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Brief Report

Type D Personality Associated With Increased Risk for Mortality in Adults With Congenital Heart Disease

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Background: Type D personality has been previously shown to increase the risk for mortality in patients with acquired heart disease. **Objective:** We aimed to compare mortality in adult patients with congenital heart disease (CHD) with and without type D. **Methods:** Survival was assessed using prospective data from the Dutch national Congenital Corvitia registry for adults with CHD. Patients were randomly selected from the registry and characterized at inclusion in 2009 for the presence of type D using the DS14 questionnaire. **Results:** One thousand fifty-five patients, with 484 (46%) males, a mean (SD) age of 41 (14) years, 613 (58%) having mild CHD, 348 (33%) having moderate CHD, and 94 (9%) having severe CHD, were included. Type D personality was present in 225 patients (21%). Type D was associated with an increased risk for all-cause mortality independent of age, sex, New York Heart Association class,

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number of prescribed medications, depression, employment status, and marital status (hazard ratio, 1.94; 95% confidence interval, 1.05–3.57; $P = .033$). **Conclusion:** Type D personality was associated with an increased risk for all-cause mortality in adult patients with CHD.

KEY WORDS: congenital heart disease, heart diseases, mortality, type D personality

Type D (distressed) personality was introduced in 1996 when prognostic factors were being studied in a cardiovascular patient population and refers to a combination of negative affectivity and social inhibition.[1] Negative affectivity is the tendency to experience negative emotions with a negative self-view, and social inhibition is the tendency to inhibit self-expression in social interaction because of fear of rejection or disapproval. Previous studies showed that 20% of the general population and up to 30% of patients with acquired heart disease (AHD) were characterized with type D.[2,3] In cardiology, most studies on type D focused on patients with AHD and showed that patients with type D more frequently reported symptoms and displayed more adverse health behaviors, such as lack of exercise and smoking.[4,5] Other characteristics of patients with type D, associated with impaired clinical outcomes, included depressive symptoms, single marital status, and increased proinflammatory levels.[4,6,7] It was demonstrated that patients with documented coronary artery disease (CAD) and type D personality had an increased risk for myocardial infarction and mortality.[6] Data on interventions for patients with type D are limited, but a recent trial on psychotherapy for patients with CAD suggested benefit for patients with type D in reducing depressive symptoms.[8]

In adult patients with congenital heart disease (CHD), the prevalence of type D seemed to be approximately 20%, although these patients were also prone to social isolation.[9,10] It has been demonstrated that adult CHD patients with type D used less healthcare while they reported a worse health status and quality of life, whereas type D was not associated with disease severity.[10] However, the impact of type D personality on long-term outcomes among patients with CHD is still unknown. Because most patients with CHD experience residual sequelae and need lifelong follow-up for timely reinterventions, data on long-term outcomes have become increasingly important.

The objective of this study was to evaluate the role of type D personality in survival of adults with CHD. Therefore, all-cause mortality was compared between CHD patients with and without type D personality.

Methods

Subjects and Data Collection

In this follow-up study, we performed secondary data analyses of the cohort of Schoormans et al,[10,11] comprising randomly selected adults with CHD enrolled in the nationwide Congenital Corvitia registry, who were approached by letter to participate in the study.[10,12] Eligible patients were randomly selected from the Congenital Corvitia registry, aiming for a representative sample of the Dutch population of adults with CHD. Patients who were given a diagnosis of Marfan syndrome, mentally impaired, or illiterate in Dutch were excluded from the study. The Congenital Corvitia registry was approved by the ethics boards of all participating centers and complies with the Declaration of Helsinki. For the questionnaire study in 2009, no ethical approval was required.

At baseline in the primary study (2009), patients filled out the DS14 questionnaire, web-based, to determine the presence or absence of a type D personality. Nonrespondents were sent a reminder after 6 and 12 weeks.[10] The DS14 questionnaire was developed to determine the presence of type D personality in a standardized way and consists of 14 items to assess 2 subscales, namely, negative affectivity and social inhibition.[2] Type D personality was defined as a cutoff score of 10 or greater on both subscales of the DS14.[2] The Hospital Anxiety and Depression Scale was used to measure depression.[11,13] Other characteristics, including data on functional class, comorbidities, marital status, and employment status, were also acquired through questionnaires at inclusion. Data on survival and cause of death were acquired through the Congenital Corvitia registry. Follow-up of these patients started at inclusion in this study (2009) and ended at the latest medical record review, death, or end of study (November 2019). All-cause mortality was the primary outcome of this follow-up study in patients with CHD.

Congenital Corvitia Registry

Congenital Corvitia is a nationwide population-based registry of adult patients with CHD in the Netherlands, which started inclusion in 2002 and encompasses patients from more than 100 hospitals in the Netherlands. The Congenital Corvitia registry was created to facilitate studies on prevalence and long-term outcomes of congenital heart defects. In the Congenital Corvitia registry, data are collected on demographics, congenital heart defects, and surgical procedures, using the European Pediatric Cardiac Code Short List scheme, and patients are followed up prospectively. All participants of Congenital Corvitia provided written informed consent at the time of enrollment in the registry.

Statistical Analyses

Data were presented as numbers (%), mean (standard deviation), or median (interquartile range). Baseline variables between patients with and without type D and the distribution of causes of death were compared using independent *t*

TABLE Baseline Characteristics

Characteristics	Total (N = 1055)	Type D (n = 225)	Non–type D (n = 830)	*P*
Male	484 (46%)	97 (43%)	387 (47%)	.315
Age, mean (SD), y	41 (14)	40 (13)	41 (15)	.987
CHD severity				.935
Mild	613 (58%)	133 (59%)	480 (58%)	
Moderate	348 (33%)	72 (32%)	276 (33%)	
Complex	94 (9%)	20 (9%)	74 (9%)	
NYHA class				<.001
I	725 (69%)	117 (52%)	608 (73%)	
II	221 (21%)	68 (30%)	153 (18%)	
III	62 (6%)	20 (9%)	42 (5%)	
IV	30 (3%)	14 (6%)	16 (2%)	
Unknown	17 (2%)	6 (3%)	11 (1%)	

Values are mean (SD) or n (%).
Abbreviations: CHD, congenital heart disease; NYHA, New York Heart Association.

tests or χ^2 tests. The Kaplan-Meier method was used to evaluate survival, and Cox proportional hazards regression analysis was used to determine the association between type D and mortality. Variables from the univariable analysis with a *P* value less than .05, namely, age and sex, were included in multivariable Cox proportional hazards regression analysis to identify independently associated variables. A 2-tailed *P* value of less than .05 was considered statistically significant. For statistical analyses, SPSS version 25.0 (IBM Corp, Armonk, New York) and R studio version 1.1.456 (R Foundation, Vienna, Austria) were used.

Results

In total, 1055 patients were included from the primary study of Schoormans et al from 7 secondary and tertiary centers; 484 (46%) were male, with a mean (SD) age of 41 (14) years. Six hundred thirteen (58%) had mild, 348 (33%) had moderate, and 94 (9%) had complex CHD. Type D personality was present in 225 patients (21%) (Table).

At baseline, there were no differences in the severity of CHD between patients with and without type D. However, the results of the questionnaires showed that patients with type D personality more frequently reported a New York Heart Association class of 2 or higher (45% vs 25%, $P < .001$). Furthermore, patients with type D more frequently had diabetes (6% vs 3%, $P = .046$), renal disease (5% vs 2%, $P = .004$), rheumatic disorders (14% vs 7%, $P = .001$), and depressive symptoms (25% vs 2%, $P < .001$) compared with patients without type D. In addition, patients with type D were unemployed more frequently (28% vs 21%, $P = .013$) and had a single marital status more often (28% vs 21%, $P = .024$).

At the end of follow-up (median, 7 years; interquartile range, 5–8), 71 patients had died: 23 patients with type D (10%) and 48 patients without type D (6%). Patients with type D had significantly worse survival compared with patients without type D after 10 years of follow-up (survival of 82% vs 87%, $P = .014$; Figure 1). Mean age at death was not significantly different between both groups, 56 (SD, 17) years for patients with type D versus 60 (SD, 17) years for patients without type D ($P = .311$). In univariable Cox regression analyses, Type D (hazard ratio, 1.85; 95% confidence interval, 1.12–3.04; $P = .015$), age, male sex, higher New York Heart Association class, number of prescribed medications, indication for depression, unemployment, and single marital status were significantly associated with all-cause mortality (see Supplementary Table 1). Type D personality remained a significant predictor of mortality in multivariable analysis (hazard ratio, 1.94; 95% confidence interval, 1.05–3.57; $P = .03$).

Analysis of causes of death showed no differences between both groups ($P = .739$): 12 cardiovascular deaths (52%) among patients with type D and 23 (48%) among patients without type D as well as 5 malignancies (22%) among patients with type D and 14 (29%) among patients without type D. In 17 cases, the cause of death was irretrievable, because these were unknown to the treating medical center and the general physician of the patient, 6 (26%) for patients with type D and 11 (23%) for patients without type D.

Discussion

To our knowledge, this is the first long-term follow-up study relating type D personality to mortality in adult patients with CHD. Our results showed that type D was an independent predictor of mortality in patients with CHD, similar to studies on type D in patients with AHD.[6] The prevalence of type D of 21% in our study population of patients with CHD is in line with the general population.[2] Furthermore, the differences in characteristics between patients with and without type D, with respect to reported comorbidities, depression, unemployment, and single marital status, were also similar to other studies.[6,7,14] Our findings indicate that characterizing type D personality in patients with CHD,

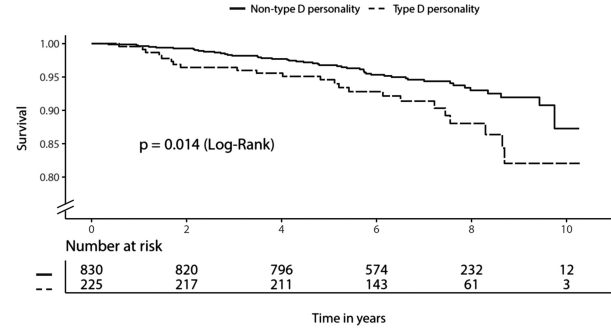

FIGURE 1. *Survival of patients with congenital heart disease and type D compared with non–type-D patients.*

What's New and Important

- Type D personality is a predictor of all-cause mortality in adult patients with CHD, whereas patients with type D also reported more comorbidities and psychosocial risk factors.
- The prevalence of type D personality in patients with CHD is similar to the prevalence in patients with AHD.
- Patients with CHD are often in lifelong follow-up in a specialized center; therefore, personality characterization should be considered early in follow-up of patients with CHD to identify high-risk patients.

similar to patients with AHD, is valuable for identifying high-risk patients who might require a more personalized follow-up.

It has been hypothesized that the increased mortality in AHD patients with type D might be a reflection of adverse health-related behaviors such as smoking, increased alcohol consumption, worse adherence to therapy, and a more sedentary lifestyle.[4] In addition, depression seems to be more frequent in patients with type D personality and is also associated with an increased risk for mortality.[14–16] In patients with CHD, these behavioral and sociodemographic factors have also been associated with worse patient-reported outcomes.[17,18] Several biological pathways have been suggested for the increased mortality in patients with type D that result in worse glycemic control, increased systemic inflammation, and autonomic dysregulation.[19] Whether the same behavioral and biological mechanisms are responsible for the increased risk for mortality in both CHD and AHD patients with type D remains to be elucidated, especially because these patient groups differ significantly, because patients with AHD are often older when they develop cardiac disease and patients with CHD are born with their cardiac disease. Patients with CHD frequently visit the hospital, starting at a young age, and continue to do so when they get older. Conversely, for patients with AHD, follow-up often starts when symptoms or a first major event occurs. These different courses of disease could lead to different outcomes in terms of mortality and mental well-being and thus result in different approaches of follow-up and treatment.

Previous studies showed that patients with type D comprise a population with specific characteristics (eg, adverse health behaviors and negative emotions) and thus might require a more tailored approach.[4,6] Sparse data are available on interventions for patients with type D to stimulate healthy behavior, to increase therapy adherence, to improve quality of life, and, possibly, to improve long-term outcomes.[20] A recent trial suggested that psychotherapy, although not effective in reducing depressive symptoms in patients with CAD, was superior in reducing depressive symptoms in patients with type D compared with usual care.[8] Mobile health tools enable remote monitoring of patients and can improve adherence and self-care.[21,22] These tools, providing more personalized surveillance, such as mobile applications that are accessible through a smartphone in the comfort of the patient's home, have shown to improve clinical outcomes and quality of life in selected patients with heart failure, and it is conceivable that these tools would be helpful to CHD patients with a type D personality in improving health behavior and long-term outcomes.[23]

Limitations

In our study, we characterized type D and no other personality types. The functional status in the current study was patient reported; it was previously demonstrated that this had adequate agreement with a cardiologist assessment.[24] However, it has also been previously demonstrated that patients with type D report more symptoms and a poorer health status; this might have resulted in an underestimation of actual functional status.[25] Our cohort represents patients with CHD registered in the Congenital Corvitia registry, who are being followed in clinical practice, and may consist of patients with more severe or complex diseases. This may have introduced a selection bias. In addition, 24% of the causes of death were irretrievable, because they were unknown to both the treating hospital and the general practitioner. Therefore, the number of cardiovascular deaths might have been underestimated. However, the percentage of unknown causes of death was similar in both groups.

Conclusions

Long-term follow-up showed that type D personality was associated with an increased risk for mortality in adult patients with CHD, whereas patients with type D personality more frequently reported comorbidities, unemployment, and single marital status. Personality characterization should be performed at an early stage in follow-up to identify patients at risk, personalize and intensify follow-up, and possibly improve outcomes.

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