



## The association between Type D personality and illness perceptions in colorectal cancer survivors: A study from the population-based PROFILES registry<sup>☆</sup>

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### ARTICLE INFO

#### Article history:

Received 14 May 2012

Received in revised form 26 June 2012

Accepted 3 July 2012

#### Keywords:

Colorectal cancer

Type D personality

Illness perceptions

Registry

### ABSTRACT

**Objective:** To examine the association between Type D personality and illness perceptions among colorectal cancer survivors 1–10 years post-diagnosis.

**Methods:** Data from two population-based surveys on colorectal cancer survivors was used. Patients diagnosed between 1998 and 2009, as registered in the Eindhoven Cancer Registry, received a questionnaire on Type D personality (DS14) and illness perceptions (B-IPQ); 81% ( $n = 3977$ ) responded.

**Results:** 750 (19%) patients had a Type D personality. They believe their illness has significantly more serious consequences, will last significantly longer, and experience significantly more symptoms that they attribute to their illness. Also, they are more concerned about their illness, and their disease more often influences them emotionally. Differences regarding ‘consequences’, ‘concern’ and ‘emotional response’ were also clinically relevant. The majority of patients stated that the cause of their disease was unknown (23.3%), hereditary (20.3%), lifestyle (15.1%), psychological distress (11.9%) or other (11.6%). Significant differences in perceptions on cause of disease between Type Ds and non-Type Ds were found for psychological distress (16.2 vs. 10.9%;  $p < 0.01$ ), randomness (1.7 vs. 5.3%;  $p < 0.01$ ) and unknown (18.8 vs. 24.4%;  $p < 0.01$ ). Multivariate analyses showed that Type D was negatively associated with ‘coherence’ and positively with ‘consequences’, ‘timeline’, ‘identity’, ‘concern’, and ‘emotional representation’.

**Conclusions:** These results elucidate the associations between personality and illness perceptions, demonstrating their close interrelatedness. Our study may be helpful in further developing theoretical models regarding giving meaning to illness and the illness perceptions that the illness elicits. Future studies should investigate whether interventions can positively impact illness perceptions of Type D cancer patients.

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### Introduction

Type D (distressed) personality has become an important research topic in the field of medical psychology in recent years. It has been described as the tendency to experience a high joint occurrence of negative affectivity and social inhibition [1]. People who score high on negative affectivity have the tendency to experience negative emotions, while people who score high on social inhibition have the

tendency not to express these emotions, because of fear of rejection or disapproval by others. Those with high levels on *both* personality traits are classified as having a Type D personality [1].

Systematic reviews among various patient groups [2,3] and healthy individuals [4] have shown that Type D personality is a stable [1,5] and powerful predictor of impaired quality of life and mental health status, above and beyond clinical characteristics. Also, studies have shown that individuals with a Type D personality reported higher rates of medically documented comorbidity [6,7], more somatic complaints [8–11], and report to feel more bothered by their illness [7,12,13] compared to those without this personality type. Findings on health care utilization among those with a Type D personality are mixed. While some studies have shown that patients with a Type D personality are less likely to seek appropriate medical care [9,12,14,15], a recent publication among cancer survivors concluded the opposite [7].

There is still a significant gap in our understanding of the determinants of these poor health outcomes among patients with a Type D personality. Perhaps the way people perceive their illness can shed some

**Abbreviations:** (ECR), Eindhoven Cancer Registry; (NA), Negative affectivity; (SI), Social inhibition.

<sup>☆</sup> This manuscript has been prepared in accordance with the style of the journal, and all authors have approved of its contents. This manuscript is not being considered for publication elsewhere and the findings of this manuscript have not been previously published or presented. There is no conflict of interest.

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new light onto this area, since patients' illness perceptions are believed to determine their behavioral and emotional self-regulation following a health threat [16]. A recent study among post myocardial infarction patients showed that those with a Type D personality possess a distinct profile of health beliefs compared to those without this personality type [17]. They believed that their illness had more serious consequences, will last significantly longer, will be significantly less controllable by them or through treatment, and they experienced significantly more symptoms that they attributed to their illness. Also, they were more concerned about their illness, experienced more emotions as a result of it, and found their illness to be less comprehensible [17].

Patients respond to their symptoms and signs of illness by forming cognitive and emotional representations of the illness that lead to coping responses [18]. However, the study among myocardial infarction patients showed that personality might influence the way people perceive their illness [17]. Besides that study, the influence of Type D personality on illness perceptions has not been investigated before. Because cancer patients with a Type D personality experience a lower quality of life and mental health status [19], report higher rates of comorbid conditions [7], and report to feel more bothered these conditions [7], assessing illness perceptions among cancer patients with and without a Type D personality seems warranted. Therefore, the goal of this study was to examine whether colorectal cancer survivors between 1 and 10 years after diagnosis with a Type D personality have different illness perceptions compared to non-Type Ds.

## Methods

### Setting and participants

Data collection was done within PROFILES (Patient Reported Outcomes Following Initial treatment and Long term Evaluation of Survivorship). PROFILES is a registry for the study of the physical and psychosocial impact of cancer and its treatment from a dynamic, growing population-based cohort of both short- and long-term cancer survivors [20]. PROFILES contains a large web-based component and is linked directly to clinical data from the Eindhoven Cancer Registry (ECR), which compiles data of all individuals newly diagnosed with cancer in the southern part of the Netherlands, an area with 10 hospitals serving 2.3 million inhabitants [21]. Data from the PROFILES registry will be available for non-commercial scientific research, subject to study question, privacy and confidentiality restrictions, and registration ([www.profilesregistry.nl](http://www.profilesregistry.nl)).

For this study, data from two large population-based surveys on survivors of colorectal cancer was used [22,23]. These surveys were set up in January 2009 and December 2010 with the goal to evaluate various patient-reported outcomes (e.g. late effects, physical and mental health status) among colorectal cancer survivors. For the 2009 survey, all individuals diagnosed with colorectal cancer from 1998 to 2007 as registered in the ECR were eligible for participation. However due to the large number of colorectal cancer survivors ( $n = 5399$ ), a weighted random selection of 2219 patients based on tumor, gender, and year of diagnosis was made [22,23]. Patients with fewer years since diagnosis were oversampled. For the 2010 survey, all individuals diagnosed with colorectal cancer from 2000 to 2009 as registered in the ECR were eligible for participation (except those already included in the 2009 survey). In both surveys, patients who had cognitive impairment, those who died prior to start of study (according to the ECR, hospital records, and the Central Bureau for Genealogy which collects information on all deceased Dutch citizens via the civil municipal registries) or those with unverifiable addresses, were excluded. Both studies were approved by the Medical Ethics Committee of the Maxima Medical Centre in the Netherlands and carried out to conform to the Helsinki Declaration.

### Data collection

Details of the PROFILES data collection method have been previously described [20]. In summary, survivors were informed of the study via a letter from their (ex-)attending specialist. The 2009 letter explained that by completing and returning the enclosed paper-and-pencil questionnaire, patients consented to participate in the study and agreed to the linkage of the questionnaire data with their disease history in the ECR. The 2010 letter included a link to a secure website, a login name, and a password, so that interested patients could provide informed consent and complete questionnaires online. If the patient did not have access to the internet, or preferred written rather than digital communication, (s)he could return our postcard by mail after which (s)he received our paper-and-pencil version of the informed consent form and questionnaire. In both studies, patients were reassured that non-participation had no consequences on their follow-up care or treatment. Non-respondents were sent a reminder letter and paper-and-pencil questionnaire within 2 months.

### Demographic and clinical characteristics

Survivors' sociodemographic and clinical information was available from the ECR which routinely collects data like date of diagnosis, tumor grade [24], clinical stage [24], and primary treatment. Comorbidity at the time of the study was assessed with the adapted Self-administered Comorbidity Questionnaire [25]. Socioeconomic status was determined by an indicator developed by Statistics Netherlands [26]. Questions on marital status, educational level, and employment status were added to the questionnaire.

### Type D personality

Type D personality was measured with the Dutch 14-item Type D Personality Scale (DS14) [1]. The DS14 is self-administered and takes only a few minutes to complete. The 14 items of this scale are answered on a 5-point response scale ranging from 0 (false) to 4 (true). Seven of these items refer to "Negative Affectivity" (NA) or the tendency to experience negative emotions in general. The remaining 7 items refer to the patient's level of "Social Inhibition" (SI) or the tendency to inhibit the expression of emotions in social interaction. Patients were categorized as having a Type D personality using a standardized cut-off score of  $\geq 10$  on both the negative affectivity and social inhibition subscales, following the protocol as previously established [1]. The DS14 is a valid and reliable scale with Cronbach's  $\alpha$  of 0.88/0.86 and a test-retest reliability over a 3-month period of  $r = 0.72/0.82$  for the two subscales, respectively [1].

### Illness perceptions

Illness perceptions were assessed using the Dutch version of the Brief Illness Perception Questionnaire (B-IPQ), an eight-item instrument used to assess cognitive and emotional representations of the illness [27]. The B-IPQ uses a single-item scale approach to assess perceptions on a continuous linear 0–10 point scale. Five of the items assess cognitive illness representations: 1. How much does your illness affect your life (consequences)? 2. How long do you think your illness will continue (timeline)? 3. How much control do you feel you have over your illness (personal control)? 4. How much do you think your treatment can help your illness (treatment control)? and 5. How much do you experience symptoms from your illness (identity)? Two items assess emotional representations: 6. How concerned are you about your illness (concern)? and 7. How much does your illness affect you emotionally (emotional representation)? One item assesses illness comprehensibility: 8. How well do you understand

your illness (coherence)? An open-ended item assesses causal beliefs whereby survivors are asked to list the 3 most important causes for their illness. Responses can be grouped into categories determined by the particular illness studied.

### Depression

Some symptoms of cancer may overlap with the somatic complaints of depression. We therefore used the Dutch version of the Hospital Anxiety and Depression Scale (HADS) since this questionnaire lacks physical indicators of psychological distress such as fatigue or weight loss, which could give false positive results if they were in fact due to (cancer or its treatment [28]). The HADS is a self-report questionnaire comprising 14 items on a four-point Likert-scale; 7 for depression and 7 for anxiety. The depression subscale mainly covers anhedonia and loss of interest, which are considered core depressive symptoms. We used a score of 8 as a cut-off value [28,29].

### Statistical analyses

Routinely collected data from the ECR on patient and tumor characteristics enabled us to compare the group of respondents, non-respondents and patients with unverifiable addresses, using t-tests for continuous variables and chi-square analyses for categorical variables. We used non-parametric equivalents, where appropriate. Differences in sociodemographic and clinical characteristics

between respondents with respect to Type D personality were analyzed in a similar way.

The B-IPQ mean scores, stratified by Type D personality, were compared with analysis of covariance (ANCOVA). Confounding background variables included for adjustment in these analyses were determined *a priori* [30] and chosen to be socioeconomic status, self-reported comorbidity, educational level, gender and depressive symptoms. Clinically meaningful differences were determined with Norman's 'rule of thumb', whereby a difference of  $\approx 0.5$  SD indicates a threshold of discriminant change in scores of a chronic illness [31]. In addition, the B-IPQ scores were compared between short- and long-term survivors (<5 vs.  $\geq 5$  years after diagnosis) while controlling for stage, grade, type of tumor, treatment, and age at diagnosis. Also, the B-IPQ scores were compared between colon and rectal cancer survivors while controlling for stage, grade, gender, treatment, and age at diagnosis and years since diagnosis. Finally, in order to see whether Type D personality (defined by a score  $\geq 10$  on both SI and NA) has additional value compared to negative affectivity only (defined by a score of  $> 10$  on NA), we compared mean scores on the B-IPQ with ANCOVA between 1) those with a Type D personality, 2) those with a high score ( $\geq 10$ ) on NA but low score ( $< 10$ ) on SI, and 3) those with a low score ( $< 10$ ) on NA. Again, confounding background variables included for adjustment in these analyses were determined *a priori* [30] and chosen to be socioeconomic status, comorbidity, educational level, gender and depressive symptoms.

Furthermore, the answers to the open-ended question of the B-IPQ regarding the main cause of the disease (e.g. colorectal cancer) were

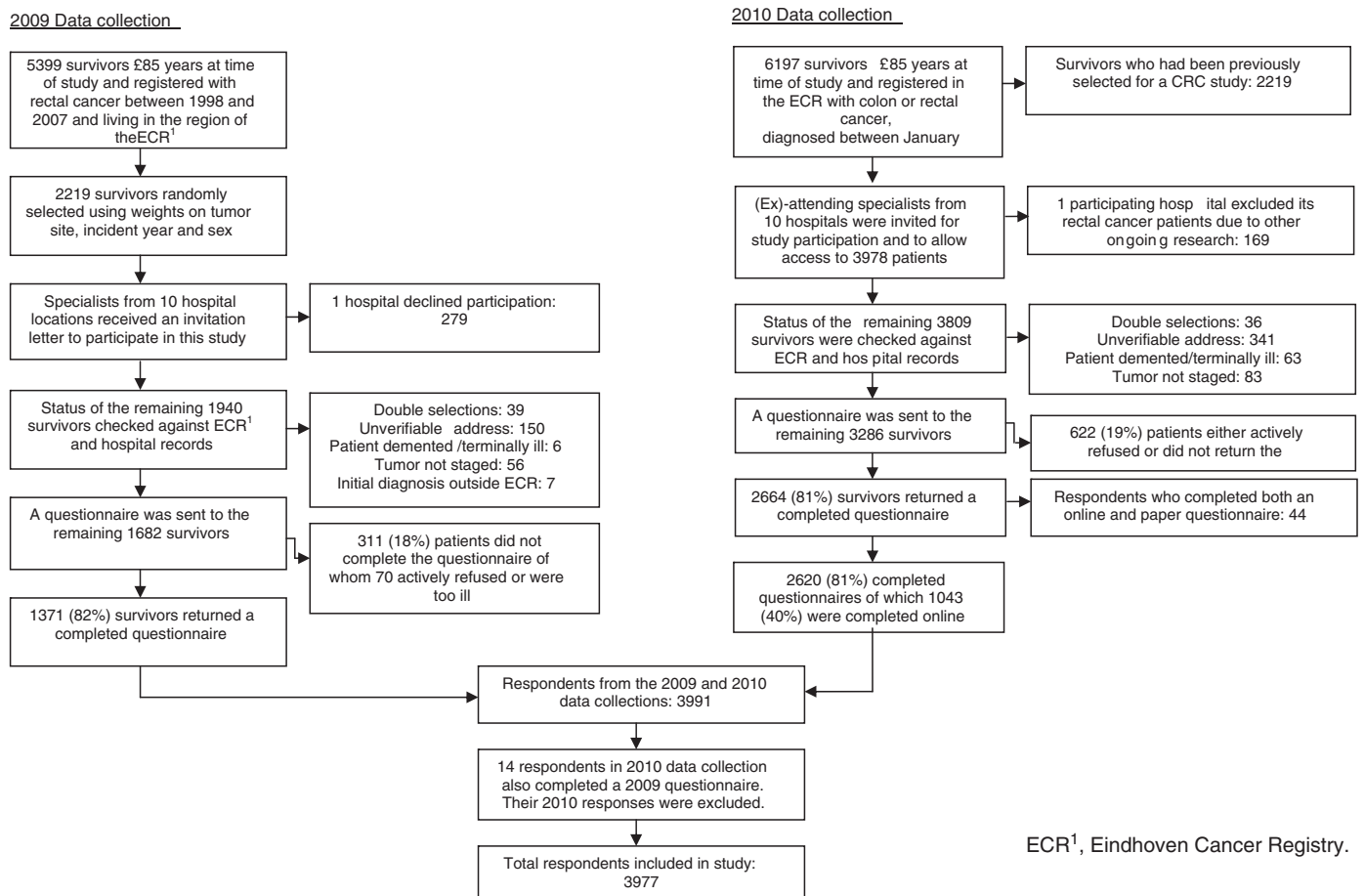


Fig. 1. Flowchart shows the data collection process.

categorized. These categories, stratified by Type D personality, were compared with chi-square analyses. Finally, multivariate linear regression models were used to investigate the association between illness perception and Type D personality. A range of sociodemographic and clinical variables was controlled for in multivariate models.

To reduce the risk of Type II errors from multiple testing, statistical differences were indicated if  $p < 0.01$ . Reported  $p$ -values were two-sided. All statistical analyses were performed using SAS (version 9.2 for Windows, SAS institute Inc., Cary NC).

## Results

### Demographic and clinical characteristics

Eighty-one percent ( $n = 3977$ ) of the 4968 cancer survivors returned a completed questionnaire (Fig. 1). In general, respondents, non-respondents and patients with unverifiable addresses differed significantly with respect to demographic and clinical characteristics (Table 1). Non-respondents were significantly older and were more often female. In addition, they were more often diagnosed with colon cancer, had disease stage II, and they were more often treated with surgery only. Finally, those with non-verified addresses were diagnosed earlier.

In total, 750 (19%) colorectal cancer patients could be classified as having a Type D personality (Table 2). There were no statistically significant differences observed between colorectal cancer survivors with and without a Type D personality in age at time of survey, years since diagnosis, type of tumor, tumor stage, grade, primary treatment, body mass index, marital status, and current work (or employment) status. However, cancer survivors with a Type D personality were more often male, reported more comorbid conditions, more often reported depressive symptoms, had a lower educational level, and had a lower socioeconomic status than non-Type D's.

### Illness perceptions

Significant differences were found between colorectal cancer survivors with and without a Type D personality regarding illness perceptions, even after controlling for socioeconomic status, comorbidity, educational level, gender and depressive symptoms (Table 3a). Those with a Type D personality believe that their illness has significantly

more serious consequences (consequences), will last significantly longer (timeline), and experience significantly more symptoms that they attribute to their illness (identity). Also, they are more concerned about their illness (concern), and their disease more often influences them emotionally (emotional response). Differences regarding 'consequences', 'concern' and 'emotional response' were also clinically relevant according to Norman's rule of thumb of half a standard deviation [31]. In comparison, differences between short- and long-term (<5 vs.  $\geq 5$  years) survivors were statistically significant (all  $p < 0.0001$ ) except for 'personal control'. However, these differences were not clinically relevant (data not shown) [31]. Also, differences between colon and rectal cancer survivors on this questionnaire were much smaller. The only significant differences were found for 'consequences' (3.6 vs. 4.3;  $p < 0.001$ ), 'timeline' (3.6 vs. 4.4;  $p < 0.01$ ), and 'identity' (3.1 vs. 3.9;  $p < 0.01$ ) and these differences were not clinically relevant.

In order to see whether Type D personality (defined by a score  $\geq 10$  on both SI and NA) has additional value compared to negative affectivity (defined by a score of  $> 10$  on NA only), we compared mean scores on the B-IPQ between 1) those with a Type D personality, 2) those with a high score ( $\geq 10$ ) on NA but low score ( $< 10$ ) on SI, and 3) those with a low score ( $< 10$ ) on NA (Table 3b). Results showed that those with a Type D personality and those with a high score on NA reported worse significantly scores for 'consequences', 'timeline', 'identity', 'concern', and 'understanding' compared to those with low scores on NA. In addition, those with a Type D personality scored significantly different on 'personal control' compared to those with high or low scores on NA. Finally, all three subgroups had significantly different scores on 'emotional response'.

Sixty-four percent of patients ( $n = 2536$ ) filled out the open-ended question on the cause of their disease. The majority of patients stated that the cause of their disease was unknown ( $n = 591$ ; 23.3%), hereditary ( $n = 513$ ; 20.3%), lifestyle ( $n = 383$ ; 15.1%), psychological distress ( $n = 301$ ; 11.9%) or other ( $n = 294$ ; 11.6%). Differences between those with and without a Type D personality were found for psychological distress (16.2% vs. 10.9%;  $p < 0.01$  respectively), randomness (1.7% vs. 5.3%;  $p < 0.01$ ) and unknown (18.8% vs. 24.4%;  $p < 0.01$ ) (Fig. 2).

In multivariate analyses, Type D personality was positively associated with the subscale 'consequences', meaning that the illness of these patients (e.g. colorectal cancer) affected their life more (Table 4). Furthermore, Type D was negatively associated with 'coherence' meaning that those with a Type D personality expressed a lower understanding of their illness. Also, Type D was positively associated with the subscale 'timeline', meaning that they believe that their illness will last long. Moreover, Type D was positively associated with 'identity' so they experienced more symptoms from their illness. In addition, Type D was positively associated with 'concern' which implies that Type Ds are more concerned about their illness. Finally, it was positively associated with 'emotional representation' which indicates that they are more emotionally affected by their illness.

**Table 1**  
Demographic and clinical characteristics of selected sample by response status.

	Mean $\pm$ SD or n (%)			p-Value
	Respondents ( $n = 3977$ )	Non-respondents ( $n = 933$ )	Non-verified addresses ( $n = 490$ )	
Mean age at time of survey ( $\pm$ SD)	69.4 $\pm$ 9.6	72.2 $\pm$ 9.9	68.4 $\pm$ 12.2	<0.0001
Mean years since last diagnosis ( $\pm$ SD)	4.7 $\pm$ 2.6	4.8 $\pm$ 2.8	5.3 $\pm$ 2.9	0.0008
Gender				
Male	2213 (56)	439 (47)	249 (51)	<0.0001
Female	1764 (44)	494 (53)	241 (49)	
Type of tumor				0.0022
Colon	2504 (63)	643 (69)	305 (62)	
Rectal	1473 (37)	290 (31)	185 (38)	
Cancer stage				<0.01
1	1157 (29)	240 (26)	133 (27)	
2	1469 (37)	393 (42)	191 (39)	
3	1106 (28)	249 (27)	121 (25)	
4	185 (5)	34 (4)	33 (7)	
Unknown	60 (2)	17 (2)	12 (2)	
Cancer grade				0.87
1	308 (8)	73 (8)	39 (9)	
2	2454 (65)	586 (66)	285 (56)	
3	506 (13)	118 (13)	61 (13)	
Unknown	497 (13)	115 (13)	71 (16)	
Primary treatment				<0.0001
SU only	1979 (50)	551 (59)	272 (56)	
SU + RT	856 (22)	146 (16)	78 (16)	
SU + CT	827 (21)	163 (18)	86 (18)	
SU + RT + CT	275 (7)	57 (6)	41 (8)	
CT only	25 (1)	8 (1)	7 (1)	
RT only	3 (0.1)	2 (0.2)	2 (0.4)	

SU: surgery; RT: radiotherapy; CT: chemotherapy.

Some variables exceed 100% due to rounding off.

We used  $t$ -tests for continuous variables and chi-square analyses for categorical variables.

**Table 2**  
Sociodemographic and clinical characteristics of colorectal cancer survivors, stratified by Type D personality.

	N (%)		p-Value
	Type D personality N = 750 (19%)	Non-Type D personality N = 3227 (81%)	
Age at time of survey (mean)	69.1 (9.7)	69.5 (9.5)	0.12
Age at time of survey			0.45
<65 years	245 (32.7)	998 (30.9)	
65–75 years	289 (38.5)	1323 (41.0)	
>75 years	216 (28.8)	906 (28.1)	
Years since diagnosis (mean)	4.6 (2.7)	4.8 (2.8)	0.57
Years since diagnosis			0.73
1–5 years	463 (61.7)	1970 (61.1)	
5–10 years	287 (38.3)	1257 (39.0)	
Gender			0.02
Male	389 (51.9)	1824 (56.5)	
Female	361 (48.1)	1403 (43.5)	
Type of tumor			0.79
Colon	469 (62.5)	2035 (63.1)	
Rectal	281 (37.5)	1192 (36.9)	
Cancer stage			0.34
1	206 (27.5)	951 (29.5)	
2	296 (39.5)	1173 (36.4)	
3	196 (26.1)	910 (28.2)	
4	38 (5.1)	147 (4.6)	
Unknown	14 (1.9)	46 (1.4)	
Cancer grade			0.05
1	75 (10.0)	233 (7.2)	
2	458 (61.1)	1996 (61.9)	
3	96 (12.8)	410 (12.7)	
Unknown	121 (16.1)	588 (18.2)	
Treatment <sup>+</sup>			0.37
SU only	391 (52.3)	1588 (49.4)	
SU + RT	156 (20.9)	700 (21.8)	
SU + CT	140 (18.7)	687 (21.4)	
SU + RT + CT	53 (7.1)	222 (6.9)	
CT only	7 (1)	18 (1)	
RT only	0 (0)	3 (0)	
Comorbidity <sup>++</sup>			<0.0001
None	174 (23.2)	1024 (31.7)	
1	199 (26.5)	879 (27.2)	
2+	377 (50.3)	1324 (41.0)	
Most frequent conditions			
High blood pressure	242 (32.3)	1038 (32.2)	0.96
Back pain	220 (29.3)	764 (23.7)	<b>0.0012</b>
Osteoarthritis	196 (26.1)	777 (24.1)	0.24
Depressive symptoms <sup>+++</sup>	344 (47.3)	436 (14.3)	<b>&lt;0.0001</b>
BMI			0.09
<18.4 (underweight)	12 (1.6)	34 (1.1)	
18.5 to 24.9 (normal)	268 (36.5)	1042 (33.4)	
25 to 29.9 (overweight)	323 (44.0)	1524 (48.8)	
>30 (obese)	131 (17.9)	521 (16.7)	
Marital status			0.10
Married	548 (73.8)	2407 (76.1)	
Single/Divorced	78 (10.5)	255 (8.1)	
Widow/Widower	117 (15.8)	501 (15.8)	
Education level <sup>++++</sup>			<b>0.02</b>
Low	168 (22.9)	621 (19.7)	
Medium	447 (60.9)	1887 (59.9)	
High	119 (16.2)	640 (20.3)	
Current occupation status			0.61
Employed	110 (15.3)	493 (16.1)	
Not employed/retired	609 (84.7)	2576 (83.9)	
Socioeconomic status			<0.001
Low	173 (24.1)	643 (20.8)	
Medium	322 (44.9)	1257 (40.7)	
High	223 (31.1)	1186 (38.4)	

Some variables exceed 100% due to rounding off.

+ SU: surgery; RT: radiotherapy; CT: chemotherapy.

++ adapted Self-administered Comorbidity Questionnaire [25].

+++ HADS: We used a score of 8 as a cut-off value for depressive symptoms [28,29].

++++ Education: Low (no or primary school); Medium (lower general secondary education or vocational training); High (pre-university education, high vocational training, university).

**Table 3a**  
Mean scores (± SD) on Brief Illness Perception Questionnaire.

(B-IPQ) of colorectal cancer patients, stratified by Type D personality.

B-IPQ dimensions (min–max)	Mean (± SD)		p-Value
	Type D personality (n = 750)	Non-Type D personality (n = 3227)	
Consequence (0–10)	5.0 (2.6)	3.6 (2.5)	<0.0001*
Timeline (0–10)	4.7 (3.2)	3.7 (3.2)	0.004
Personal Control (0–10)	4.6 (2.7)	4.8 (3.2)	0.50
Treatment Control (0–10)	6.0 (2.7)	6.4 (3.2)	0.49
Identity (0–10)	4.4 (2.7)	3.2 (2.5)	<0.0001
Concern (0–10)	5.1 (2.6)	3.7 (2.5)	<0.0001*
Understanding (0–10)	5.6 (2.9)	6.1 (3.3)	0.14
Emotional Response (0–10)	5.0 (2.7)	3.0 (2.3)	<0.0001*

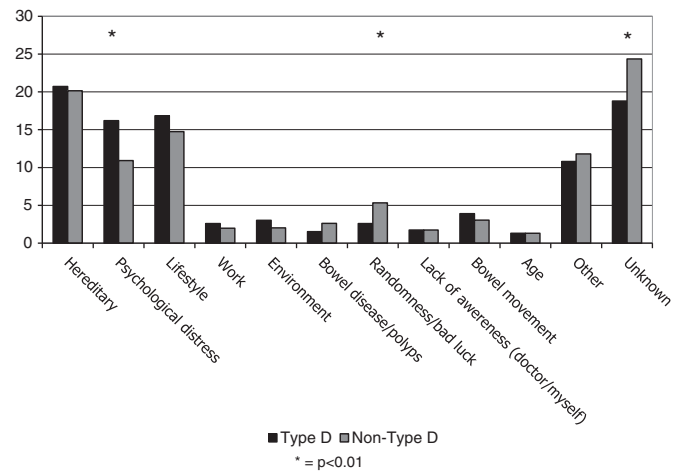
The B-IPQ was used to assess illness perceptions among colorectal cancer survivors. Confounding background variables included for adjustment in these analyses were determined *a priori* [30] and chosen to be SES, comorbidity, educational level, gender and depressive symptoms;

\* Clinically relevant difference [31].

**Discussion**

This large population-based study among patients with colorectal cancer up to 10 years after diagnosis showed that the prevalence of Type D personality was 19% in this study. This is somewhat higher compared to the prevalence found in a recent Taiwanese study among 124 colorectal cancer patients (11%) [35]. However, it is quite comparable to the prevalence found in melanoma patients (22%) [36] and the prevalence found in a mixed sample of cancer survivors (including endometrial, colorectal, lymphoma or multiple myeloma; 19%) [7,19].

In addition, this study showed that those with a Type D personality believe that their illness has significantly more serious consequences, will last significantly longer, and experience significantly more symptoms that they attribute to their illness. Also, they are more concerned about their illness, and their disease more often influences them emotionally. Furthermore, multivariate analyses showed that, besides socio-demographic and clinical characteristics (e.g. time since diagnosis, stage, comorbidity, treatment, sex, and educational level), Type D personality was negatively associated with the subscale ‘coherence’ and positively associated with the



**Fig. 2.** The percentage of patients that indicated the main cause of their disease, as assessed by B-IPQ, stratified by Type D personality (N = 2536).

subscales ‘consequences’ ‘timeline’, ‘identity’, ‘concern’ and ‘emotional representation’. Our results are in accordance with another study describing illness perceptions among post myocardial infarction patients with a Type D personality [17]. That study also showed that Type Ds have a distinct and more negative profile of illness beliefs compared to non-Type Ds. Also, a 1-year prospective study among non-metastatic colorectal cancer patients showed that personality variables can predict psychological distress symptoms’ increase and HRQOL decrease over time [45].

A possible explanation for these worse illness perceptions is that individuals with neurotic personality traits, such as those with a Type D personality, might be more prone to somatic awareness and monitoring for fear of disease recurrence [32]. Another explanation might be the fact that there also is a difference in the perceived receipt of information between these two groups. A recent study showed that cancer survivors with a Type D personality perceive to have received less information from their doctor, and are less satisfied with (the usefulness of) the received information compared to those without a Type D personality [33]. Worse illness perceptions could possibly also explain why cancer survivors with a Type D personality reported more health care utilization in comparison with non-Type Ds in a recently published study [7].

**Table 3b**

Mean scores on the Brief Illness Perception Questionnaire (B-IPQ) for those with a Type D personality, those with a high score (≥10) on negative affectivity, and those with a low score (<10) on negative affectivity.

B-IPQ	Mean (± SD)			p-Value
	Type D	High negative affectivity (NA+)	Low negative affectivity (NA-)	
	(n = 750)	(n = 2456)	(n = 463)	
Consequence (0–10)	5.0 (2.6)	4.7 (2.7)	3.4 (2.3)	<0.0001*
Timeline (0–10)	4.7 (3.2)	4.6 (3.4)	3.5 (3.1)	<0.0001*
Personal Control (0–10)	4.6 (2.7)	4.4 (2.9)	4.9 (3.2)	0.0009**
Treatment Control (0–10)	6.0 (2.7)	6.3 (3.0)	6.5 (3.3)	<0.05*
Identity (0–10)	4.4 (2.7)	4.2 (2.8)	3.0 (2.3)	<0.0001*
Concern (0–10)	5.1 (2.6)	4.9 (2.8)	3.4 (2.4)	<0.0001*
Understanding (0–10)	5.6 (2.9)	6.0 (3.3)	6.2 (3.3)	<0.01*
Emotional representation (0–10)	5.0 (2.7)	4.6 (2.6)	2.7 (2.1)	<0.0001***

Type D was defined by a score ≥10 on SI and NA; NA+ was defined as a score ≥10 on NA and <10 on SI; and NA- was defined as a score <10 on NA, irrespective of SI. Confounding background variables included for adjustment in these analyses were determined *a priori* [30] and chosen to be SES, comorbidity, educational level, gender and depressive symptoms.

\*Type D personality and NA+ are significantly different from the NA-.

\*\*Type D personality is significantly different from NA+ and NA-.

\*\*\*All subgroups are significantly different.

**Table 4**  
Standardized betas of multivariate linear regression analyses evaluating the association of independent variables with the BIPQ scales.

	B-IPQ1 consequences	B-IPQ2 timeline	B-IPQ3 personal control	B-IPQ4 treatment control	B-IPQ5 identity	B-IPQ6 concern	B-IPQ7 coherence	B-IPQ8 emotional representation
Tumor type	−0.07	−0.07*	0.001	0.03	−0.07	−0.04	−0.02	−0.05
Time (since diagnosis)	−0.13*	−0.08*	0.04	−0.08*	−0.07*	−0.12*	−0.07*	−0.07*
Stage	−0.09*	−0.10*	0.03	0.04	−0.07*	−0.07*	−0.02	−0.06*
Comorbidity	−0.08*	−0.06*	−0.02	−0.007	−0.09*	−0.08*	−0.02	−0.08*
SU + RT	0.08*	0.08*	0.04	0.03	0.12*	0.03	−0.009	0.05
SU + CT	0.05	0.003	0.02	0.07*	0.06	0.07*	0.008	0.05
SU + RT + CT	0.08*	0.003	0.03	0.08*	0.10*	0.04	0.02	0.07*
Sex	−0.05*	−0.05*	−0.002	−0.07*	−0.08*	−0.7*	−0.03	−0.07*
Marital status	−0.04	−0.03	0.01	−0.004	−0.07*	−0.03	0.03	−0.02
Educational level	−0.008	−0.03	−0.02	−0.11*	0.006	0.03	−0.13*	0.04*
Socio-economic status	−0.02	0.02	−0.02	0.01	0.006	0.001	−0.003	−0.009
Personality	0.20*	0.12*	−0.02	−0.04	0.18*	0.20*	−0.06*	0.30*

Tumor type = Colon (reference) vs. rectum; Time = > 5 years after diagnosis (reference); Stage = 1,2 (reference) vs. 3,4; Comorbidity = No comorbidity (reference) vs. one or more comorbidities; SU + RT = surgery + radiotherapy (reference) vs. surgery; SU + CT = surgery + chemotherapy (reference) vs. surgery; SU + RT + CT = surgery + radiotherapy + chemotherapy (reference) vs. surgery; Sex = Male (reference) vs. female; Marital status = Partner (reference) vs. no partner; Educational status = High (reference) vs. low; Socio-economic status = High (reference) vs. medium or low; Personality = Type D (reference) vs. no Type D;

\**p*-Value of <0.01.

Colorectal cancer survivors stated that the three most common causal attributions were unknown (23%), hereditary (20%), lifestyle (15%). A recent study on causal attributions among cancer survivors of the ten most common cancers showed quite similar results with the three most common causal attributions being lifestyle (39%), biological (including hereditary; 35%), and environmental (24%) [34]. In the present study, colorectal cancer survivors with a Type D personality more often indicated that the cause of their disease was psychological distress, but less likely to attribute their disease to a random or unknown cause. Since this is the first study on illness perceptions and Type D personality among cancer patients, comparison of these results with other studies is not possible.

From our results, paying more attention to both personality and illness perceptions of patients seems warranted. A meta-analysis of research on illness perceptions showed that illness perceptions predicted outcomes in various categories of chronic physical disorders [37]. Also, previous studies showed that illness perceptions can influence the process of adjustment and coping in a wide range of disease states [32,38,39]. Although adjusting personality is difficult, changing illness perceptions is possible, however. Two brief in-hospital intervention studies changed the perceptions of myocardial infarction patients and this resulted in a quicker return to work in the intervention group [40,41].

The present study has some limitations that should be mentioned. Although we had information on the demographic and clinical characteristics of non-respondents and patients with non-verifiable addresses, it remains unknown whether non-respondents declined to participate in the study because of poor health. In addition, although Type D personality is a stable construct [5,42], our cross-sectional analyses limits the determination of causal association between Type D personality and illness perceptions, as baseline data on these outcomes are unknown. Future studies that address this issue would be helpful in exploring this association between Type D personality and illness perceptions in cancer patients. Finally, we used the HADS in order to control for depressive symptoms when using the Type D questionnaire. However, the HADS is not the best instrument to do this, since recent publications have highlighted inherent drawbacks of this questionnaire [43,44].

Despite these limitations, the present study provides an important contribution to the limited data available on the importance of individual differences such as Type D personality regarding the illness perceptions of colorectal cancer survivors. Since our results are based on two large population-based studies with a high response rate, extrapolating these results to the larger population of colorectal cancer survivors seems justified. These results call for further research on Type D personality among various cancer survivors followed over a longer period of time. In addition, potential underlying mechanisms that may explain

these Type-D related disparities in illness perceptions should also be investigated among cancer survivors. Furthermore, our study contributes to the area of strengthening theoretical models about illness perceptions and the importance of personality characteristics in such models.

In conclusion, this study showed that patients with a Type D personality had more negative perceptions about their illness, were more concerned about their illness, and felt that their disease more often influenced them emotionally, even after adjustment for the major clinical predictors. Also, they had different beliefs about the cause of the disease compared to those without a Type D personality. Future studies should investigate whether intervention studies can improve the illness perceptions of cancer patients with a Type D personality, and what effects these improvement have on outcomes such as quality of life, use of health care facilities, or other outcomes.

#### Conflict of interest statement

There is no conflict of interest.

#### Acknowledgments

We would like to thank all patients and their doctors for their participation in the study. Special thanks go to Dr. M. van Bommel, who was willing to function as an independent advisor and to answer questions of patients. In addition, we want to thank the following hospitals for their cooperation: Amphia hospital, Breda; Bernhoven Hospital, Veghel and Oss; Catharina hospital, Eindhoven; Elkerliek Hospital, Helmond; Jeroen Bosch hospital's Hertogenbosch; Maxima Medical Centre, Eindhoven and Veldhoven; Sint Anna hospital, Geldrop; St. Elisabeth hospital, Tilburg; Twee Steden Hospital, Tilburg and Waalwijk; VieCury Hospital, Venlo and Venray, all in The Netherlands.

The present research was supported by a VENI grant (#451-10-041) from the Netherlands Organization for Scientific Research (The Hague, The Netherlands) awarded to Floortje Mols, and a Social Psychology Fellowship from the Dutch Cancer Society to Melissa Thong (#UVT2011-4960). Data collection of this study was funded by the Comprehensive Cancer Centre South, Eindhoven, the Netherlands; and an Investment Subsidy (#480-08-009) of the Netherlands Organization for Scientific Research (The Hague, The Netherlands).

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