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Increased Anxiety and Depression in Danish Cardiac Patients with a Type D personality: Cross-Validation of the Type D Scale (DS14)

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Abstract
Background Type D personality is an emerging risk factor in cardiovascular disease. We examined the psychometric properties of the Danish version of the Type D Scale (DS14) and the impact of Type D on anxiety and depression in cardiac patients.
Method Cardiac patients (n=707) completed the DS14, the Hospital Anxiety and Depression Scale, and the Eysenck Personality Questionnaire. A subgroup (n=318) also completed the DS14 at 3 or 12 weeks.
Results The two-factor structure of the DS14 was confirmed; the subscales negative affectivity and social inhibition were shown to be valid, internally consistent (Cronbach's α=0.87/0.91; mean inter-item correlations= 0.49/0.59), and stable over 3 and 12 weeks (r=0.85/0.78; 0.83/0.79; ps<0.01). Type D was an independent associate of anxiety (β, 0.49; p<0.01) and depression (β, 0.47; p< 0.01) in univariable linear regression analysis and remained a significant independent associate of anxiety (β, 0.26; p< 0.01) and depression (β, 0.17; p<0.01) in adjusted analyses.
Conclusions The Danish DS14 was shown to be a valid and reliable measure associated with increased symptoms of anxiety and depression independent of socio-demographic and clinical risk factors. The DS14 may be used in research and clinical practice to identify high-risk patients.

Keywords Anxiety · Coronary artery disease · Depression · DS14 · Type D personality · Validity

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Introduction

Psychological risk factors have been implicated in the onset and progression of cardiovascular disease (CVD) [1–3] and associated with impaired health status [2, 4, 5]. The first psychological factor to gain risk factor status was the Type A Behavior Pattern (TABP), characterized by time urgency, hostility, and impatience [6]. However, later inconsistent results in relation to TABP led psychosomatic research to shift focus from personality factors towards mood and affective disorders [7]. In this context, depression is the mood state that has received the most attention. Generally, depression has been associated with a 2- to 4-fold risk of mortality [8], an increased risk of impaired health status [5, 9–11], noncompliance [12, 13], and health-care consumption [14, 15], although a recent meta-analysis questions the status of depression as an independent risk factor in CVD [16].

Currently, there is a resurgence of interest in more chronic psychological factors, such as personality, in the context of CVD [9, 10, 17, 18]. A personality approach may have advantages over a mood state approach, as

personality is less likely to be influenced by acute events, such as acute myocardial infarction (AMI), and to be confounded by somatic health, including disease severity [19, 20]. The *distressed* (Type D) personality is an emerging risk factor in CVD that has been associated with adverse prognosis, impaired health status, and a wide range of emotional distress, such as anxiety and depression [2]. The Type D construct was developed in patients with ischemic heart disease, but as shown in a recent review, the construct has value across CVD patient groups, including peripheral arterial disease, chronic heart failure (CHF), arrhythmia, and in patients treated with revascularization procedures [2].

Patients with a Type D personality are characterized by high scores on the two stable personality traits, negative affectivity and social inhibition [21]. These patients have a gloomy outlook on life, tend to feel sad, and experience increased negative emotions (i.e., high negative affectivity), while not sharing these emotions with others due to fears of how others may react (i.e., high social inhibition). It is important to emphasize that it is the co-occurrence of a high score on both traits that incurs an increased risk of adverse health outcomes, with recent studies showing that social inhibition moderates the effect of negative affectivity on prognosis [17, 22]. In addition, the impact of Type D personality on prognosis is independent of mood states, such as anxiety and depression [17, 23] and is not confounded by somatic health, including disease severity [19, 20]. Type D also distinguishes itself from depression and other mood states in that Type D represents a normal personality construct and is a chronic risk factor (≥2 years), whereas depression is a measure of psychopathology and comprises an episodic risk factor (<2 years) [2].

Type D personality can be assessed with the Type D Scale (DS14) that was originally developed and validated in Belgian cardiac patients [21]. Although its predecessor, the Type D Scale 16 (DS16), was validated in the Danish context [27], new items were included in the DS14 to enhance the assessment of negative affectivity and social inhibition [21]. In addition, the DS14 has advantages over the DS16, as it is a shorter instrument with an easier scoring format. Hence, the DS14 is more suitable to use in clinical and epidemiological research and as a screening instrument in clinical practice to identify high-risk patients.

The aim of the current study was (1) to cross-validate the Danish version of the DS14 in a mixed group of cardiac patients and (2) to examine the impact of Type D personality on symptoms of anxiety and depression. Based on previous research, we expected the Danish DS14 to be a valid and reliable measure to assess Type D personality and that the Type D construct would be significantly correlated with symptoms of anxiety and depression.

Method

Procedure and Participants

From January 2005 till February 2007, a total of 1,138 patients were approached for participation in the current study, of whom 798 agreed to participate. However, the data quality was only adequate for 726 of these patients. Cases without scores on the DS14 were excluded from statistical analyses (n=19). For all remaining cases, missing data were imputed using the expectation-maximization algorithm, which has been demonstrated to be an effective method of dealing with missing data [24]. Data were not imputed for the Hospital Anxiety and Depression Scale (HADS) and the Eysenck Personality Questionnaire (EPQ) if cases had no scores on these measures. Recruitment was carried out through two channels. The majority of the patients were identified through a database of ischemic heart disease (IHD; n=464) and CHF patients (n=126) at Holbæk Sygehus, Denmark, and the remainder of patients (117 CHF patients) were recruited at CHF outpatient clinics at Aarhus University Hospital (Aarhus Sygehus, Skejby Sygehus, Aalborg Sygehus) and Odense University Hospital. Thus, the final sample consisted of a mixed group of 707 cardiac patients (n=243 CHF patients; n=464 IHD patients), and time since the cardiac event ranged from 0.5 to 32 years (mean (SD)=4.1±3.7). All questionnaires were filled in at home and returned by post. After 3 or 12 weeks, questionnaires were mailed to all patients of whom only 318 patients responded.

All patients completed the DS14 and the HADS at baseline, whereas only those patients recruited through the outpatient clinics completed the EPQ at baseline (n=117). All patients participating in the follow-up completed the DS14 at either 3 weeks (n=214) or 12 weeks (n=117). Retests were carried out at different time points due to different logistics in relation to the database and the outpatient clinics.

The ethics committee in the municipalities of the participating hospitals approved the study protocol. The study was conducted conform to the Helsinki Declaration, and a returned questionnaire was considered the equivalent of informed consent.

Materials

Socio-Demographic and Clinical Variables

Socio-demographic characteristics (age, gender, marital status), and smoking status were based on self-report. Information on clinical characteristics (except smoking status) was obtained from the patients' medical records and included diabetes, hypertension, hypercholesterolemia,

angina, left ventricular ejection fraction (LVEF), IHD, or CHF, and co-morbidity.

Type D Scale

The DS14 is a 14-item self-report measure, consisting of two seven-item subscales, negative affectivity (NA; e.g., "I often feel unhappy") and social inhibition (SI; e.g., "I am a closed person") [21]. Responses are indicated on a five-point Likert scale from 0 (false) to 4 (true; score range 0–28 for each subscale). A standardized cut-off ≥10 on both subscales indicates Type D caseness [21] with this cut-off being accurate in classifying Type D versus non-Type D [25]. The DS14 has good psychometric properties with Cronbach's α=0.88/0.86 and 3-month test–retest reliability r=0.72/0.82 for the negative affectivity and social inhibition subscales, respectively [21]. A recent study of a large sample of AMI patients confirmed the temporal stability of the taxonomy across 18 months and showed that the DS14 is not confounded by disease severity [20].

Eysenck Personality Questionnaire

The short form of the Eysenck Personality Questionnaire was used to assess neuroticism (12 items) and extroversion (12 items) [26]. These subscales were included to evaluate the convergent validity of the DS14 subscales negative affectivity and social inhibition, as they comprise theoretically similar constructs, yet are not completely overlapping. Hence, the neuroticism and extroversion subscales of the EPQ cannot substitute the negative affectivity and social inhibition subscales of the DS14, as the shared variance has been shown to be below 50%, indicating that, despite overlap in variance, 50% or more in the Type D subcomponents cannot be explained by the EPQ traits of neuroticism and extroversion [21, 27]. All items are answered with 0 (no) or 1 (yes) (score range 0–12), with a high score indicating more of the personality trait. The validity and reliability of the two subscales have proven satisfactory, with Cronbach's α ranging from 0.80 to 0.87 for the neuroticism subscale and from 0.72 to 0.88 for the extroversion subscale [26, 28].

Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale is a 14-item self-report measure, consisting of two seven-item subscales that assess anxiety and depressive symptoms devoid of somatic symptoms [29]. Responses to items are indicated on a four-point Likert Scale from 0 to 3 (score range 0–21), with a high score indicating more symptomatology. A cut-off score ≥8 was used for both subscales to identify patients with likely anxiety and depressive symptomatology. This cut-off has been shown to balance sensitivity and specificity optimally [30]. Previous studies have shown that the two HADS subscales are internally consistent, with Cronbach's α for anxiety (HADS-A)=0.80 and for depression (HADS-D)=0.81 [31]. A recent review confirmed the validity and reliability of the HADS across 15 studies, with Cronbach's α for HADS-A ranging from 0.68 to 0.93 and for HADS-D ranging from 0.67 to 0.90 [30].

Statistical Analyses

Two alternative confirmatory factor models were specified and estimated using LISREL 8.80 [32]. A covariance and asymptotic weight matrix was computed using PRELIS 2.80 [33]. An asymptotic weight matrix allows for weaker assumptions regarding the distribution of observed variables and results in improved fit and test statistics [34, 35]. For the confirmatory factor analysis (CFA), we specified a one-factor model and a two-factor model based on current recommendations (DS14-NA: items number 2, 4, 5, 7, 9, 12, 13; DS-SI: items number 1, 3, 6, 8, 10, 11, 14) [21]. All factors were allowed to correlate, and no correlated errors were included in any of the models. The models were estimated using maximum likelihood, and following the recommendations of Hoyle and Panter [36], we assessed the goodness of fit for each model using a range of fit indices including Satorra-Bentler scaled chi-squared (S-B χ^2), the incremental fit index (IFI) [37], and the comparative fit index (CFI) [38]. A nonsignificant Satorra-Bentler scaled chi-square and values greater than 0.95 for the IFI and CFI are considered to reflect acceptable model fit. Additionally, the root mean square error of approximation (RMSEA) [39] with 90% confidence intervals (90% CI) are reported, with values less than 0.05 indicating close fit and values up to 0.08 indicating reasonable errors of approximation in the population [40]. The standardized root mean-square residual (SRMR) [41] has been shown to be sensitive to model misspecification and its use is recommended by Hu and Bentler [42]. Values less than 0.08 are considered to indicate acceptable model fit [43]. The comparative fit of the models was assessed using the expected cross validation index (ECVI) [44], an index used for the purposes of model comparison, with the smallest value indicating the best fitting model. Cronbach's α and the mean inter-item correlation (MIIC) were calculated to determine the internal consistency of the negative affectivity and social inhibition subscales of the DS14. To determine the convergent validity of the DS14 subscales, correlations were calculated between the negative affectivity (DS14-NA) and social inhibition (DS14-SI) subscales, EPQ-Extroversion (EPQ-E) and EPQ-Neuroticism (EPQ-N), HADS-A, and HADS-D. In addition, a principal component analysis based on the six

subscales was carried out. We used correlations as well as intra-class correlations (ICC) to examine the temporal stability of the Type D construct. To further examine the clinical relevance of the Type D construct in the Danish setting, we stratified the sample by Type D and compared Type D and non-Type D patients on anxiety and depressive symptoms, using multivariable linear regression. In the multivariable analyses, we adjusted for socio-demographic characteristics (age, gender, marital status, and smoking), clinical characteristics (primary diagnosis (CHF vs. AMI), LVEF, angina, hypertension, hypercholesterolaemia, diabetes, and co-morbidity), and anxiety or depression, when the measure in question was not the dependent variable. Secondary analyses, using logistic regression analyses, were performed to investigate the impact of Type D on anxiety or depression diagnosis based on the standardized cut-off ≥8 on the HADS [30]. All analyses were performed using SPSS 13.0 for Windows.

Results

Baseline Characteristics

The prevalence of Type D personality was 16% in the mixed group of cardiac patients, 18.5% in the CHF patients, and 15% in the IHD patients. Baseline characteristics stratified by Type D personality are presented in Table 1. There were no significant differences between Type D and non-Type D patients on socio-demographic and clinical characteristics except for age, with Type D patients being slightly younger.

Confirmatory Factor Analyses

All fit indices are reported in Table 2. With regard to meeting the criteria associated with the RMSEA, SRMR, CFI, and IFI fit indices, the results indicate the two-factor model to be the better fitting of the models. Although the chi-square test for both models is large relative to degrees of freedom and statistically significant, this should not lead to the rejection of the model, as the large sample size increases the power of the test [45]. The increased power of the chi-square test can result in models with no serious misspecification being rejected, as minor discrepancies between the sample and the implied covariance matrix are detected. In addition, the ECVI also indicates the two-factor model to be a superior solution to the one-factor model. Taken together, this suggests that the theoretically driven two-factor model of the DS14 represents the best description of the current data. The standardized loadings for the two-factor model of the DS14 are presented in Table 3. All factor loadings were statistically significant ($p<0.05$).

To assess whether our two-factor model was invariant across diagnostic groups, a multi-group analysis was performed. A constrained model with all coefficients set equal across diagnostic groups was compared against an unconstrained model in which all coefficients were allowed to vary across diagnostic groups. The model fitted equally well in both diagnostic groups (S-B χ^2 (12)=15.18, p=0.23), however, when conducting the same analysis assessing invariance of the two-factor model across gender, significant differences emerged (S-B χ^2 (12)=58.21, $p<$0.01), indicating that the two-factor model did not fit equally well across gender.

Table 1 Baseline characteristics stratified by Type D personality

	Type D (n=115)	Non-Type D (n=592)	OR (95% CI)	p
Socio-demographic				
Age, mean (SD)	64 (10.78)	66 (10.28)	0.98 (0.96–1.00)	0.03*
Males, *n* (%)	84 (73)	448 (76)	1.16 (0.74–1.82)	0.53
Married/co-habiting, *n* (%)	81 (73)	442 (78)	0.75 (0.47–1.20)	0.23
Clinical				
Diabetes, *n* (%)	22 (20)	96 (17)	1.20 (0.72–2.02)	0.48
Hypertension, *n* (%)	49 (65)	245 (68)	0.84 (0.50–1.42)	0.52
Hypercholesterolaemia, *n* (%)	68 (80)	331 (79)	1.04 (0.58–1.86)	0.90
Angina, *n* (%)	86 (75)	446 (76)	0.96 (0.61–1.53)	0.88
LVEF, mean (SD)	46 (17.35)	48 (17.34)	1.00 (0.98–1.01)	0.42
CHF, *n* (%)[2]	45 (39)	198 (33)	1.28 (0.85–1.93)	0.24
Co-morbidity, *n* (%)	43 (37)	194 (33)	1.20 (0.79–1.82)	0.39
Smoking, *n* (%)	29 (25)	143 (25)	1.05 (0.66–1.67)	0.83

LVEF left ventricular ejection fraction; *CHF* chronic heart failure

*$p<0.05$

Table 2 Confirmatory factor analysis for the DS14

Model	S-B χ^2, df (p)	RMSEA 90% CI	ECVI 90% CI	IFI	CFI	SRMR
Model 1 (1 factor)	1,620.63, 77 (<0.001)	0.169 (0.16–0.18)	2.37 (2.19–2.57)	0.91	0.91	0.12
Model 2 (2 factors)	385.45, 76 (<0.001)	0.076 (0.069–0.084)	0.63 (0.55–0.72)	0.98	0.98	0.076

S-B χ^2 Satorra-Bentler scaled chi-square, *RMSEA* root mean square error of approximation, *CI* confidence intervals, *ECVI* expected cross validation index, *IFI* incremental fit index, *CFI* comparative fit index, *SRMR* standardized root mean residual

Internal Consistency

Cronbach's α as well as the MIIC was calculated for our two-factor model. MIIC was used because Cronbach's α is highly dependent on the number of items in the scale; hence, the reliability of Cronbach's α as a measure of internal consistency diminishes as the number of scale items increases [46]. In contrast, MIIC indicates the internal consistency of a scale irrespective of the number of items. Cronbach's α for the NA and SI subscales were 0.87 and 0.91, respectively, and the MIIC for the NA subscale was 0.49 and for the SI subscale 0.59 (Table 2). These coefficients satisfy the criteria for both Cronbach's α and the MIIC [46].

Convergent Validity

The left side of Table 4 presents the correlation matrix for the DS14, the HADS, and the EPQ subscales. As expected, there were strong associations between DS14-NA and HADS-D and HADS-A as well as with EPQ-N ranging from 0.65 to 0.82, respectively. These associations account for shared variances ranging between 42% and 67%, indicating that, although there is considerable overlap between DS14-NA and the other negative affect measures, there is still a considerable amount of unshared variance. There were also strong associations between DS14-SI and HADS-D, HADS-A, and EPQ-N, ranging from −0.33 to −0.52, indicating a somewhat smaller strength of associa-

Table 3 Standardized factor loadings and internal consistency of the DS14

DS14 items		NA*	SI*	Internal Consistency*
Negative affectivity				
#2	I often make a fuss about unimportant things	0.75		0.59
#4	I often feel unhappy	0.83		0.54
#5	I am often irritated	0.74		0.56
#7	I take a gloomy view of things	0.80		0.71
#9	I am often in a bad mood	0.85		0.75
#12	I often find myself worrying about something	0.84		0.71
#13	I am often down in the dumps	0.88		0.70
				α=0.87
				MIIC=0.49
Social inhibition				
#1	I make contact easily when I meet people[a]		0.66	0.68
#3	I often talk to strangers[a]		0.60	0.73
#6	I often feel inhibited in social interactions		0.71	0.66
#8	I find it hard to start a conversation		0.82	0.71
#10	I am a closed kind of person		0.88	0.76
#11	I would rather keep other people at a distance		0.82	0.76
#14	When socializing, I don't find the right things to talk about		0.81	0.79
				α=0.91
				MIIC=0.59

MIIC mean inter-item correlation

*p<0.05, all factor loadings statistically significant; factor loadings based on confirmatory factor analysis (CFA) for the total sample

[a] Items 1 and 3 uses a reverse scoring format, however scores on these items were reversed prior to conducting the CFA

tion. Corresponding with the theoretical conceptualization of extroversion, the EPQ-E showed negative correlations with all other scales, most significantly with DS14-SI (−0.64) and least with HADS-A (−0.33). The correlation between DS14-SI and EPQ-E indicates that the shared variance is 41%, again suggesting some, but not complete, overlap between these measures. A principal component analysis of the six subscales showed that DS14-NA in concert with HADS-D, HADS-A, and EPQ-N made up one factor of negative affect, whereas DS14-SI and EPQ-E loaded on a separate factor of inhibition (Table 4, right). Hence, the content of the two separate factors extracted was consistent with the theoretical conceptualization of the Type D construct (Table 4, right). Taken together, the convergent validity of the DS14 was confirmed against scales measuring similar constructs.

Temporal Stability of the Type D Construct

The temporal stability of the DS14 was examined over a short (3 weeks) and a longer period of time (12 weeks). The mean (SD) score for DS14-NA was 7.23 (5.46) and 7.40 (5.39) for DS14-SI at baseline. Pearson's correlation for NA was r=0.85 (N=214, p<0.01) and r=0.83 (N=214, p<.01) for SI between baseline and 3 weeks. Pearson's correlation for NA was r=0.78 (N=117, p<0.01) and r=0.79 (N=117, p<.01) for SI between baseline and 12 weeks. Intra-class correlation using a two-way mixed effects model, type consistency, and average measures confirmed these results at both 3 weeks (NA (ICC=0.92); SI (ICC=0.91)) and 12 weeks (NA (ICC=0.87); SI (ICC=0.88)). Taken together, these results confirm the temporal stability of the DS14.

Association of Type D with Symptoms of Anxiety and Depression

The prevalence rates of anxiety and depression in Type D and non-Type D patients are depicted in Fig. 1. Univariable linear regression analyses showed that Type D personality was associated with an increased risk of anxiety (β, 0.49; p<.001) and depression (β, 0.47; p<.001) as measured by HADS. Logistic regression analysis confirmed these results for both anxiety (odds ratio (OR), 8.92; 95% CI, 5.74–13.86; p<0.001) and depression (OR, 9.70; 95% CI, 5.95–15.82; p<0.001), with Type D being associated with a 9- to 10-fold increased risk.

In multivariable linear regression analyses, Type D personality remained independently associated with an increased risk of anxiety (β, 0.26; p<0.001) and depression (β, 0.17; p<0.01), adjusting for baseline socio-demographic and clinical characteristics and co-occurring mood state (i.e., either anxiety or depressive symptoms). Diabetes and younger age were both independently associated with anxiety and depression, whereas female gender and depressive symptoms were associated with an increased risk of anxiety, and angina and anxiety symptoms were independently associated with depression (results not shown). These results were confirmed in multivariable logistic regression analyses, with Type D being associated with a 4- to 6-fold increased risk of anxiety (OR, 6.81; 95% CI, 3.26–14.20; p<0.001) and depression (OR, 3.71; 95% CI, 1.62–8.52; p<0.001), although younger age was no longer an independent predictor of depression and angina turned out to be a significant predictor of anxiety in these analyses.

Table 4 Correlation matrix and principal component analysis for the subscales of the DS14, HADS and EPQ

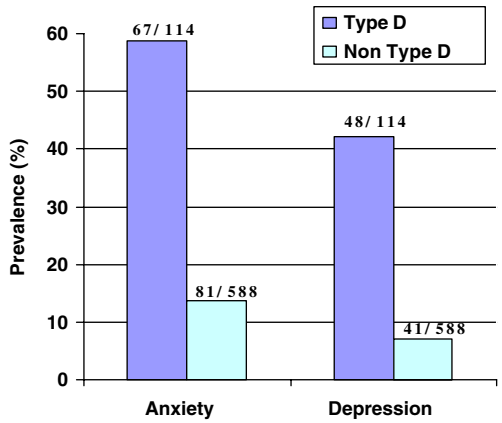
		Correlation Matrix						PCA	
		1	2	3	4	5	6	I	II
1	Social Inhibition (DS14)[a]	1.00						0.41	0.78
2	Negative Affectivity (DS14)[a]	0.57**	1.00					0.87	0.35
3	Depression (HADS)[a]	0.46**	0.65**	1.00				0.68	0.49
4	Anxiety (HADS)[a]	0.41**	0.76**	0.66**	1.00			0.92	0.16
5	Neuroticism (EPQ)[b]	0.53**	0.82**	0.60**	0.76**	1.00		0.87	0.27
6	Extroversion (EPQ)[b]	−0.64**	−0.44**	−0.52**	−0.33*	−0.44**	10.00	−0.16	−0.92
	Eigenvalues (PCA)							4.02	0.88

PCA Principal component analysis with varimax rotation based on n=117

*p<0.05; **p<0.01

[a] Analysis based on n=702

[b] Analysis based on n=117



* Whole numbers are presented on top of bars

Fig. 1 Prevalence of anxiety and depression in Type D and non-Type D patients*

Does Type D Personality Have Added Value Above and Beyond Existing Psychological Measures?

To address the question of whether the Type D personality construct merely comprised risk factors for anxiety and depression, we examined whether the addition of Type D personality improved the prediction of a model comprising baseline socio-demographic and clinical characteristics, as well as anxiety or depression, respectively. For this purpose, we ran multivariate logistic stepwise analyses using the enter procedure. The prediction of the model improved significantly with the addition of Type D personality for both anxiety (χ^2=26.85, (*df*=1), p<0.01) and depression (χ^2=9.53, (*df*=1), p<0.01), indicating that the Type D personality construct has added value above and beyond existing psychological measures.

Discussion

The current study showed that the Danish version of the Type D Scale (DS14) is a valid and reliable measure of Type D personality in a mixed group of cardiac patients. The two-factor structure was confirmed using confirmatory factor analysis, and the convergent validity was established against scales measuring similar constructs. The Danish DS14 was also shown to be a reliable instrument both in terms of internal consistency and temporal stability over 3 and 12 weeks. Type D personality was an independent associate of both anxiety and depression, adjusting for baseline characteristics and co-occurring mood states, and the prediction of the multivariable model was shown to significantly improve when Type D was added to a model comprising socio-demographic and clinical characteristics. Taken together, these results support the notion that Type D personality incurs an increased risk of mood disorders in cardiac patients.

In the current study, Type D prevalence rates ranged from 15% in IHD patients to 18.5% in CHF patients. These prevalence rates are within the range of those previously published in Type D research [2]. In addition, the conceptualization of NA, as measured by the DS14, was significantly associated with well-established measures of negative affect (i.e., the HADS subscales and EPQ-N), indicating that the DS14-NA items tap relevant aspects of negative affect. We also showed that DS14-SI was significantly associated with a theoretically similar construct, namely EPQ-E. Although statistically there is overlap between these theoretically similar measures, the magnitudes of the shared variance indicate that each measure also contains unique explanatory power. In addition, since Type D caseness is based on personality traits that are considered inherently *stable* characteristics of the person, the temporal stability of the Type D construct is expected to be good, an assumption which was also confirmed by our results. This assumption was also supported by a recent study of a large sample of post-AMI patients over an 18-month period, which also showed that Type D caseness was not confounded by indices of somatic disease [20]. Taken together, the present findings support the use of the Danish DS14 for identifying Type D caseness in cardiac patients.

A recent review on Type D personality presents an up-to-date overview of the empirical evidence for the adverse impact of Type D personality on clinical events, health status, and emotional distress, including anxiety, depression, and posttraumatic stress disorder [2]. In the current study, Type D was also found to be an independent associate of anxiety and depression when adjusting for demographic and clinical characteristics. Mood disorders are common in cardiac patients [47–51] and comprise risk factors for morbidity, mortality, and impaired health status [3, 5]. In addition, there is evidence to suggest that comorbid anxiety and depression may be especially hazardous, since their joint impact on health status has been shown to outweigh that of each factor on their own [9, 10]. In the present study, Type D caseness was associated with more than a 4- to 6-fold increased risk of anxiety and depression, suggesting that this is not just an increase of statistical but also of clinical significance. The current results are in line with previous studies conducted in the Netherlands, showing that Type D personality incurs an increased risk of anxiety and depression [2, 52], including chronic anxiety [53], as well as 12-month onset of depressive symptoms in patients free of depressive symptomatology at 6 months [9, 10]. In addition, our analysis showed that when controlling for socio-demographic and clinical characteristics known to be associated with both

anxiety and depression, Type D personality still had unique explanatory power suggesting that the increased risk associated with Type D personality is not just a result of Type D personality comprising all other risk factors for anxiety and/or depression.

Type D personality is an emerging risk factor in CVD [2], and the clinical utility of the construct depends on whether some form of behavioral intervention is available to buffer against the negative impact of Type D on health outcomes. Type D patients are in effect inefficient "copers," as they lack skills to reduce their high levels of emotional distress, in part because they do not turn to their social network for emotional support [54]. Hence, even though it may not be possible to alter the basic personality profile of Type D patients, participation in cardiac rehabilitation focusing on providing new coping skills and strategies may reduce their general levels of distress with potential benefits to health and well-being [55]. In other words, it is likely that Type D patients comprise a subgroup that may require additional intervention compared to non-Type D patients, in order to obtain the same benefits from cardiac rehabilitation and revascularization procedures [56]. For this reason, it is imperative that these high-risk patients can be identified early on, using a brief, valid, and reliable screening instrument such as the DS14.

Limitations

The results of the current study should be interpreted with some caution. First, we could not reliably estimate the divergent validity of the Danish version of the DS14, which needs to be addressed in future studies. Second, we were not able to reliably carry out a second-order CFA of the three scales used for establishing convergent validity, due to a limited sample size (n=117). Third, we used a self-report measure of anxiety and depression rather than a clinical interview. However, the HADS is a valid and reliable measure of anxiety and depressive symptomatology with good sensitivity and specificity against a clinical diagnostic interview and has been shown to predict mortality in patients referred for exercise testing [57]. An additional advantage of the HADS is that it is not confounded by somatic symptoms. Fourth, due to the cross-sectional design of the study, we cannot infer causation with respect to the impact of Type D on anxiety and depression but only establish that there is an association.

Conclusion

In conclusion, the Danish DS14 is a valid and reliable instrument for assessing Type D caseness in cardiac patients. Type D personality was associated with a 4- to 6-fold increase in the risk of anxiety and depression, adjusting for demographic and clinical risk factors. The DS14 could be used in research and clinical practice in order to identify high-risk patients, since Type D has been associated with increased distress and adverse health outcomes, including mortality. Studies are now warranted that examine the predictive validity of the DS14 in relation to prognosis in Danish cardiac patients.

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