

Introduction

In the field of medical psychology, Type D or 'distressed' personality has been of great interest among researchers. Type D personality is characterized by a high score on two key-elements; Negative Affectivity (NA) and Social Inhibition (SI) (Denollet & De Potter, 1992; Denollet, 1993). Negative affectivity refers to the tendency to experience negative emotions across time and situations (Watson & Pennebaker, 1989). Asendorpf (1993) defines social inhibition as the tendency to inhibit the expression of these negative emotions in social interactions. Several studies have proven that Type D personality positively relates with cardiac death, nonfatal Myocardial Infarct (MI), blood pressure and cortisol reactivity (Denollet, Vaes, & Brutsaert, 2000; Habra et al., 2003).

Although there is growing evidence for the relationship between Type D personality and an increased risk of Coronary Heart Disease (CHD), there is no consensus for the explanation of this relationship. Perhaps the association can be explained by behavioural factors (e.g. lifestyle, hostility, depression, quality of life) and/or physiological factors (e.g. stressreactivity, heart rate, heart-rate variability, blood pressure, cortisol levels).

The Sympathetic-Adrenomedullary (SAM) system and the Hypothalamic-Pituitary-Adrenocortical (HPA) axis are two interrelated systems that are involved in stress response. The SAM-axis is involved in sympathetic activation when exposed to a stressfull event. The signal perceived by the cortex is transmitted to the hypothalamus. This initiates a reaction by immediate activation of the sympathetic nervous system, called a fight or flight

respons. Increased heart rate and blood pressure are considered to be key-elements in sympathetic arousal (Taylor, 2006).

In this study, focus will be on physiological factors in an attempt to explain the relationship between Type D and CHD. We hypothesized that individual differences exist in cardiovascular reactivity to acute stress between Type D personality and non Type D personality.

Methods

Participants

Participants were 88 undergraduates in psychology at Tilburg University, The Netherlands, who took part in the study for course credit. The data from one participant was excluded because he had a pacemaker. The final sample consisted of 87 participants (69 female; 78.4%).

Information on the following baseline characteristics were also collected (Table 1): Age ($M = 20.6$; $SD = 4.0$); use of alcohol ($M = 4.5$; $SD = 5.8$) smoking ($N = 26$; 29.5%), and the presence of ailments in the participants parents; cerebral vascular accident ($N = 2$; 2.3%); myocardial infarction ($N = 2$; 2.3%); type 2 diabetes mellitus ($N = 2$; 2.3%); hypercholesterolemia ($N = 7$; 8.0%); hypertension ($N = 4$; 4.5%).

Psychological measures

Type D personality

To assess Type D personality, participants were asked to complete the 14-item Type D personality scale (DS14). Items on this scale are answered on a five-point Likert scale ranging from 0 to 4. The scale consists of two 7 item sub-scales assessing negative affectivity and social inhibition. Patients were categorized as Type D using a standardized cut-off score ≥ 10 on both the negative affectivity and social inhibition subscales. The DS14 is a valid and reliable scale (Cronbach's $\alpha = 0.88/0.86$, test-retest reliability over a 3-month period of $r = 0.72/0.82$ for the two subscales, respectively) (Denollet, 2005).

General Fatigue

Fatigue is considered a core symptom in Chronic Heart Failure (Smith et al., 2007). General fatigue was measured by using the Fatigue Assessment Scale (FAS). Michielsen and colleagues (2004) developed this 10-item scale. This unidimensional scale has a good reliability and content validity (Cronbach's $\alpha=.87$).

Depression

Because depression can function as a mediating variable between Type D personality and cardiovascular prognosis (Kaptein, Beunderman, Dekker, & Vingerhoets, 2006) depression was assessed with the Beck Depression Inventory-21 (BDI-21). The BDI consists of two components; a cognitive component and a somatic component ($r=.72$). This questionnaire has high internal consistency (Cronbach's $\alpha=.90$).

Hostility

"Hostility includes three dimensions; the tendency to behave antagonistically; to think cynically and attribute negative intentions to others; and to feel annoyance and anger frequently" (Gidron, Davidson, & Ilia, 2001, p.2). Hostility was measured by using the New Buss. The New Buss is a new eight-item version of the BPAQ (Buss-Perry Aggression Questionnaire). In two studies, Gidron and colleagues found that scores on the New-Buss and on the original BPAQ were highly correlated ($r = .92$ & $r = .94$). This strongly suggests that the eight item New Buss captures most of what is assessed by

the larger 29-item scale. Miller, Smith, Turner, Giujarro, & Hallet (1996) concluded that hostility is an independent and significant CHD-risk factor.

Physiological measures

In order to measure the different levels of stress between Type D and non Type D participants, heart rate (HR) and heart rate variability (HRV) were measured using an ElectroCardioGram (ECG). Three electrodes were used to derive HR. The signals were acquired continuously with a sample rate of 1000Hz. The root mean square of successive differences (RMSSD) was taken as a measure of HRV. Heart rate and RMSSD were calculated for the baseline period, the mental arithmetic task, the speech task, and the recovery period, by use of inter-beat interval time series.

Procedure

Participants subscribed for the experiment. After subscription they came to the Tilburg University ElectroCardioGram-lab. The duration of the test was approximately 45 minutes. First participants were asked to fill in multiple questionnaires. Subsequently, they were informed in the procedure of the ECG-measure. When informed consent was achieved the participant was connected to the ECG.

Participants completed a standardized computer-controlled experiment. The procedure consisted of a 5 minutes baseline period, a 7 minutes mental arithmetic task, a 6 minutes speaking task, and finally a recovery period of 5 minutes.

In the mental arithmetic task, a total time pressure of 5 seconds per trial was included to evoke stress. After three practice trials, participants had to accumulate three digit numbers. Immediately after those three numbers, a fourth number appeared. Participants were asked to judge whether the accumulation of three numbers was correct or incorrect by pressing the “correct” or “wrong” button. As the participant’s performance improved, the level of accumulation increased. To heighten the level of stress, standardized negative feedback was given by the experimenter.

In the speaking task, the participants were asked to express their positive and negative characteristics within social situations. In advance there was a three minutes preparation time followed by a three minute lap in were they had to verbally express their qualities. To evoke stress among the participant, the illusion was created that they were being videotaped to see if they were able to talk about themselves for three minutes.

To exclude order bias, the order of the mental arithmetic task and the speaking task was randomized.

Statistical Analysis

In comparing the two groups on demographic and psychological variables, t-tests were used for continuous variables and chi-square tests were used for dichotomous variables. To determine whether Type D personality and non Type D personality differ on HR and HRV during the tasks, a mixed between-within ANOVA was used, with Type D personality as categorical independent between-subjects variable and condition as categorical independent within-subjects variable. Difference contrasts were

used when a significant effect in the mixed between-within ANOVA was found.

Alpha was set at 0.05.

Results

A total of 88 participants took part in the study. The prevalence of Type D personality was 29,5%. Baseline demographic and psychological characteristics are shown in Table 1. Comparison of the demographic characteristics between Type D personality and non Type D personality indicated that there were no significant differences between the two groups. In terms of psychological characteristics, Type D personality was associated with higher scores on General Fatigue ($p < 0.001$), Depression ($p < 0.001$) and Hostility ($p = 0.001$), compared to non Type D personality.

A mixed between-within ANOVA was conducted to compare cardiovascular reactivity to acute stress between Type D personality and non Type D personality. Analysis indicated that there was a significant main effect for Type D on HR ($F = 3.534$; $p = 0.021$; partial eta squared = 0.039). Difference contrasts revealed that this significant difference in HR between the two groups was explained by significant differences on the speaking task only ($F = 6.911$; $p = 0.01$; partial eta squared = 0.074). Participants with non Type D personality showed a higher heart rate compared to participants with Type D personality. On the baseline period; mental arithmetic task; and recovery period, no significant outcomes were found (Figure 1).

The analysis did not indicate that there were significant differences on the four conditions between Type D personality and non Type D personality with respect to HRV ($F = 0.549$; $p = 0.623$; partial eta squared = 0.006). The latter result may be due to a lack of power or to the influence of (para)sympathetic activity.

Discussion:

An increasing amount of evidence suggests that Type D personality affects psychological and physical health adversely, particularly in Cardio Vascular Disease patients (Denollet, 2000). The main interest was to examine stress reactions between individuals with or without a Type D personality. In this study, focus was on physiological factors in an attempt to explain the relationship between Type D and CHD. In line with previous research on Type D and stress, done by Habra et al. (2003) and Smith & Kupper (2006), this study investigates how individuals, who were characterized as having a Type D personality, physiologically react to stressors compared to a non Type D group. It was hypothesized that individual differences exist in cardiovascular reactivity to acute stress between Type D personality and non Type D personality.

In line with the stated hypothesis, significant differences were found in stress-reactivity during the speaking task between individuals who are characterized as Type D personality and a non Type D control group. The Type D group showed less HR-reactivity during the speaking task.

The individuals, both Type D personality and non Type D personality, were all under the age of 35 and none of them had previous (early onset) cardiac disorder or a history of CHD. Interestingly, in participants aged below 35, Type D individuals significantly differed from non Type D individuals. This emphasizes that in late adolescence there already exists a difference in HR (stress reaction of the SAM) between adolescents with Type D personality and the non Type D control group. The question arises whether Type D

personality is a predictor for the later development of CHD and cardiac disorder.

Although the demographic variables had no significant value in the reaction to stressors in HR and HRV, the literature has suggested that behavioural risk factors (e.g. smoking, use of alcohol) and physical risk factors (e.g. gender, age, genetics) play an important role in cardiovascular prognosis (Kaptein et al., 2005). Type D personality subjects with depressive symptoms (both somatic and cognitive) significantly differed from non Type D subjects in our study, strengthening the point that a depression or depressive symptoms are associated with Type D personality. Significant differences between individuals who are characterized as Type D personality and a non Type D control group were also found on hostility and fatigue, two psychological extensions that are associated with Type D personality.

However, the present study has several limitations. First, the sample size was small. Future studies could include larger samples of participants to increase statistical power. Second, all participants were students from one university, making it a mono center study, which may not be a representative sample and limit generalisability. Third, all physiological data was collected with an electrocardiogram. Follow-up studies or future research could include samples of blood pressure, sympathetic activity, and cortisol as well.

Overall, this study found that blunted cardiac reactivity was associated with Type D personality. While only significantly higher levels of heart rate were found on the speaking task, this may be a more appropriate acute stressor in hence to the mental arithmetic task.

Conclusion

In this study, the hypothesis that individual differences exist in cardiovascular reactivity to acute stress between Type D personality and non Type D personality was examined.

A significant difference was found in HR between Type D personality and non Type D personality on the speaking task. Participants with a non Type D personality had a higher heart rate on this task, compared to the Type D personality group. This can be explained by the fact that persons with Type D personality experience more chronic stress in life.

In the present study, Type D personality was not significantly associated with heart rate variability. This result may be due to a lack of power, because of a relatively small and homogeneous sample of participants. Another explanation could be the influence of (para)sympathetic activity.

Type D personality also had a significant association with higher levels of fatigue, depression and hostility. The fact that persons with Type D personality experience more negative emotions and inhibit the expression of these emotions could be the explanation for this finding.

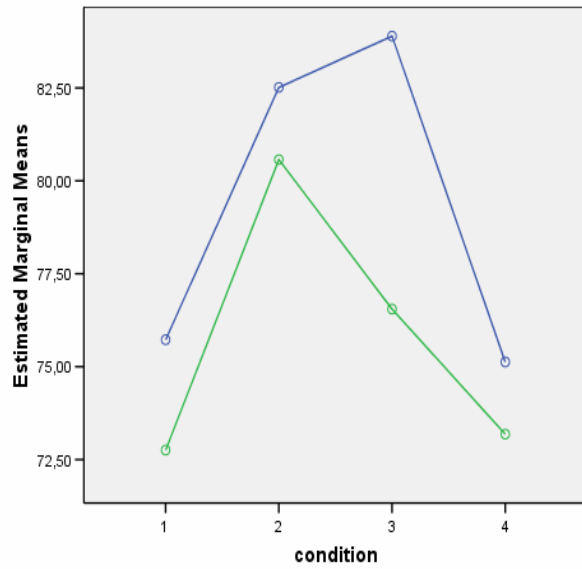
Conclusively, the data suggests that the relationship between Type D personality and Coronary Heart Disease (CHD) may be explained by physiological factors.

References

1. Asendorpf, J. B. (1993). Social Inhibition: A General-Developmental Perspective. In H. C. Traue & J. W. Pennebaker (Eds.), *Emotion Inhibition and Health* (pp. 80-99). Seattle: Hogrefe & Huber Publishers.
2. Denollet, J. (1993). Biobehavioural Research on Coronary Heart Disease: Where is the Person? *Journal of Behavioral Medicine*, *16*(2), 115-141.
3. Denollet, J., & De Potter, B. (1992). Coping subtypes for men with coronary heart disease: relationship to well-being, stress and Type-A behaviour. *Psychological Medicine*, *22*, 667-684.
4. Denollet, J., Vaes, J., & Brutsaert, D. L. (2000). Adverse Effects of Type D Personality and Younger Age on 5-Year Prognosis and Quality of Life. *Circulation*, *102*, 630-635.
5. Habra, M. E., Linden, W., Anderson, J. C., & Weinberg, J. (2003). Type-D Personality is related to cardiovascular and neuroendocrine reactivity to acute stress. *Journal of Psychosomatic Research*, *55*, 235-245.
6. Taylor, S. E. (2006). *Health Psychology*. New York: McGraw-Hill, pp. 152-181.
7. Watson, D., & Pennebaker, J. W. (1989). Health Complaints, Stress, and Distress: Exploring the Central Role of Negative Affectivity. *Psychological Review*, *96*(2), 234-254.
8. Denollet, J. (2005). DS14: standard assessment of negative affectivity, social inhibition and type D personality. *Psychosomatic medicine*, *67*, 89-97.

9. Kaptein, A. A., Beunderman, R., Dekker, J., & Vingerhoets, A. J. J. M. (2006). *Psychologie en geneeskunde: behavioural medicine*. Houten: Bohn Stafleu van Loghum.
10. Smith, O. R. F., Michielsen, H. J., Pelle, A. J., Schitter, A. A., Winter, J. B., & Denollet, J. (2007). Symptoms of fatigue in chronic heart failure patients: Clinical and psychological predictors. *European Journal of Heart Failure, 9*, 922-927.
11. Miller, T. Q., Smith, T. W., Turner, C. W., Giujarro, M. L., & Hallet, A. J. (1996). A Meta-analytic review of research on hostility and physical health. *Psychological Bulletin, 119*, 332-348.
12. Gidron, Y., Davidson, K., & Ilia, R. (2001). Development and Cross-Cultural and Clinical Validation of a Brief Comprehensive Scale for Assessing Hostility in Medical Settings. *Journal of Behavioral Medicine, 24* (1).

Figure 1



— = Type-D
— = non Type-D

1 = baseline period
2 = mental arithmetic task
3 = speaking task
4 = recovery period

TABLE 1. PREDICTORS OF TYPE-D (UNIVARIATE ANALYSES)

| | All subjects (n=88) | Type-D (n=26) | Non Type-D (n=62) | T-value/ χ^2 -value | 95% C.I. | p |
|-------------------------------------|---------------------|---------------|-------------------|--------------------------|-----------------|--------------|
| Demographic characteristics | | | | | | |
| Age, mean (SD) | 21 (4) | 20 (3) | 21 (4) | 0.94 | -1.397 / 2.310 | 0.626 |
| Female gender | 69 (78) | 22 (85) | 47 (76) | | | |
| Partner | 51 (58) | 14 (54) | 37 (60) | | | |
| Educational level: high | 86 (98) | 26 (100) | 60 (97) | | | |
| Smoking | 26 (30) | 5 (19) | 21 (34) | | | |
| Alcohol consumption, mean (SD) | 5 (6) | 4 (5) | 5 (6) | 1.040 | -1.293 / 4.132 | 0.301 |
| Family history | | | | | | |
| Diabetes mellitus type 2 | 2 (2) | 1 (4) | 1 (2) | | | |
| Hypertension | 4 (5) | 1 (4) | 3 (5) | | | |
| Hypercholesterolemia | 7 (8) | 2 (8) | 5 (8) | | | |
| Myocardial infarction | 2 (2) | 0 (0) | 2 (3) | | | |
| Cerebrovascular accident | 2 (2) | 0 (0) | 2 (3) | | | |
| Questionnaires | | | | | | |
| Beck Depression Inventory | | | | | | |
| Somatic, mean (SD) | 4 (4) | 6 (3) | 3 (3) | -4.746 | -5.045 / -2.067 | 0.000 |
| Cognitive, mean (SD) | 2 (3) | 4 (4) | 1 (2) | -3.660 | -5.177 / -1.461 | 0.001 |
| Depressive symptoms | 14 (16) | 10 (38) | 4 (6) | | | |
| Total, mean (SD) | 6 (6) | 10 (7) | 4 (4) | -4.513 | -9.979 / -3.770 | 0.000 |
| New Buss, mean (SD) | 19 (5) | 21 (6) | 17 (5) | -3.331 | -6.460 / -1.631 | 0.001 |
| Fatigue Assessment Scale, mean (SD) | 21 (5) | 25 (5) | 19 (5) | -4.528 | -7.265 / -2.832 | 0.000 |

Values are expressed as n (%) of patients unless otherwise indicated.