



## Prevalence of mental disorders among depressed coronary patients with and without Type D personality. Results of the multi-center SPIRR-CAD trial



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### ABSTRACT

**Objective:** Type D personality, as with formal mental disorders, is linked to increased mortality in coronary heart disease (CHD). Our aim was to determine the prevalence of mental disorders among depressed CHD patients with and without Type D personality.

**Methods:** Depressive symptoms (HADS, HAM-D), Type D personality (DS-14) and mental disorders based on DSM-IV (SCID I and II) were assessed. Results were calculated by Kruskal-Wallis tests, Fisher's exact tests and logistic regression analyses.

**Results:** 570 CHD patients were included (age  $59.2 \pm 9.5$  years; male 78.9%, HADS-D depression  $10.4 \pm 2.5$ ; HAM-D  $11.3 \pm 6.6$ ; Type D 60.1%). 84.8% of patients with Type D personality and 79.3% of non-Type D patients suffered from at least one mental disorder ( $p = 0.092$ ), while 41.8% of Type D positives and 27.8% of Type D negatives had at least two mental disorders ( $p = 0.001$ ). Patients with Type D personality significantly more often had social phobia [odds ratio (95% confidence interval): 3.79 (1.1 to 13.12);  $p = 0.035$ ], dysthymia [1.78 (1.12 to 2.84);  $p = 0.015$ ], compulsive [2.25 (1.04 to 4.86);  $p = 0.038$ ] or avoidant [8.95 (2.08 to 38.49);  $p = 0.003$ ] personality disorder.

**Conclusions:** Type D personality among depressed CHD patients is associated with more complex and enduring mental disorders. This implies higher treatment demands.

**Trial registration:** ISRCTN 76240576; NCT00705965

### 1. Introduction

The “Type D” (distressed) personality construct was introduced by Denollet in 1995 [1]. It is characterized by the combination of two enduring basic traits, “negative affectivity” (i.e. dysphoria, anxiety, irritability) and “social inhibition” (i.e. inhibited behavior during social interaction). These two basic traits are recorded psychometrically on two scales of the self-rated DS-14 questionnaire. Although Type D is considered a risk factor for mental distress and physical illness, it is not

equivalent to a specific mental disorder, such as depression. Instead, the construct emphasizes “the role of normal traits rather than psychopathology” [2]. Type D personality is assumed when both scales of the DS-14 lie above the median of Denollet's validation sample. Type D therefore just reflects the upper half of an empirical distribution in the population rather than a clinical condition. The prevalence of Type D personality in the general population was reported as 21% in Belgium [2] and 31% in Germany [3]. Among German patients, the prevalence of Type D was 25% in cardiology and 62% in psychosomatic medicine

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[4].

Numerous studies and two meta-analyses [5,6] have shown that the Type D personality is an independent predictor of poor outcome for various heart diseases. Although more recent studies could no longer demonstrate a connection between the Type D pattern and poorer cardiac prognosis [7–9], the review by Grande et al. [6] concludes that Type D seems to have a significant overall prognostic effect, although the size of this effect may have been overestimated in the early studies.

Most previous studies linking Type D personality to psychopathology measured both, Type D and related constructs such as depression or exhaustion, with self-rating scales. Only two studies have used validated observer ratings to investigate the connection between Type D personality and depression or panic disorder [10,11] and none has looked at a broader range of mental disorders according to ICD or DSM in patients with vs. without the Type D personality.

One study looking at depressive episodes (as per CIDI) and Type D personality (as per DS-14) in 1205 post-myocardial infarction patients from the MIND-IT trial showed that depression and Type D represent two widely different forms of distress: While 17% of the patients were diagnosed with depression and 19% were considered Type D, the majority of depressed patients (56%) did not show the Type D pattern and the majority of Type D patients (63%) were not clinically depressed. Combined depression and Type D was found in no > 7.5% of the whole sample. Depression and Type D also showed different associations with cardiac health: Patients who were suffering from depression without having the Type D personality pattern (34%) had the most severe heart disease (in terms of ejection fraction and clinical heart failure), whereas patients with depression and the Type D pattern did not differ in their cardiac status from those who had none of these two risk factors [7,10]. Unfortunately that study did not consider other mental disorders beyond depression. The second study [11], investigating 410 patients with non-cardiac chest pain presenting to an emergency ward, used MINI interviews to diagnose depression or panic disorder. In this highly selected group, a total of 27% had isolated panic disorder, 4% had depression, and 36% had comorbid panic disorder and depression. While isolated panic disorder or depression were unrelated to Type D, Type D patients had a substantially increased percentage of comorbid panic disorder and depression as compared to non-Type D patients (58% vs. 23%), underlining a possible role of Type D as a risk factor for more complex psychopathology rather than an indicator of a specific disorder. Accordingly, also 54% of non-Type D patients in that study also had panic disorder and/or depression. Other mental disorders were not specifically assessed.

While the association of Type D with a broader spectrum of interview-diagnosed mental disorders has not been investigated so far, shedding light on this association might be important to guide treatment. Based on the definition of Type D personality as a “trait”, it is assumed that there could be an association especially with more complex or enduring mental disorders, especially personality disorders (according to DSM-IV) which, unlike (episodic) depression cannot be expected to improve with usual medical care and may interfere with treatments for heart disease. It would therefore be useful to identify these patients early in the disease process and offer them specific treatment.

For example, the SPIRR-CAD trial in 570 depressed coronary patients found a significant moderating effect of Type D on change in depression scores: While Type D patients tended to fare better with psychotherapy, non-Type D patients improved similarly with psychotherapy or usual care only [12].

The aim of this research was therefore to investigate the connection of Type D personality with defined mental disorders (as per DSM-IV) and their comorbidity among depressed CHD patients.

## 2. Material and methods

### 2.1. Design

The present study was conducted as part of the multi-center Stepwise Psychotherapy Intervention for Reducing Risk in Coronary Artery Disease (SPIRR-CAD) trial. SPIRR-CAD is a randomized, controlled intervention trial on the effect of a stepped, combined, psychodynamic-cognitive-behavioral, individual and group psychotherapeutic intervention on depressive symptoms among CHD patients. The study design and primary outcome have been published elsewhere [12,13]. Briefly, the trial was based on the assumption that trait negative affectivity and social inhibition might impede remission of depressive symptoms and need special attention. The intervention therefore had a focus on coping with these personality traits in the context of cardiac illness. The results of the trial indeed showed that, although psychotherapy was not significantly superior to usual care in the whole sample, Type D was a significant moderator of psychotherapy success [12]. The trial was conducted in accordance with the Helsinki Declaration and the ethics committees at all trial sites approved the protocol. All patients gave their written informed consent before being included into the trial.

The current analysis is based on cross-sectional baseline data for Type D and mental comorbidity.

### 2.2. Participants

In 10 tertiary care centers all German-speaking men and women aged between 18 and 75 and admitted between November 2008 and April 2011 with any manifestation of coronary heart disease (from stable angina pectoris through to acute coronary syndromes) and recent coronary angiograms were screened for the presence of depressive symptoms (depression score > 7 on the Hospital Anxiety and Depression Scale [HADS]).

Exclusion criteria were severe heart failure, the presence of other acute life-threatening diseases (e.g. progressive malignancies), severe chronic inflammatory diseases, chronic obstructive pulmonary disease with acute exacerbation or systemic administration of corticoids, medication with immunosuppressants following organ transplantation, and severe mental illness (severe depressive episode, acute suicidal tendency, bipolar disorder, psychotic disorder, dementia or current substance dependence) [12,13].

### 2.3. Measures

Clinical data including pre-treatments, comorbidities and current therapy were taken from the patients' records. Details about the severity of heart-related symptoms (CCS class, NYHA class) and socio-demographic information were recorded by a questionnaire and structured interview.

The presence of Type D personality was determined using the German version of the 14-item Type D scale (DS-14) [2,4], which showed good psychometric properties in a validation study of 2421 individuals (cardiology patients, psychosomatic patients and healthy factory workers). The self-assessment questionnaire, which is considered the current standard in assessing Type D personality [2], consists of two 7-item scales (“negative affectivity” and “social inhibition”). Participants are instructed to rate each item on a five-point Likert scale of 0 (not at all) to 4 (very much). Type D personality is assumed when both the negative affectivity and social inhibition scores are 10 or higher [2,4]. In the validation study the two-factorial structure of the original scale could be clearly replicated. Cronbach's alpha was > 0.8 for both subscales.

The presence of current symptoms of depression and anxiety was determined using the German version of the Hospital Anxiety and Depression Scale (HADS) [14,15]. The HADS is a widely used self-rating

screening instrument, which has frequently been used and validated in cardiology patients and shows good psychometric properties. Both its subscales (depression and anxiety), each consisting of seven items, can be completed in a few minutes and objectively scored [16].

In addition, the severity of current depressive symptoms was measured by trained raters using the German version of the Hamilton Depression Rating Scale (HAM-D), which comprises a list of 21 symptoms and is widely used internationally as a standard instrument in clinical trials [17].

The presence of mental disorders was investigated using the Structured Clinical Interview for Diagnosis of Mental Disorders (SCID I and SCID II). The SCID yields diagnoses according to axis 1 and axis 2 of the DSM-IV. Due to its high level of reliability and good validity, it is recommended as the gold standard tool in clinical diagnostics and research [18]. All interviews were conducted by trained interviewers who were blind to patients' Type D status.

#### 2.4. Statistical methods

Patient characteristics were described using count (percentage) or mean  $\pm$  standard deviation (SD), as appropriate. Groups of patients with vs. without Type D were compared using Fisher's exact test or Kruskal-Wallis test. Association between SCID diagnosis and Type D was evaluated by Fisher's exact test. To guard against possible confounding, the variables age and sex were included in logistic regression models. Representativeness of the randomized study collective for the screening collective was evaluated with chi-square/Fisher's exact test (for qualitative data) or one-way ANOVA with post-hoc comparisons (for quantitative data).

Based on logistic regression models, odds ratios (OR), corresponding 95% confidence intervals (CI) and *p*-values (Wald test) were computed. All reported *p*-values are two-sided and considered statistically significant if lower than 0.05. Calculations were done with SPSS Statistics 22 (IBM Corp., Armonk, NY, USA).

### 3. Results

#### 3.1. Participant characteristics

Of 18,542 patients with known CHD aged  $\leq 75$  years, 6436 without previous exclusion criteria had valid HADS and DS-14 scores. Among 1622 patients scoring positive on the HADS, additional exclusion criteria recognized only after completion of the screening questionnaires or unwillingness to participate in the intervention trial, left a total of 570 participants entering the main trial.

As there was no information about Type D status for one of these patients, the number of patients considered in the Type D analysis was  $n = 569$  (79% men; mean age 59 years).

Socio-demographic and clinical data of the study sample can be found in Table 1.

Three-fifths of the participants were Type D positive, and men tended to be overrepresented in that group. While the Type D positives did not differ from the negatives in terms of marital status they cohabitated with other persons significantly more frequently.

HADS anxiety and depression scores and Hamilton depression ratings were significantly higher among Type D positives than negatives. In addition, Type D patients were significantly less likely to suffer from arterial hypertension.

#### 3.2. Representativeness

Among the 6436 patients who completed the screening questionnaire, participants in the current study had a significantly higher HADS depression score than those who were ineligible or had to be excluded for various reasons after initial screening (average 10.4 vs. 4.8;  $p < 0.001$ ). This difference was mainly due to the inclusion criteria

for the intervention trial, elevated HADS depression scores in particular. Trial participants were also younger (average 59 vs. 63 years;  $p < 0.001$ ) and much more likely to have Type D personality (60.1 vs. 26.1%,  $p < 0.001$ ), as could be expected from the huge difference in depression scores.

Furthermore, patients participating in the intervention trial were significantly younger (average age 59 vs. 62 years;  $p < 0.001$ ) and more likely to have Type D personality (60.1% vs. 53.4%;  $p = 0.011$ ) than the patients who were eligible based on HADS depression scores and medical inclusion/exclusion criteria but chose not to take part in the intervention trial. Regarding sex distribution and HADS depression scores there were no significant differences between participants and eligible patients who refused to participate.

#### 3.3. DSM-IV diagnoses and their associations with Type D

Prevalences among the total sample were 33.7% for major depressive episodes, 13.7% for adjustment disorders, 15.6% for anxiety disorders (generalized anxiety disorder 5.8%, panic disorder 6.3%, social phobia 3.5%, and other phobias 8.4%), 2.5% for alcohol abuse, 2.6% for pain disorders, 18.1% for dysthymia, 2.8% for depressive personality disorder (as per SCID), 4.6% for avoidant personality disorder, and 6.9% for obsessive-compulsive personality disorder. Cluster A personality disorders (paranoid, schizoid, schizotypal) were found in 3.3%, cluster B personality disorders (histrionic, antisocial, narcissistic, borderline) in 2.8%, cluster C personality disorders (obsessive-compulsive, dependent, avoidant, depressive) in 14.4% and any personality disorder plus dysthymia in 30.4%.

Among trial participants, 84.8% of patients with Type D personality and 79.3% of non-Type D patients suffered from at least one mental disorder according to DSM-IV [OR = 1.51 (95% CI 0.96 to 2.36);  $p = 0.072$ ]. Type D patients were significantly more likely to have more than one mental disorder [1.89 (1.31 to 2.73);  $p = 0.001$ ] than non-Type D patients (Table 2, Fig. 1).

When looking at specific diagnoses there was a significantly elevated risk of dysthymia [1.78 (1.12 to 2.84);  $p = 0.015$ ], obsessive-compulsive personality disorder [2.25 (1.04 to 4.86);  $p = 0.038$ ], avoidant personality disorder [8.95 (2.08 to 38.49);  $p = 0.003$ ], and social phobia [3.79 (1.1 to 13.12);  $p = 0.035$ ] among those with Type D personality.

Type D patients also had a significantly elevated risk of cluster C personality disorders [3.11 (1.75 to 5.54);  $p < 0.001$ ], any personality disorder [2.32 (1.57 to 3.44);  $p < 0.001$ ] and anxiety disorder [1.74 (1.06 to 2.86);  $p = 0.028$ ]. All associations remained stable when adjusted for age and sex.

### 4. Conclusions

The SPIRR-CAD trial is the first study in which the type and frequency of all comorbid mental disorders have been investigated by means of structured interviews and related to the presence or absence of (self-rated) Type D personality. Overall, in this at least mildly depressed group of CHD patients, mental disorders are not generally more frequent among patients with Type D personality than in those without. Type D patients, however, are more likely to suffer from complex mental disorders in terms of multiple diagnoses. The prevalence of social phobia, dysthymia and personality disorders, especially those with avoidant or obsessive-compulsive symptoms, is significantly elevated in Type D patients. This association has been postulated on theoretical grounds [19] but has never been shown before. Due to the trial's selection criteria requiring at least mild depressive symptoms for inclusion and leading to substantial oversampling of both depressed and Type D patients, it is little surprising that depressive episodes are no more frequent among Type D patients than non-Type Ds in our sample. Since patient selection was based on elevated depression scores but not on Type D per se, the at least twofold increased prevalence of

**Table 1**  
Baseline characteristics (socio-demographic and clinical) of the sample.

Characteristics		Type D negative (n = 227)	Type D positive (n = 342)	p		
Sex	Male	171	(75,3)	0,09		
	Female	56	(24,7)			
Age	Mean (SD)	59,7	(9,1)	58,8	(9,7)	0,33
Marital status	Single	20	(9,2)	24	(7,5)	0,37
	Cohabiting	140	(64,5)	230	(71,7)	
	Divorced/separated	43	(19,8)	50	(15,6)	
	Widowed	14	(6,5)	17	(5,3)	
Persons in household	> 1 person	142	(67,6)	250	(78,6)	<b>0,006</b>
Highest vocational education	No vocational education	14	(7)	25	(8,3)	0,25
	Still in vocational education	3	(1,5)	0	(0)	
	Vocational school/training	103	(51,5)	156	(52)	
	Technical/master school	26	(13)	47	(15,7)	
Employment	University (of applied science)	54	(27)	72	(24)	0,62
	Full time	57	(28,1)	80	(25,7)	
	Part time	23	(11,3)	47	(15,1)	
	Not working	34	(16,7)	55	(17,7)	
	Retired	89	(43,8)	129	(41,5)	
Monthly income	< 1000 €	39	(18,8)	55	(18,3)	0,78
	1000 to < 2000 €	74	(35,7)	103	(34,3)	
	2000 to < 3000 €	47	(22,7)	80	(26,7)	
	≥ 3000 €	47	(22,7)	62	(20,7)	
Smoker	Yes	77	(33,9)	109	(32,2)	0,72
Taking antidepressants	Yes	23	(10,1)	46	(13,5)	0,29
Current psychotherapy (within last 12 months)	Yes	19	(8,4)	44	(12,9)	0,10
HADS-D Anxiety (raw value)	Mean (SD)	9,8	(3,6)	10,9	(3,8)	<b>0,001</b>
HADS-D Depression (raw value)	Mean (SD)	9,9	(2,2)	10,7	(2,7)	<b>&lt; 0,001</b>
HAMD (21 item sum)	Mean (SD)	10,3	(6,6)	12,0	(6,5)	<b>0,002</b>
CCS class	I	72	(34,1)	103	(32,1)	0,47
	II	57	(27)	99	(30,8)	
	III	37	(17,5)	43	(13,4)	
	IV	45	(21,3)	76	(23,7)	
NYHA class	I	83	(38,1)	113	(34,3)	0,79
	II	97	(44,5)	154	(46,8)	
	III (– IV)	38	(17,5)	62	(18,8)	
Diabetes mellitus	Yes	60	(26,7)	79	(24,1)	0,55
Hypertension	Yes	207	(92)	289	(86,3)	<b>0,04</b>
Hyperlipidemia	Yes	190	(83,7)	285	(83,6)	0,69
BMI	Mean (SD)	28,4	(4,9)	28,5	(4,9)	0,81
Myocardial infarction	Yes	129	(56,8)	170	(49,7)	0,23
Bypass surgery	Yes	44	(19,5)	54	(15,8)	0,50
Coronary intervention	Yes	195	(86,3)	307	(90)	0,20
Resuscitation	Yes	13	(5,8)	26	(7,6)	0,22

Type D in the SPIRR-CAD sample when compared to unselected CHD samples from the literature [e.g., 9,10] once more demonstrates a close link between Type D and depressive symptoms. Accordingly, among the 6436 patients who completed the SPIRR-CAD screening questionnaires, those screening positive for depression had an odds ratio of 4.9 (95% CI 4.4–5.6) for coexisting Type D personality as compared to non-depressed patients. Such associations of Type D with self-rated symptoms of depression have been observed in multiple previous studies of cardiac patients [4,11]. In analogy to our results, Type D personality has also been associated with an increased risk of social anxiety in cardiac patients [20], and in the general population [21]. In the general population, Type D personality has also been associated with an increased risk of self-rated symptoms of depression, panic, somatization, and feelings of social isolation [22].

However, so far little was known about Type D and diagnosable mental disorders, with only two studies [10,11] comparing interview-based diagnoses of mental disorders in cardiac patients with vs. without Type D. Although those studies found some association of Type D with depression – in one of the studies only when it was comorbid with panic disorder – associations were not particularly strong and other mental disorders were not studied. In our sample which only included patients with at least mild self-reported depressive symptoms, Type D is only mildly related to their severity and shows no clear association with diagnosable depressive episodes. This might suggest that screening for

Type D is not necessary, once depressive symptoms are present.

However, the most important finding in our study is that, despite the fact that all participants in the SPIRR-CAD study had elevated levels of depressive symptoms, we were able to show that Type D was still associated with more mental comorbidity as well as more severe and enduring psychopathology, i.e. social phobia, dysthymia and personality disorders. This clearly shows that Type D personality is more than depression. It supports findings from other studies not only in the field of psychopathology but also in bio-psychological research. Even after adjustment for depressive symptoms, Type D personality has been shown to be independently associated with biological mechanisms that may contribute to cardiovascular disease [23], including increased macrophage activity [24] and endothelial dysfunction [25]. In addition, there are findings of developmental precursors of mental health problems in Type D individuals, such as a higher prevalence of fearful and preoccupied attachment in individuals with Type D personality [26].

The association with enduring psychopathology could also be an explanation of why Type D personality among patients with heart disease was a stronger predictor of the persistence of depressive symptoms than the baseline HADS score [27]. On the other hand, it has been criticized that there is no significant difference in the temporal stability between the DS 14 and HADS scores, which tend to detect episodically occurring mood symptoms, whereby the DS 14's significance as a marker of chronic risks is weakened in turn [28].

**Table 2**  
Mental disorders in depressed CHD patients with and without Type D personality.

Characteristics	Total (n = 569)	Type D negative (n = 227)	Type D positive (n = 342)	Unadjusted regression model			Adjusted regression model (age, sex)			
				OR	95% CI	p*	OR	95% CI	p*	
Cluster: affective disorders <sup>a</sup>	308	(54,1)	123	(54,2)	1,00	(0,71 to 1,40)	1000	1,01	(0,71 to 1,42)	0,972
Major depressive disorder	192	(33,7)	75	(33)	1,05	(0,74 to 1,50)	0,787	1,07	(0,74 to 1,55)	0,706
Major depressive disorder, mild	82	(14,4)	40	(17,6)	0,65	(0,41 to 1,05)	0,088	0,68	(0,42 to 1,1)	0,117
Major depressive disorder, moderate	110	(19,3)	35	(15,4)	1,54	(0,99 to 2,40)	0,065	1,52	(0,97 to 2,39)	0,066
Major depressive disorder, recurrent	66	(11,6)	21	(9,3)	1,49	(0,86 to 2,57)	0,182	1,57	(0,89 to 2,74)	0,117
Depressive disorder NOS	43	(7,6)	17	(7,5)	1,02	(0,54 to 1,92)	1000	1,00	(0,53 to 1,9)	0,998
Adjustment disorder with depressed mood	29	(5,1)	13	(5,7)	0,81	(0,38 to 1,71)	0,567	0,78	(0,37 to 1,66)	0,519
Adjustment disorder with mixed anxiety and depressed mood	49	(8,6)	20	(8,8)	0,96	(0,53 to 1,74)	0,880	0,96	(0,53 to 1,75)	0,897
Cluster: anxiety disorders <sup>b</sup>	89	(15,6)	26	(11,5)	1,75	(1,07 to 2,85)	0,026	1,74	(1,06 to 2,86)	0,028
Generalized anxiety disorder	33	(5,8)	13	(5,7)	1,02	(0,50 to 2,10)	1000	1,14	(0,55 to 2,37)	0,729
Panic disorder with and without agoraphobia	36	(6,3)	9	(4)	2,08	(0,96 to 4,50)	0,078	2,01	(0,92 to 4,38)	0,078
Social phobia	20	(3,5)	3	(1,3)	3,91	(1,13 to 13,48)	0,020	3,79	(1,1 to 13,12)	0,035
Other phobias	48	(8,4)	18	(7,9)	1,12	(0,61 to 2,05)	0,760	1,12	(0,6 to 2,08)	0,720
Alcohol abuse	14	(2,5)	2	(0,9)	4,09	(0,91 to 18,45)	0,055	3,88	(0,86 to 17,55)	0,078
Pain disorders	15	(2,6)	5	(2,2)	1,34	(0,45 to 3,97)	0,791	1,37	(0,46 to 4,08)	0,577
Cluster: personality disorders + dysthymic Dis. <sup>c</sup>	173	(30,4)	46	(20,3)	2,32	(1,57 to 3,44)	< 0,001	2,32	(1,57 to 3,44)	< 0,001
Cluster A <sup>d</sup>	19	(3,3)	5	(2,2)	1,90	(0,67 to 5,34)	0,244	1,96	(0,69 to 5,55)	0,205
Cluster B <sup>e</sup>	16	(2,8)	5	(2,2)	1,48	(0,51 to 4,30)	0,608	1,38	(0,47 to 4,05)	0,562
Cluster C <sup>f</sup>	82	(14,4)	16	(7)	3,15	(1,77 to 5,60)	< 0,001	3,11	(1,75 to 5,54)	< 0,001
Dysthymic disorder	103	(18,1)	30	(13,2)	1,78	(1,12 to 2,83)	0,014	1,78	(1,12 to 2,84)	0,015
Obsessive-compulsive personality disorder	39	(6,9)	9	(4)	2,33	(1,08 to 5,00)	0,028	2,25	(1,04 to 4,86)	0,038
Avoidant personality disorder	26	(4,6)	2	(0,9)	8,49	(1,99 to 36,29)	< 0,001	8,95	(2,08 to 38,49)	0,003
Depressive personality disorder	16	(2,8)	3	(1,3)	2,95	(0,83 to 10,47)	0,118	2,95	(0,83 to 10,5)	0,096
At least 1 disorder existing	470	(82,6)	180	(79,3)	1,46	(0,94 to 2,25)	0,092	1,51	(0,96 to 2,36)	0,072
At least 2 disorders existing	206	(36,2)	63	(27,8)	1,87	(1,30 to 2,69)	0,001	1,89	(1,31 to 2,73)	0,001

Note: data are presented as N (%) unless otherwise indicated.

<sup>a</sup> Cluster: Affective disorders: 296,21, 296,22, 296,31, 296,32, 309,0, 309,28, 311.

<sup>b</sup> Cluster: anxiety disorders: 300,02, 300,21, 300,22, 300,23, 300,29.

<sup>c</sup> Cluster: personality disorders: Cluster A, Cluster B, Cluster C, 300,4.

<sup>d</sup> Cluster A: 301,0, 301,20, 301,22.

<sup>e</sup> Cluster B: 301,7, 301,83, 301,50, 301,81.

<sup>f</sup> Cluster C: 301,82, 301,6, 301,4, 301,9.

\* p-Values are from Wald test; OR for unadjusted and adjusted logistic regression models (age, sex).

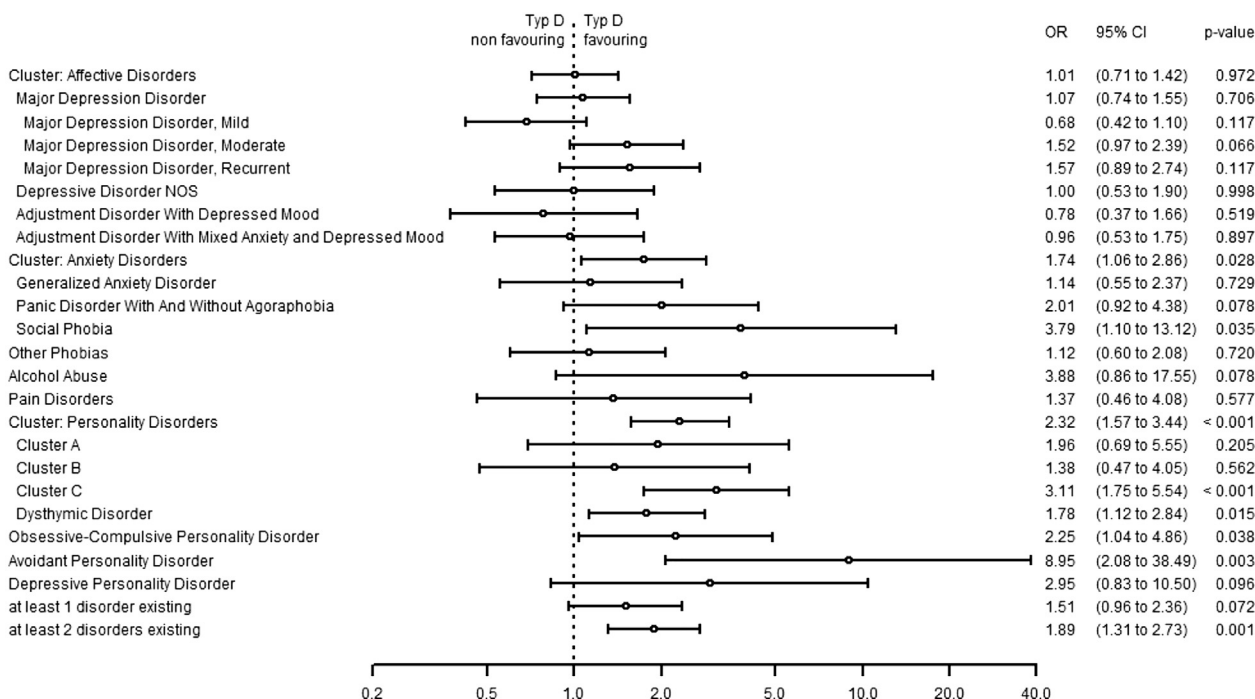


Fig. 1. Logistic regression models adjusted for age and sex on the association of Type D personality with mental disorders in mild to moderately depressed CHD patients with and without the Type D personality. Abbreviations: OR, odds ratios; CI, 95% confidence intervals.

One important argument for the relevance of assessing Type D as a separate construct comes from the main SPIRR-CAD findings, where Type D was a significant moderator of treatment effects on depressive symptoms: While depressed non-Type D patients improved regardless of the specific psychotherapy intervention, the intervention tended to be superior to usual care in the Type D group [12]. This indicates that Type D patients with heart disease may require specific attention in addition to usual care. Given that we could now for the first time empirically document the theoretically expected association of Type D with certain diagnosable personality disorders, this suggestion appears more than plausible. In clinical practice, where thorough interview diagnostics are not generally available, the DS-14 might serve as a risk indicator for more complex and enduring mental disorders requiring special attention, although the associations we found were not strong enough to recommend the DS-14 as a screening tool for specific mental disorders.

The main strength of our study consists in the size of the sample and a complete record of all mental disorders in accordance with DSM-IV by the gold standard SCID interview, performed by trained and blinded raters. A limitation with regard to the general applicability of the results is that all study participants had CHD and at least mild symptoms of depression (as per HADS), so that no conclusion is possible with regard to the significance of the Type D personality for the prevalence of mental disorders among physically healthy persons or CHD patients without symptoms of depression. Although SPIRR-CAD was conducted at 10 sites across Germany, it will need to be tested whether the associations found here also hold in other cultural contexts. The prevalence of Type D personality among our main study participants at 60% was considerably higher than among unselected German cardiology patients at 25% [4] or the total SPIRR-CAD screening population (29%) but similar to a previous sample of psychotherapy patients [4], reflecting the inclusion criteria for SPIRR-CAD as a psychotherapy trial.

Another limitation consists in the inclusion and exclusion criteria. The 75% of patients without relevant depressive symptoms during screening were excluded because it was expected that they couldn't benefit from the psychotherapy intervention. On the other hand, some patients with severe physical or mental disorders requiring immediate

medical or psychiatric treatment could not be randomized into the trial for ethical reasons. This may have introduced some selection bias towards patients with mild to moderate severity of physical and mental illness.

As expected, screening for depressive symptoms also led to increased prevalences of mental disorders other than depression in our sample when compared with unselected CHD patients. In a study of 523 CHD patients assessed when entering a rehabilitation program, there were 5% with generalized anxiety disorders, 2% with social phobia, 1% with agoraphobia and 1% with panic disorder as per Mini-International Neuropsychiatric Interview [29]. Interestingly, corresponding rates in SPIRR-CAD were similar for generalized anxiety disorder but substantially higher for social phobia and panic disorder/agoraphobia. The prevalence of depressive episodes at 34% in our total sample was due to the selection for depression (HADS-D > 7). This is, of course, considerably higher than in the general population, in which the 12-month prevalence of diagnosed depressive disorders among 50 to 59-year olds is 8.4% [30] and also far higher than in unselected CHD patients (22% current major depression) [31].

In conclusion, among depressed CHD patients the association of Type D personality with complex and enduring mental disorders such as social phobia, dysthymia and personality disorders of cluster C as per DSM IV may imply significantly higher demands for secondary prevention as well as medical and psychosocial treatment as compared to non-Type D patients. Patients at increased risk can be identified with the DS-14. However, future research will need to study the prognostic relevance and mechanisms of some understudied mental disorders in cardiac patients, especially personality disorders and social phobia. It also needs to be shown whether Type D just predicts outcomes by means of its association with such enduring mental conditions or whether it also increases risk in the absence of diagnosable mental disorders.

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### Disclosure statement

All authors have completed the Unified Competing Interest form at [http://www.icmje.org/coi\\_disclosures.pdf](http://www.icmje.org/coi_disclosures.pdf) and declare that (1) all authors received funding by the DFG for the submitted work; (2) xxx received personal honoraria from Bayer Vital, Daiichi Sankyo, Boehringer Ingelheim, Sanofi-Aventis, and MSD; xxx received personal honoraria from Servier, Pfizer, Heel, Novartis, and Hogrefe Huber publishers. xxx received personal honoraria from Bristol Myers Squibb, Heel, and Bayer Healthcare, outside the submitted work in the past three years, that could be perceived to constitute a conflict of interest.

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