYHA functional class

[8,9], diuretics, long-acting nitrates, ACE inhibitors, beta-blockers, spironolactone and psychotropic agents, since these variables have been identified as potential determinants of impaired health status in the CVD literature, or were significant in univariable analyses in the current study. Since LVEF is a measure of disease severity and may be a potential confounder of health status, LVEF was added as a covariate in the multivariable analyses. Finally, we adjusted for baseline health status.

To enhance clinical interpretability, multivariable logistic regression analyses were performed as secondary analyses, dichotomising the scores on the MLWHFQ using the highest tertile and on the subdomains of the SF-36 using the lowest tertile. All analyses were performed using *SPSS 14.0* for Windows.

3. Results

3.1. Patient characteristics

Of 287 patients asked to participate, 228 (79.4%) agreed (Fig. 1). There were some differences between participants and non-participants, namely, participants were younger (mean age = 65.6 ± 9.2 versus 70.6 ± 8.3; $p < .001$), more often male (75.3% versus 50.9%; $p = .001$), more likely to have hyperlipidaemia (53.6% versus 32.1%; $p = .004$), and less likely to be prescribed aspirin (45.2% versus 64.3%; $p = .010$) as compared to non-participants. When comparing participants to the group of patients that refused participation at 12-month follow-up (Fig. 1), we found that the patients that still participated in the study at 12 months were significantly more often prescribed digitalis (31.3% versus 8.0%; $p = .016$) as compared to patients that refused further participation.

Of the 166 patients who completed the 12-month follow-up, 38 (23%) patients had a Type D personality, and 52 patients (31%) had significant depressive symptoms. There were no significant differences between patients with and without a Type D personality on any of the demographic and clinical baseline characteristics (all p values > .05; Table 1).

Table 1
Baseline characteristics stratified by Type D personality

	Total sample	Type D ($n = 38$)	Non-Type D ($n = 128$)	p
Demographics				
Age, mean (SD)	66 (9)	67 (9)	65 (9)	.30
Male sex	125 (75)	31 (82)	94 (73)	.39
Living with a partner	123 (74)	27 (71)	96 (75)	.68
Lower education	54 (33)	17 (45)	37 (29)	.08
Clinical variables				
LVEF [a] %, mean (SD)	30 (7)	31 (7)	30 (8)	.44
NYHA [b] class III and IV	76 (46)	22 (58)	54 (42)	.09
Ischaemic aetiology	89 (54)	19 (50)	70 (55)	.71
Smoking	38 (23)	7 (18)	31 (24)	.52
Comorbidities				
Diabetes	43 (26)	10 (26)	33 (26)	1.00
Renal insufficiency	21 (13)	6 (16)	15 (12)	.58
Hypertension	56 (34)	14 (37)	42 (33)	.70
Hyperlipidaemia	89 (54)	22 (58)	67 (52)	.58
Medication				
ACE inhibitors	127 (77)	31 (82)	96 (75)	.52
ARBs	22 (13)	5 (13)	17 (13)	1.00
Diuretics	127 (77)	33 (87)	94 (73)	.13
Spironolactone	38 (23)	8 (21)	30 (23)	.83
Digitalis	52 (31)	13 (34)	39 (31)	.69
Beta-blockers	110 (66)	25 (66)	85 (66)	1.00
Long-acting nitrates	31 (19)	9 (24)	22 (17)	.35
Aspirin	75 (45)	19 (50)	56 (44)	.58
Statins	84 (51)	21 (55)	63 (49)	.58
Psychotropic agents	24 (15)	7 (18)	17 (13)	.43

Numbers are presented as n (%) unless otherwise stated.
[a] LVEF = left ventricular ejection fraction.
[b] NYHA = New York Heart Association functional class.

3.2. Physical health status

The results of the MANOVA for repeated measures indicated a significant overall improvement in disease-specific and generic health status over time ($F(1,165 = 27.999$; $p < .001$), as well as main effects for both Type D personality ($F(1,164 = 29.000$; $p < .001$) and depressive symptoms ($F(1,164 = 74.650$; $p < .001$) on health status.

With reference to disease-specific physical health status, there was a significant general improvement over time ($F(1,164 = 4.861$; $p = .029$). However, patients with a Type D personality reported significantly lower disease-specific physical health status ($F(1,164 = 12.173$; $p = .001$) compared with patients without a Type D personality (Fig. 2a). The interaction effect Type D × time was not significant ($p = .89$), indicating a stable effect of Type D personality over a 12-month period.

There were no improvements on the generic physical health status subdomains over time, except for role physical functioning ($p = .004$) (Table 2). Patients with a Type D personality reported significantly more impaired generic physical health status on all subdomains (Fig. 2a). These main effects for Type D personality on the generic physical health status subdomains were all significant (Table 2) and stable, as indicated by non-significant interaction effects Type D × time (data not shown).

The main effects for depressive symptoms on disease-specific ($F(1,164 = 56.308$; $p \leq .001$) and generic physical health status (Table 2) were also significant and stable over time, as indicated by the non-significant interaction effects depression × time (data not shown).

3.3. Mental health status

Disease-specific mental health status improved significantly over 12 months ($F(1,164) = 12.777$; $p < .001$), but there was a main between-subjects effect for Type D personality ($F(1,164) = 42.646$; $p < .001$). Patients with a Type D

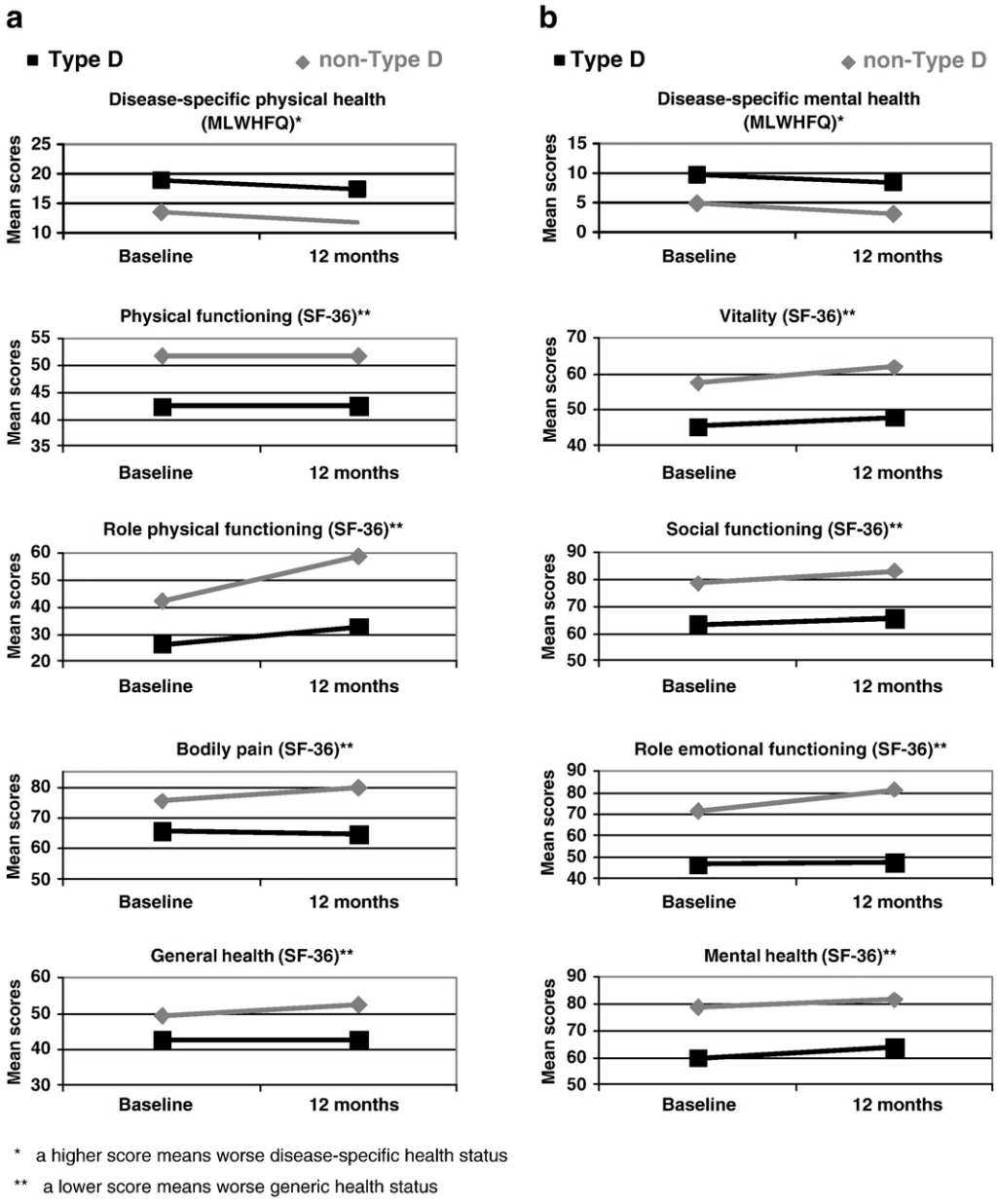

Fig. 2. a. Mean disease-specific and generic physical health status scores at baseline and 12-month follow-up stratified by Type D personality. b. Mean disease-specific and generic mental health status scores at baseline and 12-month follow-up stratified by Type D personality.

personality reported worse disease-specific mental health status as compared to patients without a Type D personality (Fig. 2b). This effect was stable over time, as indicated by the non-significant interaction effect Type D × time ($p = .59$).

There were significant improvements on two subdomains of generic mental health status over 12 months, i.e., vitality and mental health, and there was a trend for an improvement in social functioning (Table 2). Patients with a Type D personality reported significantly more impaired generic mental health (Fig. 2b), as the main effects for Type D personality were significant for all subdomains (Table 2). Once again, the effects of Type D personality were stable over time, as indicated by the non-significant interaction effects Type D × time (data not shown). There were also main effects for depressive symptoms on disease-specific ($F(1,164) = 39.943$; $p < .001$) and generic (Table 2) mental health status, and these effects were stable over time, as indicated by the non-significant interaction effects depression × time (data not shown).

3.4. Independent predictors of health status at 12 months

In univariable linear regression analyses, sex, educational level, NYHA functional class, diuretics, long-acting nitrates, ACE inhibitors, beta-blockers, spironolactone, psychotropic

Table 2
Effects of Type D personality and depression on generic health status

	Main effect time	Main effect Type D	Main effect depression
Physical subdomains			
Physical functioning	No; $p=.97$	$F=4.5$; $p=.04$	$F=47.5$; $p<.001$
Role physical functioning	Yes; $p=.004$	$F=9.6$; $p=.002$	$F=43.5$; $p<.001$
Bodily pain	No; $p=.54$	$F=11.5$; $p=.001$	$F=17.9$; $p<.001$
General health	No; $p=.35$	$F=6.8$; $p=.01$	$F=34.0$; $p<.001$
Mental subdomains			
Vitality	Yes; $p=.013$	$F=13.5$; $p<.001$	$F=59.1$; $p<.001$
Social functioning	No; $p=.09$	$F=19.0$; $p<.001$	$F=38.4$; $p<.001$
Role emotional functioning	No; $p=.22$	$F=28.2$; $p<.001$	$F=26.1$; $p<.001$
Mental health	Yes; $p=.017$	$F=38.4$; $p<.001$	$F=30.8$; $p<.001$

agents, and baseline health status were significant predictors of physical and/or mental health status (all p values $<.05$; results not shown).

When adjusting for the above mentioned variables, as well as for age, LVEF, and depressive symptoms, Type D personality was an independent predictor of disease-specific mental health status, social functioning, role emotional functioning, bodily pain and general health (Table 3). There was also a tendency for the subdomain mental health of generic mental health status ($p=.078$). Depression was an independent predictor of role physical functioning and bodily pain (Table 3). Furthermore, depression was a near-significant predictor of vitality ($p=.057$).

In secondary analyses, we dichotomised health status as an outcome measure in order to enhance clinical interpretability as advocated by others [36], and to compare the results with those of other studies on Type D personality and health status (e.g. [15]). Patients with a Type D personality had a three- to six-fold increased risk for impaired social functioning (OR=3.39, 95%CI:1.18–9.73, $p=.02$), role emotional functioning (OR=5.96, 95% CI:2.01–17.70, $p=.001$) and mental health (generic: OR=3.91, 95%CI:1.34–11.41, $p=.013$; disease-specific: OR=3.96, 95%CI:1.48–10.54, $p=.006$).

Table 3
Significant predictors of impaired physical (A) and mental (B) health status at 12 months (multivariable analyses)

Physical health status (A)	DPH	PF	RPF	BP	GH
	β; p	β; p	β; p	β; p	β; p
Type D personality	n.s.	n.s.	n.s.	−.14; .050	−.13; .04
Depressive symptoms	n.s.	n.s.	−.16; <.001	−.20; .018	n.s.
Male sex	n.s.	n.s.	n.s.	n.s.	n.s.
Higher age	n.s.	n.s.	n.s.	n.s.	n.s.
Lower educational level	n.s.	n.s.	n.s.	n.s.	n.s.
Higher NYHA class	n.s.	n.s.	n.s.	n.s.	n.s.
LVEF	.12; .049	−.10; .041	n.s.	n.s.	n.s.
Diuretics	n.s.	n.s.	n.s.	n.s.	n.s.
Long-acting nitrates	n.s.	n.s.	n.s.	n.s.	n.s.
ACE inhibitors	n.s.	n.s.	n.s.	n.s.	n.s.
Beta-blockers	n.s.	n.s.	n.s.	n.s.	n.s.
Spironolactone	n.s.	n.s.	n.s.	n.s.	−.13 ; .04
Psychotropic agents	n.s.	n.s.	n.s.	n.s.	n.s.
Baseline health status	.58; <.001	.71; <.001	.39; <.001	.31; <.001	.61; <.001
Mental health status (B)	**DMH**	**SF**	**REF**	**VI**	**MH**
	β; p	β; p	β; p	β; p	β; p
Type D personality	.25; <.001	−.14; .04	−.28; <.001	n.s.	n.s.
Depressive symptoms	n.s.	n.s.	n.s.	n.s.	n.s.
Male sex	−.13; .04	n.s.	n.s.	n.s.	n.s.
Higher age	n.s.	n.s.	n.s.	n.s.	n.s.
Lower educational level	n.s.	n.s.	n.s.	n.s.	n.s.
Higher NYHA class	n.s.	n.s.	n.s.	n.s.	n.s.
LVEF	.19; .004	n.s.	n.s.	n.s.	n.s.
Diuretics	n.s.	n.s.	n.s.	−.11; .04	n.s.
Long-acting nitrates	n.s.	−.14; .03	n.s.	n.s.	n.s.
ACE inhibitors	.16; .012	n.s.	n.s.	n.s.	n.s.
Beta-blockers	n.s.	n.s.	n.s.	n.s.	n.s.
Spironolactone	n.s.	n.s.	n.s.	n.s.	n.s.
Psychotropic agents	.18; .006	n.s.	n.s.	n.s.	n.s.
Baseline health status	.47; <.001	.54; <.001	.22; .006	.61; <.001	.56; <.001

DPH = disease-specific physical health status; PF = physical functioning; RPF = role physical functioning; BP = bodily pain; GH = general health; DMH = disease-specific mental health status; SF = social functioning; REF = role emotional functioning; VI = vitality; MH = mental health; NYHA class = New York Heart Association functional class; LVEF = left ventricular ejection fraction; n.s. = not significant ($p>.05$).

Furthermore, there was a trend for Type D personality to predict impaired role physical functioning (OR = 2.2, 95% CI:.89–5.40, $p = .09$).

3.5. Post-hoc analyses with subscales of the BDI

The BDI is a reliable measure of depression that is often used in patients with heart disease [34,35], but use of this measure may lead to an overestimation of depression, because it measures several somatic complaints that are relevant in both depression and CHF. As such, the BDI comprises a cognitive/affective (items 1–13) and a somatic (items 14–21) subscale [37]. In post-hoc multivariable linear regression analyses, both subscales of the BDI were significant or near-significant, independent predictors of disease-specific physical and mental health status in CHF (results not shown).

4. Discussion

This is the first prospective study to examine the effect of Type D personality and its stability over time on a broad measure of health status in patients with CHF, while adjusting for depressive symptoms. Although there was a general improvement in health status over time, patients with a Type D personality reported significantly more impaired health status as compared to patients without a Type D personality. Moreover, Type D personality exerted a stable, negative effect on these outcomes over a 12-month period. When adjusting for potential confounders, including depressive symptoms, measures of disease severity, and baseline health status, Type D personality remained an important predictor of disease-specific mental health status and of most domains of generic mental health status. In general, there were no significant improvements on the subdomains of generic physical health status over time, but patients with a Type D personality reported significantly more impaired generic physical health status compared to patients without a Type D personality, and Type D personality independently predicted the subdomains bodily pain and poor general health.

Personality as a determinant of individual differences in CHF patients' health status has largely been overlooked, as there is only one cross-sectional study on the relationship between Type D personality and health status in CHF. This study found that Type D personality was a significant associate of impaired disease-specific health status adjusting for disease severity [21]. In the current study, this finding was replicated in a prospective design, using a larger sample of CHF patients and a broad measure of health status. Two recent studies, one in PCI [15] and one in ICD [31] patients also reported on the impact of Type D personality on health status over time and used the SF-36 subdomains as indicators of generic health status. Our results were consistent with the results of these two studies in that patients with a Type D personality reported consistently more impaired generic health status on all subdomains of the SF-36. In the study in PCI patients [15], Type D personality was an independent predictor of all subdomains of the SF-36, except for physical functioning. In the current study, Type D personality was also not related to role physical functioning and vitality. Furthermore, general improvements in generic physical health status over time were found in the PCI [15] and ICD [31] studies. In the current study we found no improvements in generic physical health status, except for role physical functioning. However, the CHF patients in the present study were chronically ill with hardly any options left concerning invasive interventions, whereas the patients in the two other studies had had an invasive treatment for their heart disease.

Apart from Type D personality, we also found depressive symptoms to be an important predictor of impaired health status. This result is consistent with other studies focusing on depression as a determinant of health status in CHF (e.g. [13,14,37,38]). However, the present findings indicate that Type D personality was also an important determinant that may predict individual differences in health status above and beyond depressive symptoms. Therefore, our results elaborate on findings from previous studies on determinants of health status in CHF. The results are in line with those of previous studies, indicating that depressive symptoms and Type D personality are different forms of psychological distress. A recent substudy of the Myocardial Infarction and Depression Intervention Trial (MIND-IT) showed that Type D personality was less confounded by disease severity than post-MI depression [39]. Furthermore, Denollet and Pedersen [40] showed very recently that, in patients with CAD, Type D personality was a predictor of major cardiac events, but depression was not. Finally, Whitehead et al. [41] showed that Type D personality was associated with disruptions of HPA-as functioning, as indicated by disturbances in cortisol secretion, whereas depression, measured with the BDI, was not. In the current study, we have shown that Type D personality is a predictor of health status above and beyond depressive symptoms. Importantly, depressive symptoms also independently predicted health status. Thus, these results further support the notion that depressive symptoms and Type D personality are different, but equally relevant, forms of psychological distress.

There was an overall significant improvement in health status over time, which suggests general treatment benefits or better adjustment to the disease. However, the negative effect of Type D personality on health status was stable over a 12-month period. These results indicate that Type D personality is not a temporal psychological risk factor for impaired health status in CHF, but an enduring one, and that patients with a Type D personality do not only need optimal pharmacological treatment but also more intensive psychological coaching and intervention. Vulnerable patients, such as patients with a Type D personality or with significant depressive symptoms, should be offered psychological treatment, with the aims of improving self-management abilities [42], learning to better adjust to their disease, and extending their social network and sources of social support. Impaired self-management [42], maladjustment to the condition of CHF, and low social support [43] could be

possible behavioural mechanisms explaining the relationship between Type D personality and impaired health status in CHF. Since impaired health status has been associated with death and (re)hospitalisation in patients with heart disease [5,6,36,44], efforts such as counselling of subgroups of patients at high risk for impaired health status are warranted.

A number of limitations must be considered in interpreting the results of this study. First, study participants were required to visit the outpatient clinic to be included in the study, and hence the sample could be biased by mobility and younger age. Second, there were some differences on clinical variables between participants and non-participants and between patients that remained in the study and patients that refused participation at follow-up. Third, we used self-report measures to assess health status and self-report may be prone to socially desirable behaviour. Strengths of the study are its prospective design, the use of a broad measure of health status, and the adjustment for confounders, including depressive symptoms, disease severity, and baseline health status.

In conclusion, we found Type D personality to be a stable, independent predictor of health status in patients with CHF over a 12-month period, also when adjusting for depressive symptoms. Since health status is an important patient-centred outcome, with patients generally preferring better health status over prolonged survival, and impaired health status being associated with poor prognosis [5,6,36,44], high-risk patients, such as patients with a Type D personality, require a form of behavioural and psychosocial intervention in addition to their management of CHF. Furthermore, it seems timely now to include personality factors in cardiovascular research, as we need more studies that lead to a fuller understanding of the influence of personality factors on health outcomes [45].

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