DS14: Standard Assessment of Negative Affectivity, Social Inhibition, and Type D Personality

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Objective: Type D personality—a joint tendency toward negative affectivity (NA) and social inhibition (SI)—is related to poor cardiac prognosis, but there is no standard for assessing Type D. This study reports on the Type D Scale-14 (DS14) as a standard measure of NA, SI, and Type D. **Methods:** The study included 3813 participants (2508 from the general population, 573 cardiac patients, 732 hypertension patients). They all filled out the DS14, containing 7-item NA and SI subscales; 275 subjects also completed the NEO-FFI, and 121 patients filled out the DS14 twice. **Results:** Factor analysis of the DS14 yielded 2 dominant traits; all of the NA and SI items loaded between 0.62 to 0.82 on their corresponding factor ($N = 3678$). The NA scale covered *dysphoria*, *worry,* and *irritability;* the SI scale covered *discomfort in social interactions*, *reticence,* and *lack of social poise*. The NA and SI scales were internally consistent ($\alpha = 0.88/0.86$; $N = 3678$), stable over a 3-month period (test–retest $r = 0.72/0.82$) and not dependent on mood and health status ($N = 121$). NA correlated positively with neuroticism ($r = 0.68$); SI correlated negatively with extraversion ($r = -0.59/-0.65$). Scale-level factor analysis confirmed the construct validity of the DS14 against the NEO-FFI. Using a cutoff of 10 (NA $\geq$10 and SI $\geq$10), 1027 subjects (28%) were classified as Type D, 21% in the general population versus 28% in coronary heart disease and 53% in hypertension ($p \leq .001$). Age, sex, and Type D (odds ratio, 3.98; 95% confidence interval, 3.2–4.6; $p < .0001$) were independently associated with cardiovascular morbidity. **Conclusion:** The DS14 is a brief, psychometrically sound measure of negative affectivity and social inhibition that could readily be incorporated in epidemiologic and clinical research. **Key words:** negative affectivity, social inhibition, Type D personality, heart disease, hypertension, heart failure, depression.

CHD = coronary heart disease; **DS14** = Type D Scale-14; **GMS** = Global Mood Scale; **HCS** = Health Complaints Scale; **LVEF** = left ventricular ejection fraction; **NA** = negative affectivity; **NEO-FFI** = NEO Five Factor Inventory; **SI** = social inhibition.

INTRODUCTION

Psychologic stress has been related to an increased risk of coronary heart disease (CHD) (1) and hypertension (2). Personality is a major determinant of chronic stress, but the controversy surrounding Type A behavior made it unfashionable to include global traits in CHD research (3). Subsequent research predominantly focused on specific traits such as hostility and anger (4). Hostility has been associated with sympathetic nervous system activation (5,6), hypertension among young adults (7), and recurrent cardiovascular events among cardiac patients (8,9). Anger has also been associated with an increased risk of CHD (10), whereas anger inhibition has been shown to predict high blood pressure (11) and increased risk of cardiovascular mortality (12).

It is premature, however, to write off associations between global traits (13) and CHD. In addition to focusing on hostility/anger proneness, there is a need to adopt a broader personality perspective in the early identification of high-risk patients. Negative affectivity (NA) and social inhibition (SI) are 2 global traits (13) that are relevant in this context. NA refers to the tendency to experience negative emotions across time/situations (14,15). High-NA individuals experience more feelings of dysphoria, anxiety, and irritability; have a negative view of self; and scan the world for signs of impending trouble (14). SI refers to the tendency to inhibit the expression of emotions/behaviors in social interactions to avoid disapproval by others (16). High-SI individuals tend to feel inhibited, tense, and insecure when with others (17,18).

Individuals who are high in both NA and SI have a *distressed* or Type D personality, given their vulnerability to chronic distress (19,20). Type D patients are at increased risk for a wide range of adverse health outcomes (Table 1), including mortality and morbidity (19–25), even after invasive treatment with a drug-eluting stent (24). They are also at risk for posttraumatic stress (26) and vital exhaustion (27). Physiological hyperreactivity (28), immune activation (29), and inadequate response to cardiac treatment (23,24,27) are mechanisms that may explain this detrimental effect of Type D. Type D may also be associated with early onset of CHD in men (30), and the combination of Type D and younger age designates a poor prognosis in CHD (23). Finally, Type D patients are at risk for clustering of psychologic risk factors, including depression, anxiety, and irritability, and low levels of self-esteem, well-being, and positive affect (31–35).

A limitation of this research is the lack of a standard for assessing NA, SI, and Type D. In addition, the Type D construct was designed to emphasize the role of normal traits rather than psychopathology (32), but information on Type D in the general population is lacking. Finally, little is known of the stability of NA and SI over time in patients recovering from a cardiac event. Therefore, this article reports on a standard measure of NA, SI, and Type D.

The Type D Scale-14 (DS14) was specifically developed to assess NA, SI, and Type D in a reliable and standardized way that poses little burden to respondents. Items of the DS14 were derived from its predecessor, the DS16 (31), but also included new items that were developed to enhance the assessment of NA and SI (32). NA refers to the tendency to experience feelings of dysphoria, anxiety, and irritability. Six NA items of the DS16 were related to dysphoria (eg, "I often feel unhappy," "I am often down in the dumps"), whereas 2 items were related to anxiety and irritability (ie, "I often find myself

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TABLE 1. Main Findings of Studies on Type D Personality

Main Findings	Subjects	Study Design	Country	Publication
↑ All-cause mortality‡	105 patients with CHD	Prospective FU	Belgium	*Psychosom Med* 1995 (19)
↑ All-cause mortality (OR = 4.1‡)	303 patients with CHD	Prospective FU	Belgium	*Lancet* 1996 (20)
↑ Development of cancer (OR = 7.2†)	246 men with CHD	Prospective FU	Belgium	*Psychol Med* 1998 (21)
↑ Cardiac death/nonfatal MI (RR = 4.7‡)	87 MI patients (LVEF ≤50%)	Prospective FU	Belgium	*Circulation* 1998 (22)
↑ Cardiac death/nonfatal MI (OR = 8.9‡)	319 patients with CHD	Prospective FU	Belgium	*Circulation* 2000 (23)
↑ Death/nonfatal MI (OR =5.3‡)	875 patients post-PCI	Prospective FU	Netherlands	*J Am Coll Cardiol* 2004 (24)
↑ Sudden cardiac arrest (OR = 9.4*)	99 SCA—119 CHD patients	Case–control	Netherlands	*J Psychosom Res* 2000 (25)
↑ Posttaumatic stress disorder (OR = 4.5*)	112 MI patients, 115 controls	Case–control	Denmark	*J Psychosom Res* 2004 (26)
↑ Symptoms of vital exhaustion‡	171 patients with CHD	Intervention	Netherlands	*J Psychosom Res* 2001 (27)
↑ Blood pressure and cortisol reactivity*	173 undergraduate students	Experimental	Canada	*J Psychosom Res* 2003 (28)
↑ Proinflammatory cytokines (OR = 9.5†)	42 men with heart failure	Cross-sectional	Belgium	*Brain Behav Immun* 2003 (29)
↑ Risk of early ischemic CHD in men*	100 patients with CHD	Cross-sectional	USA	*J Psychosom Res* 2004 (30)
↓ Self-esteem, ↑ depression‡	100 patients with CHD	Cross-sectional	Belgium	*Ann Behav Med* 1998 (31)
↓ Positive affect, ↑ negative affect‡	734 hypertensive patients	Cross-sectional	Belgium	*J Psychosom Res* 2000 (32)
↑ Anxiety, somatization,‡ depression†	135 adults, working population	Cross-sectional	Belgium	*Psychol Health* 2002 (33)
↑ Anxiety, depression, irritability‡	83 patients with CHD	Cross-sectional	USA	*J Cardiovasc Risk* 2002 (34)
↑ Anxiety (OR = 7.0‡), depression (OR = 7.4‡)	182 patients with ICD	Cross-sectional	Netherlands	*Psychosom Med* 2004 (35)

*$p < .05$.
†$p < .01$.
‡$p < .001$.
FU = follow-up study; ICD = implantable cardioverter defibrillator; LVEF = left ventricular ejection fraction; MI = myocardial infarction; PCI = percutaneous coronary intervention; SCA = sudden cardiac arrest.

worrying about something," "I am often in a bad mood"). SI refers to discomfort in social interactions, lack of social poise, and the tendency to avoid confrontation in social interaction leading to nonexpression (16). Five SI items of the DS16 were related to discomfort and social poise (eg, "When socializing, I don't find the right things to talk about," "I make contact easily when I meet people" [reverse-keyed]), whereas the remaining three SI items of the DS16 were related to dominance.

The rationale and strategy used to revise the DS16 has been described in detail elsewhere (32) and is summarized briefly here. The DS16 was initially revised to include the most prominent low-order traits from the NA and SI domains. Four new NA items were added to better reflect feelings of anxiety and irritability (eg, "I often make a fuss about unimportant things," "I am often irritated") and 4 new SI items to enhance the assessment of social inhibition and lack of social poise (eg, "I often feel inhibited in social interactions"). The 3 DS16 dominance items were deleted and replaced by 3 new SI items to adequately reflect the tendency to avoid potential dangers involved in social interaction (ie, "I am a closed kind of person," "I would rather keep other people at a distance," and "I am a reserved kind of person"). As described previously, this strategy resulted in a pool of 24 items that were selected to cover the NA and SI personality domains by 12 items each (32).

To devise a brief measure with little burden to patients, 7 items were selected to cover the domains of NA and SI, respectively. Inclusion of items in the DS14 was based on conceptual and psychometric grounds. Conceptually, the NA items had to cover the tendency to experience feelings of dysphoria, anxious apprehension, and irritability, and the SI items social discomfort, reticence, and lack of social poise (32). Psychometrically, items with the highest item-total correlations were selected (36). The DS14 is presented in Appendix A.

The purpose of this study was to examine 1) the validity of the DS14, 2) the prevalence of Type D personality in the general population and in coronary patients and hypertension patients, and 3) the stability of the NA and SI traits in patients who participated in cardiac rehabilitation.

METHODS

Subjects

With reference to purpose 1) and 2), the sample included 3678 subjects from the general population and from cardiac and primary health care. Subjects from the general population ($N = 2508$; 1235 men and 1273 women; mean age, 45.6 ± 15.9 years; range, 16–101 years) included 1721 subjects from the CentERdata survey research institute, Tilburg University, and 787 subjects from the Dutch-speaking part of Belgium that were specifically selected to be representative of the Dutch and Belgian population. The educational level was low in 22%, middle in 45%, and high in 33% of these subjects; 81% was married or living together with a partner. The response rate in the general population subgroup was 86%. Subjects with a clinical condition included 438 Belgian patients with CHD (409 men and 29 women; mean age, 57.6 ± 8.6 years; range, 27–78 years) from the cardiology department of the University Hospital of Antwerp, Belgium, and 732 Belgian patients with hypertension (378 men and 354 women; mean age, 61.7 ± 8.5 years; range, 45–75 years) who were seeing their general practitioner. The response rate in the clinical subgroup was 91%.

To examine the stability of the DS14 scales, the present study also included a group of 135 patients (109 men and 26 women; mean age, 58.1 ± 11.2 years) who participated in the cardiac rehabilitation program of the University Hospital of Antwerp. On admission to the program, all patients filled out the DS14 as well as mood and health status questionnaires; 121 patients (89.6%) filled out the same questionnaires at the end of this 3-month program. There were 75 patients with CHD and 60 patients with chronic heart failure; left ventricular ejection fraction (LVEF) in these patients was 59% ±

9% versus 32% ± 11%, respectively ($p < .0001$). Type D personality was not significantly associated with age, sex, educational level, diagnosis of heart failure, or LVEF but was associated with poor health and mood status (Table 2).

Type D Personality

The DS14 was used to assess NA, SI, and Type D personality. Subjects rated their personality on a 5-point Likert scale ranging from 0 = false to 4 = true. The NA and SI scales can be scored as continuous variables (range, 0–28) to assess these personality traits in their own right. A cutoff of 10 on both scales is used to classify subjects as Type D (ie, NA ≥10 and SI ≥10). Like in previous research (19–23), this cutoff corresponds to a median split of the NA and SI scores among cardiac patients in the present study ($N = 438$ and $N = 135$); ie, 29% of the cardiac patients (167 of 573) were classified as Type D. This figure corresponds very well with the 27% to 31% of cardiac patients that were classified as Type D in previous research (19,20,23). Scoring of the NA and SI scales and classification of Type D are presented in Appendix B.

Five-Factor Model of Personality

A subset of 275 subjects (140 from the general population; 135 cardiac rehabilitation patients) filled out the NEO-Five Factor Inventory (NEO-FFI) to validate the DS14 against this personality model. The NEO-FFI includes five scales of neuroticism, extraversion, openness, agreeableness, and conscientiousness (37). NA correlates positively with neuroticism, SI correlates negatively with extraversion, and both NA and SI correlate negatively with conscientiousness (33).

Mood and Health Status

To examine the extent to which DS14 scores were affected by changes in mood status, patients from the rehabilitation sample also completed the Global Mood Scale (GMS) and the Health Complaints Scale (HCS). The GMS (38) comprises a 10-item negative affect and a 10-item positive affect scale that correlate 0.50 to 0.90 with standard mood/distress scales such as the Profile of Mood States and the State-Anxiety Inventory. Evidence shows that the GMS is the most responsive outcome measure available in the context of cardiac rehabilitation (39). The HCS (40) comprises 12 somatic complaints (eg, tightness of chest, shortness of breath) and 12 frequently reported symptoms of perceived disability; these items are rated on a 5-point scale of distress. Both the GMS and HCS are psychometrically sound measures (39).

Statistical Analyses

Subjects had to complete all items of the DS14; given its brevity and the simplicity of its item wording, there were almost no missing values. When a score on an item was missing, subjects were asked to further complete the scale. Principal components analysis (varimax rotation) was used to examine the internal–structural validity, ie, the ability of items to reflect the personality traits of NA and SI (36). Cronbach's α was used to examine the internal consistency of the DS14. The NA and SI scales were analyzed on the second-order level in the hierarchy of personality constructs that is defined by the intercorrelations among traits (36). Pearson's correlations and factor analysis of scale scores were used to examine the construct validity of the DS14 against the NEO-FFI. Logistic regression analysis (enter model) was used to estimate the risk of CHD and hypertension in Type D individuals, adjusting for age and sex.

Test–retest correlations over a 3-month period were calculated for the DS14 personality and GMS mood scales of rehabilitation patients. Fisher-Z test was used to examine whether differences between test–retest correlations of personality and mood scales were significant. Changes in personality versus mood scores were analyzed by repeated-measures multivariate analyses of variance (MANOVAs) with measure (DS14/GMS/HCS scales) and time (entry/end scores) as within-subjects factors. For this purpose, the same scaling of scores ranging between 0 and 28 on the DS14/GMS/HCS was obtained by recalculating scores on the GMS (score/40*28) and HCS (score/96*28). Finally, correlations between change scores in mood and personality were examined by Fisher-Z test.

RESULTS

Internal Validity

Factor analysis was used to examine the internal–structural validity of the NA and SI items ($N = 3678$). Consistent with the DS14 personality model, eigenvalue and scree plot criteria indicated 2 dominant personality domains (Figure 1). Succeeding factors were much smaller (eigenvalue <1.0) and explained a minor proportion of variance in personality.

All of the 7 NA items and 7 SI items had a loading ranging between 0.62 and 0.82 on their corresponding trait factor; this was replicated in the coronary and hypertension subsamples (Table 3). Cronbach's α (0.88 and 0.86) and item-total correlations (between 0.52 and 0.75) indicated a high level of internal consistency for these trait scales. Factor analysis of the 7 NA items showed that the NA scale covered dysphoria (items 4, 7, and 13), worry (items 2 and 12), and irritability (items 5 and 9). Factor analysis of the 7 SI items indicated that the SI scale covered discomfort in social interactions (items 6,

TABLE 2. Baseline Characteristics of Cardiac Rehabilitation Patients ($N = 135$)

Characteristics	Total Sample	Non-Type D Patients ($n = 89$)	Type D Patients ($n = 46$)	p Value
Demographic				
Age	58.1 y (11.2)	58.8 y (11.5)	56.5 y (10.7)	NS
Male sex	$n = 109$ (81%)	$n = 73$ (82%)	$n = 36$ (78%)	NS
Lower educational level	$n = 36$ (27%)	$n = 21$ (24%)	$n = 15$ (33%)	NS
Disease severity				
Diagnosis of heart failure	$n = 60$ (44%)	$n = 36$ (40%)	$n = 24$ (52%)	NS
LVEF in heart failure patients	32.1% (11.2)	33.8% (11.9)	29.5% (9.9)	NS
LVEF in coronary patients	58.7% (9.1)	59.1% (9.1)	57.6% (9.1)	NS
Subjective health status				
Somatic complaints (HCS)	13.8 (9.0)	11.7 (8.2)	17.0 (9.8)	.002
Feelings of disability (HCS)	18.6 (12.3)	14.9 (11.5)	23.4 (11.1)	.0001
Subjective mood status				
Negative affect (GMS)	14.1 (9.0)	11.8 (8.1)	17.9 (8.9)	.0001
Positive affect (GMS)	19.5 (8.1)	21.8 (8.5)	15.8 (6.3)	.0001

NS = not significant ($p > .10$); CHD = coronary heart disease; GMS = Global Mood Scale; HCS = Health Complaints Scale; LVEF = left ventricular ejection fraction.

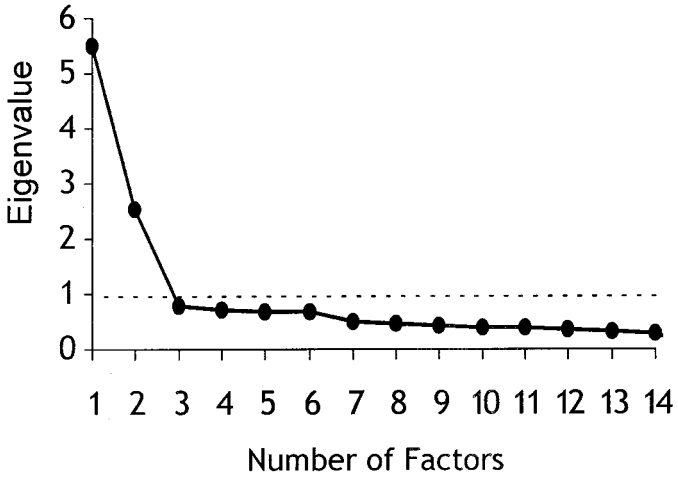

Figure 1. Scree plot showing the eigenvalues of the factors representing the items from the DS14. This scree plot indicated a marked "elbow" that inflected after the second factor. Succeeding factors explained a minor proportion of variance in personality and had an eigenvalue<1.0.

8, and 14), reticence (items 10 and 11), and social poise (items 1 and 3), respectively (data not shown). These findings clearly supported the internal validity of the NA and SI scales. These scales shared 14% of variance (r =0.37). Women scored higher on NA than men (M = 8.1 ± 5.6 vs. 6.3 ± 5.3, p <.0001); men scored higher on SI than women (M = 10.2 ± 6.6 vs. 9.7 ± 6.2, p = .03).

Construct Validity

In subjects from the general population, SI and NA correlated $r = -0.59$ and $r = 0.68$ with extraversion and neuroticism, respectively, indicating 35% to 46% of shared variance (Table 4, left). Hence, these traits were related but not identical. SI and NA correlated negatively with conscientiousness and agreeableness (5% to 15% shared variance). Second-order factor analysis of scale scores indicated that SI (0.83)/extraversion (−0.84) and NA (0.86)/neuroticism (0.85) represented major personality domains, which corroborated the construct validity of the DS14. These findings were replicated in cardiac patients (Table 4, right), ie, SI and NA correlated $r = -0.65$ and $r = 0.68$ with extraversion and neuroticism, respectively, and correlated negatively with conscientiousness/agreeableness. Once again, second-order factor analysis yielded SI (0.89)/extraversion (−0.84) and NA (0.92)/neuroticism (0.79) as major dimensions of personality.

Cardiovascular Morbidity

Using a cutoff of 10 on both DS14 scales (NA ≥10 *and* SI ≥10), 28% of subjects (1027 of 3678) were classified as Type D (25% men vs. 31% women, p <.0001). In the subject sample as a whole, Type D was more prevalent in coronary patients (28%) and hypertension patients (53%) as compared with subjects from the general population (Figure 2, left). Confining these analyses to an age-restricted subgroup (40–70 years; mean, 55.1 ± 8.6) that is representative of a cardiac population yielded similar results (Figure 2, right), ie, Type D personality was more prevalent in coronary (27%) and hypertension (54%) patients as compared with subjects from the general population (19%). Therefore, logistic regression analyses were used to test a model of cardiovascular morbidity,

TABLE 3. Factor Structure and Internal Consistency of the DS14 (N = 3678)

Items of the DS14	FA—Total Sample		Internal Consistency†	FA—CHD (N = 438)		FA—HYPT (N = 732)	
	Factor I	Factor II		Factor I	Factor II	Factor I	Factor II
Negative Affectivity							
(4) I often feel unhappy	**0.74**	0.17	0.65	**0.72**	0.08	**0.77**	0.19
(7) I take a gloomy view of things	**0.78**	0.22	0.72	**0.78**	0.24	**0.77**	0.19
(13) I am often down in the dumps	**0.82**	0.17	0.75	**0.79**	0.15	**0.80**	0.15
(2) I often make a fuss about unimportant things	**0.69**	0.07	0.59	**0.71**	0.11	**0.66**	0.08
(12) I often find myself worrying about something	**0.75**	0.10	0.66	**0.75**	0.12	**0.71**	0.12
(5) I am often irritated	**0.70**	0.07	0.60	**0.71**	0.12	**0.70**	0.04
(9) I am often in a bad mood	**0.72**	0.15	0.63	**0.72**	0.15	**0.69**	0.17
eigenvalue I =5.49			α = 0.88				
Social Inhibition							
(6) I often feel inhibited in social interactions	0.34	**0.70**	0.66	0.38	**0.68**	0.39	**0.70**
(8) I find it hard to start a conversation	0.16	**0.79**	0.71	0.19	**0.81**	0.20	**0.75**
(14) When socializing, I don't find the right things to talk about	0.17	**0.74**	0.66	0.22	**0.77**	0.23	**0.73**
(10) I am a closed kind of person	0.14	**0.74**	0.65	0.21	**0.78**	0.22	**0.75**
(11) I would rather keep other people at a distance	0.24	**0.62**	0.56	0.14	**0.62**	0.18	**0.65**
(1) I make contact easily when I meet people*	−0.05	**−0.82**	0.71	0.00	**−0.79**	−0.01	**−0.84**
(3) I often talk to strangers*	0.05	**−0.68**	0.52	0.01	**−0.68**	0.11	**−0.70**
eigenvalue II =2.54			α = 0.86				

*Reverse keyed.
†Corrected item-total correlations.
CHD = coronary sample; HYPT = hypertension sample; factor loadings are presented in boldface.

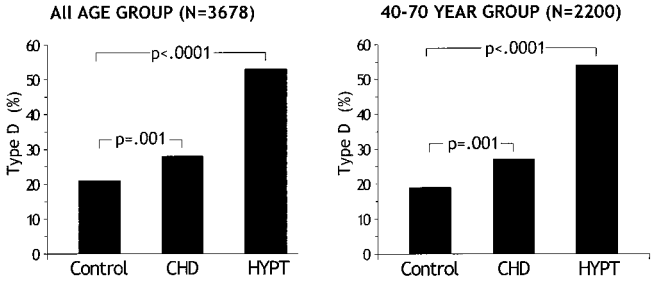

Figure 2. Percentage of subjects with Type D personality as a function of cardiovascular morbidity. Control, subjects from the general population (N = 2508); CHD, patients with coronary heart disease (N = 438); HYPT, patients with hypertension (N = 732).

with Type D personality, sex, and age as independent variables.

Type D was associated with CHD (odds ratio [OR], 2.14) and hypertension (OR, 5.50) after adjustment for age and sex in the sample as a whole (Table 5, left). Once again, confining these regression analyses to the age-restricted subgroup yielded similar results (Table 5, right). Age, male sex, and Type D (OR, 3.98 and 3.90, respectively) were independently associated with the combined end point of CHD/hypertension. Hence, Type D personality represented an individual difference variable that was independently associated with cardiovascular morbidity in the present study.

Temporal Stability

Factor analysis confirmed the structural validity of the DS14 in the sample of 135 cardiac rehabilitation patients (data not shown). Test–retest correlations in the 121 patients who also completed questionnaires at the end of this 3-month program were 0.82 and 0.72 for the SI and NA scales, respectively, indicating that the relative rankings of DS14 scores among patients were stable over time. Moreover, test–retest correlation of the DS14 SI and NA traits were significantly higher than that of the GMS negative affect (0.53; $Z = -6.09$ and $Z = -3.48$, $p < .0001$) and positive affect (0.49; $Z = -6.69$ and $Z = -4.08$, $p < .0001$) mood scales, respectively. Hence, scores on the DS14 scales reflected stable tendencies to experience negative emotions and to be socially inhibited across time.

DS14 and Changes in Mood Status

The DS14 scales also had to be relatively independent from changes in mood status. In the rehabilitation sample, mood scores changed significantly over the 3-month intervention period (Figures 3B–D; $p < .0001$). Repeated-measures MANOVA with measure (personality/mood) and time (entry/end scores) as within-subjects factors indicated a *measure* × *time* interaction effect (F [5, 115] = 15.0, $p < .0001$). In contrast to mood, NA and SI did not change significantly over time (Figure 3A). There was a significant decrease in negative *affect* (GMS) as a mood state but not in negative *affectivity* (DS14) as a personality trait (Figure 3B; *measure* × *time* interaction effect, $p < .0001$). This finding was replicated

TABLE 4. Construct Validity of the DS14 Scales (N = 275)

		Subjects from the General Population (N = 140)							Cardiac Patients (N = 135)						
		Correlations *		Second-Order Factor Analysis †					Correlations*		Second-Order Factor Analysis†				
		SI	NA	I	II	III	IV	V	SI	NA	I	II	III	IV	V
DS14	Social Inhibition	—	—	0.37	**0.83**	−0.05	−0.10	−0.02	—	—	**0.89**	0.08	−0.15	−0.19	0.03
DS14	Negative Affectivity	—	—	**0.86**	0.30	0.02	0.06	−0.23	—	—	0.22	**0.92**	−0.03	−0.19	0.02
NEO-FFI	Extraversion	*−0.59*	−0.36	−0.10	**−0.84**	0.30	−0.07	0.16	*−0.65*	−0.42	**−0.84**	−0.30	0.20	−0.05	0.05
NEO-FFI	Neuroticism	0.43	*0.68*	**0.85**	0.16	−0.32	−0.13	−0.08	0.31	*0.68*	0.16	**0.79**	−0.47	0.01	−0.13
NEO-FFI	Conscientiousness	−0.36	−0.31	−0.18	−0.24	**0.91**	−0.06	0.18	−0.42	−0.36	−0.28	−0.21	**0.91**	0.10	−0.08
NEO-FFI	Agreeableness	−0.23	−0.39	−0.20	−0.12	0.17	0.07	**0.95**	−0.27	−0.30	−0.10	−0.13	0.08.	**0.97**	−0.04
NEO-FFI	Openess	−0.09	−0.01	−0.04	−0.01	−0.05	**0.99**	0.06	0.03	−0.03	−0.01	−0.05	−0.05	−0.03	**0.99**

*Correlations>0.50 are presented in italics.
†Factor analysis of scale scores on the DS14 and NEO-FFI; loadings of scales that are assigned to a factor are presented in boldface.
SI = social inhibition; NA = negative affectivity; NEO-FFI = NEO Five-Factor Inventory.

TABLE 5. Type D: Independently Associated With Cardiovascular Morbidity*

	All Age Group (N = 3678)				40- to 70-Year Group (N = 2200)			
	Variable	**Odds ratio**	[95% CI]	p	Variable	**Odds ratio**	[95% CI]	p
Personality†								
CHD	Type D	**2.14**	[1.64–2.81]	.0001	Type D	**2.11**	[1.55–2.86]	.0001
Hypertension	Type D	**5.50**	[4.43–6.83]	.0001	Type D	**5.75**	[4.51–7.33]	.0001
Logistic regression model								
CHD/hypertension	Age	**1.09**	[1.08–1.10]	.0001	Age	**1.10**	[1.09–1.11]	.0001
	Male sex	**2.00**	[1.67–2.39]	.0001	Male sex	**2.30**	[1.89–2.81]	.0001
	Type D	**3.98**	[3.15–4.58]	.0001	Type D	**3.90**	[3.15–4.83]	.0001

*CHD hypertension, and CHD or hypertension coded as 1, respectively.
†Adjusting for age and sex.

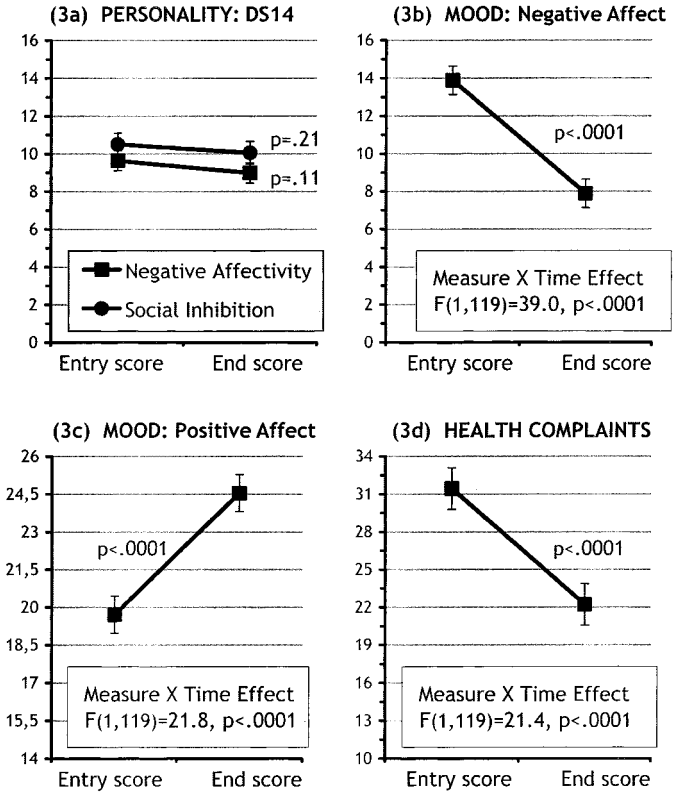

Figure 3. Changes in mean scores on personality, mood, and health status measures before and after cardiac rehabilitation (N = 121). Standard deviations of entry and scores: 6.7 and 6.5 (DS14–social inhibition); 6.0 and 5.8 (DS14–negative affectivity); 8.9 and 7.7 (GMS–negative affect); 8.3 and 8.0 (GMS–positive affect); 18.9 and 17.6 (HCS–total score).

when contrasting the positive affect and health complaints measures with NA (Figures 3C and 3D) and with SI (data not shown).

Correlations between change scores on the HCS, GMS, and DS14 scales were calculated to examine the extent to which changes in mood status were associated with changes in SI/NA. Changes in mood were not associated with changes in SI (Table 6; r = 0.13/0.07/−0.16). Changes in negative mood correlated highly with changes in health complaints (r = 0.71) as compared with changes in NA (r = 0.28, Z = −7.96, p <.00001). Factor analysis of change scores confirmed that changes in personality scores were distinctly different from changes in mood/health status. Hence, scores on the DS14 were not mood state-dependent but proved to be stable over time.

DISCUSSION

Psychosomatic research lacks short, easy-to-use measures of NA and SI. The present findings support the use of the DS14 to assess these global traits in epidemiologic and clinical research. Factor analytic and reliability criteria provided evidence for its 2-factor structure and internal consistency. Correlations with neuroticism/introversion and scale-level factor analysis confirmed the construct validity of the DS14 in the 5-factor personality space. Scores on the NA and SI scales were stable over a 3-month period of time and were not mood state-dependent. Age and sex are frequently studied as individual difference variables in psychosomatic research (41,42). The present findings indicate that it is feasible to include global personality traits as well.

Personality refers to a complex organization of traits that reflect consistencies in the general affective level and behavior of individuals (43). Accordingly, the DS14 was stable over time. NA and SI do not cover the entire range of individual differences in personality, but these traits proved to represent major domains of personality both in general and in cardiac populations. NA is associated with increased vulnerability to anxiety and depression (43) and SI with increased vulnerability to interpersonal stress and failure to adapt (18). Hence, some Type D individuals will cross the threshold for diagnosis of psychopathologic disorder, whereas others will do so only during times of elevated stress (32). These personality traits are not pathologic by themselves; many Type D individuals will display subclinical levels of emotional distress all their lives (32).

Negative emotions, including depression, anxiety, and anger, may predict the development and progression of CHD (44,45) and increased healthcare consumption in cardiac patients (46). The DS14 NA scale represents well the tendency to experience these negative emotions across time (15,45). High-NA scorers tend to feel unhappy, tend to worry, and are easily irritated. How people cope with these emotions during

TABLE 6. Correlations Between Change Scores in Health Complaints, Affective Mood Status, and DS14 Personality Traits (N = 121)

	Change Scores: Correlations*			Second-Order Factor Analysis†	
	Health Complaints	Negative Affect	Positive Affect	Factor I	Factor II
Change score—Health Complaints (HCS)	—			**0.86**	0.20
Change score—Negative Affect (GMS)	*0.71*	—		**0.89**	0.03
Change score—Positive Affect (GMS)	*−0.46*	*−0.47*	—	**−0.71**	−0.13
Change score—Social Inhibition (DS14)	0.13	0.07	−0.16	−0.03	**0.89**
Change score—Negative Affectivity (DS14)	*0.46*	0.28	−0.25	0.34	**0.76**

*Correlations>0.40 are presented in italics.
†Factor analysis of change scores on the mood, health complaints, and personality measures; loadings of scales that are assigned to a factor are presented in boldface.
DS14 = Type D Scale-14; GMS = Global Mood Scale; HCS = Health Complaints Scale.

social interactions may be another determinant of stress-related disease (32). High-SI individuals tend to inhibit the outward signs of inner feelings as a strategy for downregulating emotion (47). Emotional inhibition is associated with increased cardiovascular reactivity (47,48), decreased cardiovascular recovery and heart rate variability (49,50), and increased risk of cardiac morbidity and mortality (11,12,51–53).

Apart from a relative failure to use more adaptive emotion regulation strategies, increased vulnerability to interpersonal stress is by itself a disease-promoting characteristic of SI. High-SI individuals perceive the social world as threatening (16) and display physiological hyperreactivity under conditions of social engagement (28,54). Hence, SI has been related to elevated levels of catecholamines and increased heart rate/blood pressure (28,55–58). This relation between SI and increased activity of the sympathetic nervous system also mediates immune functions (59). Introversion has been associated with susceptibility to viral pathology (60) and natural killer cell cytotoxicity (55), and SI with immune dysregulation in HIV (56,61) and heart failure (29).

In addition to the measurement of NA and SI as distinct traits, the DS14 allows for the assessment of Type D. Psychologic risk factors for cardiac disease may cluster together (44); the DS14 was designed to identify those patients who are at risk for this clustering of factors. Hence, Type D was more prevalent among coronary and hypertensive patients as compared with subjects from the general population. Controlling for age and sex, Type D was associated with a 4-fold increased risk of cardiovascular morbidity; this figure corresponds well with research on Type D personality in the Hungarian population (62). The prevalence of Type D in hypertension patients was strikingly high (53%). A Canadian study found that Type D was associated with increased blood pressure reactivity to stress in young, healthy adults (28).

The findings of the present study need to be interpreted with some caution given the case–control design of the study. Other limitations include lack of control for unhealthy behaviors such as smoking, obesity, and other behavioral risk factors for cardiovascular morbidity. The absence of data regarding the discriminant validity of the DS14 and its relationship to psychopathology and personality disorders comprises another limitation. Moreover, generalization of findings from previous studies on Type D personality is limited by the variety of measures that was used to assess this construct (32). However, with the introduction of the DS14, standard assessment of NA, SI, and Type D now will be possible.

Type D is associated with increased risk of cardiac events and impaired quality of life (63), but many questions remain to be addressed about the Type D construct. These include the exact definition of this construct, the mechanisms by which Type D affects health, and the effect of intervention (64). Evidence suggests that the Type D construct, originally developed in Belgian patients, is equally applicable in other nationalities (24–28,30,62,65). However, more research is needed to examine the crosscultural validity of Type D. The availability of a brief, psychometrically sound scale that could readily be incorporated in epidemiologic and clinical research will greatly increase the likelihood of answers to these and other questions.

In a recent article, Albus, Jordan, and Herrmann-Lingen recommended the use of the DS14 in patients with CHD (66). Recently, Linden and colleagues also argued that psychosomatic research needs to "explore newer personality constructs to see how such traits contribute to our understanding of the pathogenic effects of personality on heart disease" (28). This calls for a valid personality scale that poses minimal burden to patients and that can be easily used in combination with standard distress measures. The DS14 fulfills all of these criteria.

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Appendix

DS14 Name : ..... Today's date : .....

Below are a number of statements that people often use to describe themselves. Please read each statement and then ***circle*** the appropriate ***number*** next to that statement to indicate your answer. There are no right or wrong answers: Your own impression is the only thing that matters.

0=FALSE **1**=RATHER FALSE **2**=NEUTRAL **3**=RATHER TRUE **4**=TRUE

1	I make contact easily when I meet people	0	1	2	3	4
2	I often make a fuss about unimportant things	0	1	2	3	4
3	I often talk to strangers	0	1	2	3	4
4	I often feel unhappy	0	1	2	3	4
5	I am often irritated	0	1	2	3	4
6	I often feel inhibited in social interactions	0	1	2	3	4
7	I take a gloomy view of things	0	1	2	3	4
8	I find it hard to start a conversation	0	1	2	3	4
9	I am often in a bad mood	0	1	2	3	4
10	I am a closed kind of person	0	1	2	3	4
11	I would rather keep other people at a distance	0	1	2	3	4
12	I often find myself worrying about something	0	1	2	3	4
13	I am often down in the dumps	0	1	2	3	4
14	When socializing, I don't find the right things to talk about	0	1	2	3	4

Scoring of the DS14.

1. **Scoring of Negative Affectivity and Social Inhibition.**
The Negative Affectivity and Social Inhibition scales can be used as continuous variables to assess each of these two personality traits in their own right. Scores on both scales range from 0 - 28, and can be calculated as follows:

Negative Affectivity = sum of scores on items **2 + 4 + 5 + 7 + 9 + 12 + 13.**

Social Inhibition = sum of scores on items **1** [*reversed*] + **3** [*reversed*] + **6 + 8 + 10 + 11 + 14.**

2. **Interpretation of Raw Scores - General Population (*N*=2508).**
The following table can be used for the interpretation of raw scores on the Negative Affectivity and Social Inhibition scales. This interpretation differs for men and women regarding Negative Affectivity, but not Social Inhibition.

Negative Affectivity	Mean (SD)	Very Low	Low	Below Average	Average	Above Average	High	Very High
Men (*N*=1235)	6.3 (5.3)	0	1	2 - 3	4 - 6	7 - 10	11 - 16	17 - 28
Women (*N*=1273)	8.0 (5.6)	0	1 - 2	3 - 5	6 - 8	9 - 12	13 - 18	19 - 28
Social Inhibition	**Mean**	**Very Low**	**Low**	**Below Average**	**Average**	**Above Average**	**High**	**Very High**
Men (*N*=1235)	10.2 (6.6)	0	1 - 3	4 - 7	8 - 11	12 - 15	16 - 21	22 - 28
Women (*N*=1273)	9.7 (6.2)							

3. **Assessment of Type D Personality.**
With reference to assessment of Type D personality, **10** is the cut-off for both scales. Subjects are classified as Type D if **both** *Negative Affectivity is greater than or equal to 10* **and** *Social Inhibition is greater than or equal to 10.*