NEGATIVE AFFECT, INTROVERSION, AND PHYSIOLOGICAL

MARKERS OF CARDIOVASCULAR DISEASE

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Cardiovascular risk factors have expanded to include personality and other psychological characteristics. Negative affect (NA) has a longstanding history in cardiovascular health, but the path by which NA leads to cardiovascular disease (CVD) is yet to be defined. The following study examined the relationship of high NA and low extroversion (EX) with physiological cardiovascular markers in a sample of non-medical, professional adults. Our results indicated that individuals high in NA and low in EX displayed a significantly lower platelet count and a significantly higher mean platelet volume. Individuals high in NA displayed a significantly lower cholesterol risk ratio, while individuals high in EX displayed significantly higher platelet counts. Personality was not significantly related to blood pressure, high or low density lipoproteins. Understanding the relationships among psychological variables and physiological markers will help clinical researchers design interventions that reduce the likelihood of CVD.

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CHAPTER 1

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death in the United States

(CDC, 2005). CVD includes patients with high blood pressure, heart failure, stroke, and

coronary heart disease (CHD). According to the Heart Disease and Stroke Statistics

(AHA, 2006), 71.3 million (34.2%) adults in the United States are living with CVD, and

in 2003, over 910,000 adults died as a result of CVD. Treatments in cardiac rehabilitation

have demonstrated success when targeting behavioral risk factors, such as diet and

exercise, as well as reduction of psychological distress in cardiac patients (Linden, 2000).

Research has focused on psychological risk factors, such as hostility and depression that

may predict CVD among otherwise healthy individuals (Wielgosz & Nolan, 2000;

Matthews, 2005; Suls & Bunde, 2005; Rozanski, Blumenthal, & Kaplan, 1999; Linden,

2000), but further investigation is necessary to understand the role of psychological

correlates in health outcomes that predispose an individual for risk of CVD.

Stable personality traits are a means of assessing chronic attributes of individuals

and may have great predictive abilities (Denollet, 2000). Global traits refer to patterns of

behavior that are present across situations at various times in an individual's life (Funder,

1991). Traits affect behavior in situations that are chosen as well as situations in which

control or choice is limited (Funder, 1991).

Type D personality consists of two personality traits: Negative affectivity (NA)

and social inhibition (SI; Denollet, 2005). NA is the tendency of an individual to

experience negative emotions across time and situations. NA is a personality trait that has been defined as a pervasive characteristic, which includes a stable tendency to be distressed and have a poor self view (Watson & Clark, 1984). Individuals who score highly on measures of NA tend to dwell on internal thoughts, feelings and behaviors, specifically focusing on negative aspects of themselves, others and the world. NA includes affective categories such as depressed affect, anxiety, and anger (Watson & Clark, 1984). NA is a personality trait that is not synonymous with depression or anxiety, but rather identifies negative emotions evident at subclinical levels (Denollet, 2000). SI refers to the tendency to feel discomfort in social interactions, to exhibit a lack of social poise, and to avoid confrontation. SI can be compared to the personality trait, introversion. Type D has repeatedly been shown to be an independent predictor of hard medical outcomes (i.e. morbidity and mortality) in cardiac patients and provides a possible method of psychological assessment of cardiovascular risks in non-medical samples (Schiffer, Pavan, Pedersen, Gremigni, Sommaruga, & Denollet, 2006).

<div align="center">Negative Affect and Cardiovascular Disease</div>

Many studies have examined the relationship between more severe or clinical levels of NA, such as depression, anxiety and anger, and CVD. Variables addressing social interactions or interpersonal skills that would be comparable to the Type D subscale of SI have also been examined. In order to understand the importance of the Type D construct, it is first important to recognize the contribution that personality and

other psychological constructs have made to the field of Cardiopsychology, as well as why these studies miss key elements in predicting cardiovascular risks.

The Type A behavior pattern (TABP) has received a considerable amount of attention since its introduction to the world of cardiology. TABP involves the clustering of characteristics such as hostility, competition, and impatience (Sarafino, 2006). Early research produced mixed findings regarding the connection between TABP and CVD, yet a strong link was made when structured interviews were used to determine Type A status, rather than surveys (Sarafino, 2006). TABP has been shown to increase risks of CVD two-fold in healthy samples and five-fold in patients (Rozanski et al., 1999), but other reviews have demonstrated a somewhat weaker relationship between TABP and CVD (Kuper, Marmot, & Hemingway, 2002). Examination of the Type A construct led investigators to deduce that the primary component of the behavioral style most associated with negative health outcomes was the hostility component.

Hostility generally involves anger, cynical attitudes and mistrust (Rozanski et al., 1999). Mixed results have been found regarding the relationship between hostility and CVD and its predictive ability separate from the TABP (e.g. Rozanski et al.). Expression of anger has been linked to risks of CVD as well as cardiac events (Vogele, Jarvis, & Cheeseman, 1997; Mendes de Leon, 1992). High trait anger has been linked to an increased risk of CHD, higher blood pressure, and cardiac events and appears to have a dose response relationship (Williams et al., 2000; Bishop & Quah, 1998). Gallo & Matthews (2003) found substantial evidence that hostility puts an individual at risk for CHD and atherosclerotic progression. Contrary to these findings, Habra, Linden,

Anderson and Weinberg (2003) examined the role of hostility to CVD risk factors and found no significant relationships, despite the inclusion of a lab task that involved harassment. Further, they found that hostility was associated with lower blood pressure at baseline. This study points out the inconsistencies that are often found when examining hostility and cardiovascular risk factors.

In 2000, Kubzansky and Kawachi concluded that of studies examining the contribution of anger, anxiety and depression to CHD, anxiety demonstrated the most compelling predictive relationship with CHD in initially healthy individuals (yet noted the plausibility of the predictive power of depression and anger). Gallo & Matthews (2003) also reported a strong link between anxiety symptoms and negative cardiac events, particularly sudden coronary death, in prospective studies of community samples. CVD has also been linked to anxiety disorders ranging from panic disorder to worry (Rozanski et al., 1999). Contrary to these findings, Kuper et al. (2002) found a weaker association between anxiety and prospective CHD, with four studies showing a moderate to strong association between anxiety and CHD, and four a lack of association (Kuper et al.).

Suls and Bunde (2005) found weaker associations for anxiety and CHD prognosis, yet concluded that negative emotions, in particular, depression and anxiety, have a strong connection with CHD in populations who were healthy at baseline. Further, sixty-six percent of studies supported a link between depression and mortality or disease progression; however, many studies did not. Gallo & Matthews (2003) found evidence in support of hopelessness and depression in relation to cardiovascular morbidity and

mortality in community and patient samples. Rozanski et al. (1999) found a consistent link between depression and CVD, with increased risks along a continuum depending on the degree of depression. In healthy populations, Kuper et al. (2002) found that fifteen studies demonstrated a moderate to strong effect between depression and CHD, yet seven did not show an association.

Suls and Bunde (2005) concluded that depression and anxiety serve as significant risk factors for CHD, but their exact role in disease progression is still unknown. They suggest that the presence of NA, regardless of which type of negative emotion is present, is important in predicting CHD risk (Suls & Bunde, 2005). Examining conditions such as major depression and panic disorder help researchers to understand the possible role NA has on cardiovascular health. These studies are informative in that they strongly indicate that clinical levels of depression and anxiety play a prominent role in CVD, but they do not reveal the extent to which sub-clinical levels of NA impact cardiovascular health, if in fact, they do.

Social Interactions and Health

EX/introversion is another personality trait that appears in the health literature. EX includes characteristics such as sociability, friendliness and talkativeness (McCrae & Costa, 1987), whereas introverts are individuals who are socially uninvolved or inactive (Jackson, 1994). Higher levels of EX have been linked to healthier outcomes, but less is known about introversion and health. Miller, Cohen, Rabin, Skoner, and Doyle (1999) found low EX to be related to higher systolic and diastolic blood pressure,

norepinephrine, epinephrine, and lower cortisol, even after controlling for behavioral practices and demographic factors. Goodwin and Friedman (2006) found that individuals with mental illnesses were significantly lower in EX. Further, EX was significantly higher in those that did not have high blood pressure or a history of stroke. Grant and Langan-Fox (2007) found EX to be negatively correlated with physical ill health.

Related to EX/introversion, social relationships appear to be closely related to CVD risks (e.g. Rosanski et al., 1999). Lack of social support may act on the autonomic nervous system causing adverse cardiac events, or indirectly through behaviors such as lowered adherence, smoking and physical inactivity (Haskell, 2003). Studies have examined variables such as social network, instrumental versus emotional support, acculturation and the absence of support (Rozanski et al.). In healthy populations, a small number of social ties and low perceived emotional support have been linked to CVD over time. In patient and healthy samples, there is an inverse graded relationship between the amount of social support and the onset of CVD or cardiac events. Some studies have suggested that social support decreases the risks of Type A behavior, which has also been linked to CVD (Rozanski et al.). Kubzansky and Kawachi (2000) differentiate between repression, suppression and expression of emotional experience, noting that all have been linked to cardiovascular risk, yet some findings are inconsistent (Kubzansky & Kawachi, 2000). In a review of etiological and prognostic studies examining CHD risks, Kuper et al. (2002) found six out of nine studies demonstrated a moderate effect in predicting CHD in healthy population, while 14 out of 21 studies demonstrated a moderate effect of

social support on cardiovascular events in patient samples. Further examination of this construct is warranted.

Type D Personality in Cardiac Samples

Since its onset in the early 1990s, Type D has received a large amount of attention regarding its relation to CVD. In a sample of 2508 cardiac patients, hypertensive patients and individuals from the general population, Type D was associated with a four-fold increase in cardiovascular morbidity after controlling for age and sex (Denollet, 2005). Type D personality has been linked to cancer (Denollet, 1998), hypertension (Denollet, 2000), poor response to cardiac treatment (Denollet et al., 2006) and mortality (Denollet & Sys, 1996). As would be expected, maladaptive psychological constructs, such as depression, lower quality of life and anxiety, have also been associated with Type D personality in cardiac samples as well (Pedersen & Denollet, 2003; Schiffer, Pavan, Pedersen, Gremigni, Sommaruga, & Denollet, 2006).

Type D has also been linked to the incidence of depression post-percutaneous coronary intervention. Aquarius, Denollet, Hamming, and De Vries (2005) found that in both healthy and patient samples, those with Type D personality had lowered physical health, less independence, lower overall quality of life and higher perceived stress than their non-Type D counterparts. Van den Broek, Martens, Nyklicek, van der Voort, and Pedersen (2006) examined the impact of partner status and Type D on anxiety and depressive symptoms at 2 month follow-up in patients and found that anxiety and

depressive symptoms was highest for patients who were Type D and did not have a partner, yet lowest for patients who were not Type D and did have a partner.

Type D has shown long-term predictive ability in cardiac samples as well. Denollet, Pedersen, Vrints, and Conraads (2006) found that Type D predicted various cardiac events at five year follow up, after adjusting for symptoms of stress and medical variables. Further, at five year follow-up, Type D and psychological stress revealed a three-fold increase in the chance of a negative cardiac event, such as death (Denollet et al., 2006). Schiffer, Pedersen, Broers, Widdershoven and Denollet (2008) found that in heart failure patients, Type D was an independent predictor of clinically significant anxiety at one year follow-up, yet depressive symptoms, anxiety sensitivity, demographic and medical variables were not.

Type D in Non-Cardiac Samples

In non-cardiac samples, Type D has been associated with multiple adverse health outcomes as well. Ehrstrom, Kornfeld and Rylander (2007) found that women with recurrent infections were significantly higher in Type D than controls, and tended to worry more, displayed a lack of meaningfulness or perceived balance between work and leisure, and exhibited higher psychological tension, listlessness, and burnout, despite similarities in social support, demands, earlier life events and perceived control. Oginska-Bulik (2006) found that Type Ds saw their work environment as more stressful, had a higher level of depersonalization, lower sense of accomplishment, were more exhausted, had more symptoms of mental health and somatic complaints, and exhibited higher

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anxiety, insomnia and depression than non-Type Ds. In a sample of non-medical city employees, Type D was significantly related to somatic complaints, anxiety, depressive symptoms and problems with sleep (De Fruyt & Denollet, 2002). Type D has been associated with decreased social support, even after controlling for neuroticism (Williams et al., 2008), as well as health altering behaviors. For example, Type Ds were less likely to eat sensibly, spend time outdoors, and they let things get them down than their non Type D counterparts (Williams et al.). There appears to be a clear link between Type D and psychological and physical health in non-medical samples, but further research is necessary to understand the direct role of Type D on specific health outcomes.

Only a few studies have examined Type D and cardiovascular risks in non-medical samples. Habra et al. (2003) examined 173 (50% male; mean age = 20) undergraduate Canadian students and found that the Type D components were predictors of systolic and diastolic blood pressure and heart rate reactivity to acute stress in a laboratory induced cognitive stressor, even after controlling for traditional biological risk factors (Habra et al., 2003). The individual components of Type D (NA and SI) were examined because the global construct of Type D did not appear to have as much predictive ability. SI was linked with heightened systolic and diastolic reactivity in men. Surprisingly, high levels of NA were linked with lesser heart rate reactivity in men. These authors suggest that the synergistic effect of NA and SI may become more pronounced over time and their subjects were too young to display these stable patterns.

Preckel, von Kanel, Kudielka, and Fischer (2005) examined vital exhaustion, effort-reward balances, overcommittment, and Type D personality in a sample of 816

(90% male; mean age = 40) European aircraft employees. Vital exhaustion involves

fatigue, difficulty sleeping, malaise and apathy and has been linked to CVD (Preckel et

al.; Kop, Hamulyak, & Pernot, 1998). Type D was shown to be strongly related to vital

exhaustion (r = 0.57). Multiple regression analyses revealed that depression,

overcommitment, decision authority, effort-reward imbalance, adverse physical

conditions and Type D explained 52% of the variance in vital exhaustion, with Type D

explaining the largest portion (Preckel et al.). The Habra et al. and Preckel et al. studies

contribute to a necessary area of research, but demonstrate a need for further examination

of the relationship between Type D and cardiovascular risks in samples with equal

distribution of men and women and a wider age range.

How is Type D Different?

Denollet and colleagues present compelling evidence that Type D is distinct from

other psychological variables (i.e. TABP, depression, repression) that have historically

been linked to CVD (Pedersen & Denollet, 2003). Studies examining the Type D

construct in cardiac patients have consistently found that it is the combination of these

traits that is deleterious to cardiovascular health, rather than either alone (Schiffer, Pavan,

Pedersen, Gremigni, Sommaruga, & Denollet, 2006). The combination of NA with SI is

what sets Type D apart from studies that have examined the role of NA and SI as separate

constructs in cardiovascular health (Pedersen & Denollet, 2003). Denollet has shown that

individuals high in NA, but not SI, as well as individuals high in SI, but not NA, are not

at increased risk for cardiac events (Denollet, Sys, Stroobant, Rombouts, Gillebert, &

Brutsaert, 1996). These combined characteristics tend to inhibit the expression of emotions or behaviors in social interactions and that is what puts an individual at increased risk of experiencing a cardiac event.

Rationale for the Present Study

The Type D construct appears to be a promising diagnostic tool in the field of Cardiopsychology. Further research is necessary to determine the long-term effects of Type D on CVD in healthy samples. Normative studies have been conducted using the Type D scale (DS14; Denollet, 2005) in Hungary (Kopp, Skrabski, Csoboth, Rethelyi, & Stauder, 2003), Germany (Grande, Jordan, Kummel, Struwe, Schubmann, Schulze, Unterberg, von Kanel, Kudielka, Fischer, & Herrman-Lingen, 2004), Denmark (Denollet, 2005) Italy (Gremigni & Sommaruga, 2005), and China (Xiao-Nan et al., 2006), but not yet on a U.S. sample (Schiffer, Pavan, Pedersen, Gremigni, Sommaruga, & Denollet, 2006). In a validation study of the Type D construct, De Fruyt and Denollet (2002) found that neuroticism ($r = 0.68$ with NA) and EX ($r = -0.52$ with SI), measured by the NEO-FFI, explained about half of the variance in the Type D construct, and recommend analyzing archival databases using neuroticism and EX as similar, but not identical constructs.

The aim of this study is to examine constructs that follow the pattern of Type D and assess their relation to physiological markers of CVD risk. We have chosen to use psychometrically sound measures that conceptually measure NA and introversion, thus mirroring the Type D construct. This will allow us to determine whether the theoretical

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foundation suggested by Type D generalizes to similar constructs. We hypothesized that individuals with higher levels of NA paired with lower levels of EX will present physiological outcomes associated with CVD risks. If cardiovascular risk factors can be identified in healthy subjects, this may allow early detection and use of preventative measures with a greater effectiveness rather than intervention after the disease process is well established.

METHOD

Participants

One hundred eighteen employees of a company located in the southwest United States were recruited from a continuing education class to participate in a study about health. Participants were middle and upper level management professionals self-selected by application, recommendation of their supervisor, and approval of an oversight committee. These individuals were offered feedback at the end of the study concerning research findings. The sample included 80 males and 38 females ranging in age from 28 years to 63 years (M = 42.0, SD = 6.8). Ethnic backgrounds included 88.1% Caucasian, 5.1% African-American, 2.5% Hispanic, 3.4% Asian-American, and 0.8% Native-American. The majority of the sample had received a college degree (83.9%) with 42.4% having received post-graduate degrees. Eighty-two percent of the sample reported being married. The study was approved by the University of North Texas institutional review board.

Measurement

Extroversion

The Jackson Personality Inventory – Revised (JPI-R; Jackson, 1994) contains 300 true-false items. The JPI-R is a well established and highly regarded measure of personality (Jackson, 1994). This paper-and-pencil questionnaire yields information about 15 distinct, bipolar personality dimensions which combine to make up five higher-

order factors. Internal consistency for the extroversion subscale ranges from 0.72-0.88 across samples and validity coefficients range from .30 to .80 (Jackson, 1994). The extroverted cluster of the JPI-R consists of the sociability, social confidence and energy level subscales. High scores on this scale suggest that the individual is interpersonally outgoing, sociable and extroverted. Low scores on this scale suggest that the individual is socially uninvolved, inactive, and introverted.

Negative Affect

Two scales were used to measure NA in our sample. Items were selected from Part II of the Clinical Analysis Questionnaire (CAQ; Cattell & Krug, 1980). The CAQ is a paper and pencil questionnaire that contains 144 questions that allow respondents to choose among three response types for each question, yes (often), sometimes, or no (never). It is used to assess both deviant behavior and normal coping skills. Part II has been shown to have acceptable internal consistency (r = .75) and test-retest reliability ranging from .67 to .90. The CAQ is unique in that it includes seven subscales that measure distinct aspects of depression. The NA subscale of the DS14 is described as a measure of dysthymia and tension (Denollet, 2005). In order to choose the depression subscale that most appropriately matched the NA subscale of the DS14 (Denollet, 2005), a panel of experts was chosen to select the best measure (see Appendix A). Scale 5 (D5; Low Energy Depression) was selected and consisted of 12 items. High scores on this scale indicate feelings of sadness and gloom, with little zest for life. Internal consistency for D5 was good at 0.84. An experimental scale was also created to measure NA. Seven

CAQ items (see Appendix B) were chosen to match each of the items of the NA subscale of the DS14 (Denollet, 2005). Internal consistency for the scale was adequate at 0.75. These items were labeled as D8. Low scores on D8 indicated higher NA.

Physiological Markers

Physiological measures included a lipid profile, a complete blood count (CBC), and systolic blood pressure (SBP) and diastolic blood pressure (DBP).

The lipid profile included measures of low density and very low density lipoproteins (LDL/VLDL), high density lipoproteins (HDL), and a risk ratio of total cholesterol to HDL. Cholesterol is found among lipids in the blood and in all cells of the body (AHA, 2008). LDL is the primary cholesterol carrier in the blood and can slow blood flow through arteries that connect to the brain and heart (AHA, 2008). One-hundred sixty mg/dL or higher is considered a high level of LDL, whereas levels at or below 70mg/dL are ideal (AHA, 2008). HDL is responsible for carrying approximately one-third to one-fourth of blood cholesterol (AHA, 2008). High levels of HDL appear to protect against cardiac events, whereas low levels (40 mg/dL or below in men and 50 mg/dL or below in women) are viewed as risk factors (AHA, 2008). The risk ratio is a calculation that takes into consideration the protective elements of HDL given the total cholesterol.

Blood pressure is defined as the resultant pressure the blood produces as it flows against artery walls (AHA, 2008). SBP is a measure of the pressure caused when the heart contracts, while DBP is a measure of the pressure that results when the heart is

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relaxed (AHA, 2008). A SBP between 120-139 mmHg or a DBP between 80-89 mmHg is considered pre-hypertensive, with SBP levels of 140 mmHg or higher or DBP levels of 90 mmHg or higher indicating hypertension (AHA, 2008).

The CBC included total platelet count and mean platelet volume (MPV). Platelets are blood cells that are involved in cellular mechanisms and serve many important functions in cardiovascular health (Guyton & Hall, 2000). A normal platelet count ranges between 130,000 to 400,000 platelets per microliter (Guyton & Hall, 2000). Levels below 50,000 indicate thrombocytopenia, while levels above normal may indicate thrombocytosis (Guyton & Hall, 2000). An important function of platelets is to initiate clotting in order to repair tiny ruptures in blood vessels that occur thousands of times a day. MPV is a measure of the average size of platelets in the blood and is a marker of high platelet reactivity (Greisenegger, Endler, Hsieh, Tentschert, Mannhalter & Lalouschek, 2004). A low platelet count has been associated with CVD, while a high MPV is associated with CVD (Bath & Butterworth, 1996 &1998).

Procedure

Participants were contacted during classes at the beginning of a week-long continuing education program and were invited to participate in a study concerning personal beliefs, stress, emotional management, and health factors. The continuing education course was a leadership class that focused on transformational learning in organizations. Data collection, data analysis, and publication of findings was described to participants. Information and assurances were given about the confidentiality of

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individual results. Volunteers met in groups of 15 to 30 at scheduled times where they received an explanation as to the general purpose of the study, informed consent was obtained, and volunteers were told that they could withdraw from participation in the study at any time. Volunteers then completed a packet of questionnaires and scheduled an appointment to return two or three days later for a blood draw by a licensed medical technician. Participants were instructed to fast and abstain from using alcohol or drugs after 9:00 p.m. on the evening before the blood draw. Data collection occurred on the same campus and building but in areas separate from their continuing education courses.

Ninety-six of the 118 elected to have blood drawn for the biological measures. Prior to the blood draw, each participant was interviewed by a physician to review current health status. While waiting for the blood draw, participants completed demographic information and a medical interview with a physician who screened participants with respect to medication, and acute or current illness.

Data Analysis

All analyses were performed using SPSS 14 (Chicago, IL, USA). Independent samples t-tests were used to examine gender differences among EX, D5 and D8 scores. Gender differences were present among D5 and D8 scores, but not EX. A median split for each gender was used to categorize EX and D5 and D8 scores into high and low. Individuals categorized as low in EX and high in NA were labeled as D5/LEX and D8/LEX.

Assumptions necessary for the statistical procedures used were examined. The continuous independent variables (D5, D8, and EX) were not normally distributed, but were negatively skewed. A reflect and square root transformation was used to transform EX, which resulted in a normal distribution (Tabachnik & Fidell, 2007). Both a square root and logarithm transformation (Tabachnik & Fidell, 2007) did not help the D5 distribution to become more normal; therefore, original data for the D5, D8, and EX scales were used in the analyses. Because assumptions of normality were not met, nonparametric analyses were used for all analyses.

CHAPTER 3

RESULTS

Univariate and Bivariate Analyses

Our sample consisted of 103 completed questionnaires. Due to missing data or inability to participate in the blood draw, 101 lipid profiles and 77 blood pressures were completed. We performed univariate descriptive analyses on variables of interest. Table I presents participant characteristics. Table II presents means, standard deviations, and ranges.

Univariate analyses were conducted to examine differences among demographic variables. Significant differences were found between European and non-European Americans on systolic ($t = 2.60$, $p < .05$) and diastolic ($t = 2.03$, $p < .05$) blood pressures, with European-Americans displaying significantly lower blood pressures than non-European Americans. Males and females differed significantly on several dependent variables, with males displaying higher levels of LDL ($t = -4.60$, $p < .001$), risk ratio ($t = -5.03$, $p < .001$), systolic ($t = 4.23$, $p < .001$) and diastolic ($t = 2.74$, $p < .01$) blood pressures. Individuals who received a college degree or higher, had significantly higher levels of EX ($t = -3.92$, $p < .001$) and lower levels of D8 ($t = -4.15$, $p < .001$). Males and females also differed significantly on levels of D5 ($t = -2.70$, $p < .01$) and D8 ($t = 2.81$, $p < .01$), with females displaying higher levels than males. Males and females did not significantly differ in educational levels, ethnicity, or relationship status; however, males were significantly older than females in our sample ($t = 2.38$, $p < .05$).

Correlations

Because our variables of interest were not normally distributed, we used Spearman's Rank Order Correlation to determine the significance of relationships among variables (see Table III). Significant correlations were identified between the D5 measure and risk ratio (from $r = -0.22$, $p < .05$), with higher levels of D5 being negatively correlated with risk ratio. The D8 measure was not significantly correlated with any of the physiological variables. EX was significantly positively related to platelet count ($r = .23$, $p < .05$). Several of the physiological measures correlated significantly with one another (i.e. $r = -0.38$, $p < .01$ between risk ratio and diastolic blood pressure and $r = 0.28$, $p < .01$ between HDL and platelet count), suggesting valid measurement of these constructs.

Variables of Interest

A Mann-Whitney U test was used to examine group differences between individuals high in NA and low in EX on all physiological measures of interest. D5 of the CAQ was used to categorize individuals as high on NA and low EX using a median split after controlling for gender differences. Group differences are outlined in Table IV. Individuals categorized as D5/LEX displayed significantly lower platelet counts ($Z = -2.46$, $p < .05$) and a significantly higher MPV ($Z = -2.07$, $p < .05$) than individuals who were either low on D5 or high in EX. This suggests that less optimal platelet characteristics might be a result of inhibiting negative emotions. No significant differences were found among D5/LEX on lipid or blood pressure variables.

Item analysis was used to categorize individuals high in D8 and low EX using a median split after controlling for gender differences. Table V outlines these findings. No significant differences were found among individuals categorized as D8/LEX on platelet, lipid or blood pressure variables. These findings suggest that individuals high on D8 and low in EX do not differ from others on physiological markers of CVD.

Group differences were also examined using a Chi-square test for independence between D5/LEX, D8/LEX and categorized blood pressure variables. Blood pressure variables were categorized based on recommendations of the American Heart Association (AHA, 2008). Systolic blood pressure was categorized as either equal to or greater than 120 mmHg, or less than 120mmHg. Diastolic blood pressure was categorized as either equal to or greater than 80 mmHg, or less than 80mmHg. No significant differences were found between groups using either D5/LEX or D8/LEX suggesting that these personality characteristics do not relate to blood pressure levels in our sample.

CHAPTER 4

DISCUSSION

The results of this study suggest that a relationship exists between the personality variables NA and EX and physiological measures of CVD; however, further research is necessary. Using recommendations from previous literature (De Fruyt & Denollet, 2002), we examined group differences between individuals high in NA and low in EX and found that these individuals do appear to have lower platelet counts and mean platelet volumes compared to individuals that do not have these personality characteristics. Differences in platelet characteristics between CVD patients and healthy controls have been well established in the literature (i.e. Nijm, Wikby, Tompa, Olsson, & Jonasson, 2005).

Platelet aggregation is a suggested pathway by which cardiac events occur in patients with comorbid depression and CVD (O'Connor, Gurbel, & Serebruany, 2000). Laghriss-Thode, Wagner, Pollock (1997) examined platelet characteristics in a group of healthy controls, CVD-depressed patients, and CVD-non-depressed patients and found that CVD-depressed patients had the highest level of platelet factor 4, a protein that appears to prevent anti-coagulant effects, whereas CVD-non-depressed and controls did not significantly differ on this factor. Although we did not include platelet factor 4 in our study, we did find that platelet count was negatively associated with high NA and low EX, and positively associated with HDL. Musselman et al. (1996) examined medically healthy depressed and non-depressed patients and found that depressed individuals demonstrated greater platelet binding at baseline as well as after a mild cardiovascular

challenge compared to controls. These authors suggest that heightened platelet aggregation may explain the link between depression and increased risks of CVD, morbidity and mortality (Musselman et al., 1996). Our findings suggest that in a non-clinical sample, inhibition of negative emotions may impact cardiovascular health through platelet characteristics; however, longitudinal studies examining platelet count as well as other platelet characteristics are necessary to draw definitive conclusions.

We did not find a significant relationship among lipid variables and blood pressure measures when using scale selection or item analysis to match our NA variables with Denollet's (2005) work. This was unexpected given the extensive literature backing the relationship among these personality variables and CVD (i.e. Pedersen & Denollet, 2003). On the other hand, several studies have found that depressed individuals exhibit lower lipid levels than non-depressed individuals (i.e. Steegmans, Hoes, Bak, Van der Does, & Grobbee, 2000). Additional research similar to our study needs to be conducted to examine the relationship between NA and lipid health, rather than focusing on depressed, clinical samples because it is important to understand if NA has an effect on cholesterol health or if these relationships are only seen at the extreme end in clinically depressed individuals.

Given our sample demographics and the variables examined, we do not have sufficient literature available to compare our results with other studies. No other studies have examined the relationship between high NA paired with low EX in a sample of non-medical, middle-aged adults. It is possible that our measures were not sensitive enough to detect the specific form of NA that contributes to CVD. Our sample had a positively

skewed distribution on both NA measures and EX. It is also possible that our sample did

not display enough variation in NA and EX to detect significant differences that might be

evident in a larger and more diverse sample.

Individuals who were elevated on D5, as a continuous variable, demonstrated a

significantly lower risk ratio, which suggests that this expression of negative emotionality

was associated with healthier cardiovascular factors via cholesterol. This is consistent

with several studies that have shown that individuals with various manifestations of NA

have statistically lower cholesterol levels than healthy controls (Suarez, 1999; Maes et

al., 1994; Fava, Abraham, Pava, Shuster, & Rosenbaum, 1996). Suarez (1999) found trait

depression in healthy young adult women to be inversely related to total cholesterol and

the total cholesterol/HDL ratio, yet not significantly related to LDL or HDL alone.

Contrary to these findings, Ledochowski, Murr, Sperner-Unterweger, Neurauter

and Fuchs (2003) found depression scores to be positively associated with total

cholesterol levels in a sample of male and female healthy outpatients ages 15-85 in

Austria. This suggests that the relationship between NA and cholesterol is not yet well

understood. It is possible that different manifestations of NA have different effects on

lipid function. In our findings, despite a significant relationship between D5 and D8, D8

was not strongly associated with any physiological variables of interest. D8 items were

chosen based on content match to the NA subscale of the DS-14 (Denollet, 2005), while

D5 is a measure of low energy depression. It is possible that because D5 was a more

extensive measure of a sub-type of depression, it was able to detect subtle differences in

cholesterol, whereas the seven items of the D8 scale were not. It is also possible that D5 has a specific relationship with lipid functioning while D8 does not.

None of the personality variables were significantly related to blood pressure measures in our sample. Hildrum, Mykletun, Stordal, Bjelland, Dahl, and Homen (2007) examined the relationship among low blood pressure with depression in a sample of over 60,000 men and women. They found that individuals in the lowest blood pressure percentile had a significantly higher likelihood of depression than the reference group with normal levels of blood pressure. Related to extroversion, giving social support has been associated with lower systolic and diastolic blood pressure in a sample of male and female undergraduate students (Piferi & Lawler, 2006). It is possible that the heightened level of extroversion in individuals in our sample serves as a buffer against the adverse effects that NA may have on blood pressure.

Individuals who reported higher levels of EX, when examined as a continuous variable, also displayed a higher platelet count. EX has been shown in previous literature to be associated with more favorable health outcomes (Goodwin & Friedman, 2006; Langan-Fox, 2007). Very little research has been conducted examining the role of EX with cardiovascular risk factors and no studies have examined the relationship between EX and platelet characteristics. Future studies need to examine the relationship between EX and platelet factors that may contribute to CVD.

The present study contributes to the cardiovascular literature. Few studies have examined the relationship among personality variables linked to CVD and physiological markers of cardiovascular risks in non-patient samples (Habra et al., 2003). This study

not only examines the relationships among physiological markers of CVD in a non-medical population, but it examines the relationship between personality measures that have been strongly related to CVD and cardiovascular risks. Blood pressure and lipid variables were not significantly related to personality in most of our findings. It is possible that cholesterol and blood pressure are not the best measures to detect risk in individuals with heightened levels of NA; rather, platelet function might be a better measure. Replication of these findings is necessary to conclude that personality does or does not put an individual at risk for CVD. It is important for other researchers with similar databases to examine these variables in similar samples.

Despite multiple strengths, the present study had several limitations. Our sample was collected from an educational workshop for professionals, which resulted in a sample of highly educated individuals. Cardiovascular risks appear to have an inverse relationship with education level (Pleis, 2007). Although risks are less prevalent in educated individuals, there is still a need to examine psychological risk factors because stress and psychological factors may contribute to more adverse health outcomes in this population, rather than would lack of resources for medical care, poor nutrition, and physical inactivity.

Interventions designed to target stress reduction and relaxation have demonstrated success in various populations (Rozanski et al., 2005). Lett et al. (2007) examined the role of social support and depression in post-MI patients and found that higher perceived social support was associated with more favorable outcomes in individuals without elevated depression; however, in depressed individuals, social support did not appear to

matter. Karlsson et al. (2007) examined the role of a cardiac rehabilitation program designed to target stress management and behavioral changes in cardiac patients. They found that Type D patients demonstrated significant reductions in depression and anxiety, and improvements in quality of life. Future studies need to examine the effects of these interventions on hard outcomes, such as mortality and morbidity.

Eighty-seven percent of our sample self-identified as European-American. Although European-Americans report a higher incidence of any type of heart disease diagnosis, African Americans have significantly higher likelihood of being diagnosed with hypertension, and incidence of stroke than European Americans, Asian-Americans, or Latino-Americans (Pleis, 2007). We also had a higher number of men than women in our sample, which limits generalizability. Incidence of heart disease, hypertension and stroke is similar for men and women and it is important to include both genders in cardiovascular research (Pleis, 2007). Future studies should include gender-balanced samples that are more ethnically diverse and whose ages extend across the lifespan.

Another limitation to our study was our use of measures. The CAQ is a beneficial method of personality assessment because it provides a measure of seven distinct aspects of depression; however, we could not find a perfect content match of the measure that we wished to examine. On the other hand, the construct of NA should be captured with any depression subscale used on the CAQ, particularly when specific items were chosen to match the scale of interest. Although future studies will need to examine the relationship of high NA and low EX in non-cardiac samples using the DS-14, studies also need to

determine whether the substantial links between Type D and CVD are limited to studies using the DS-14 versus other reliable and valid measures of NA and EX.

Our personality variables did not display a normal distribution within our sample. Although this limits generalizability, we controlled for this limitation by using non-parametric analyses. Non-parametric methods may decrease power, reducing the number of significant relationships that might be present (Pallant, 2005). Therefore, it is possible that with a larger sample size, the distribution would become more normal and we might see stronger relationships among the personality and physiological variables. Despite this limitation, we were still able to find significant relationships between personality and platelet count and personality and risk ratio.

Although our study has obvious limitations, it provides a step in the literature toward a much needed area of study. Substantial evidence exists between personality and cardiac events and risk factors in patient samples (Pedersen & Denollet, 2003), but little is known about individuals before the onset of disease, yet this is the time when early detection of risk and preventative intervention can be most effective. Our study suggests that a relationship does exist between personality and physiological markers of CVD; however, further research is needed to determine the exact role of personality in cardiovascular health. Despite its limitations, the present study provides a step forward in a much needed area of research.

Table 1

*Demographic Summary (*N = *103)*

Variable	Mean	(*SD*)	Range
Age	41.96	6.94	28 - 63

	N	Percentage
Ethnicity:		
European American	90	87.4%
African American	5	4.9%
Asian	4	3.9%
Native American	1	1.0%
Education:		
High School	2	1.9%
Some College	14	13.6%
College Graduate	45	43.7%
Post Graduate	42	40.8%
Relationship Status:		
Single	10	9.7%
Married	86	83.5%
Widowed	2	1.9%
Divorced	5	4.9%

Table 2

Mean, Standard Deviation, and Range Statistics for Variables of Interest

Variables	Mean	(*SD*)	Possible Range
D5	1.67	(3.16)	0 - 24
D8	18.91	(2.41)	7 - 21
EX	36.24	(8.90)	0 - 60
	N	Percentage	
D5/LEX	33	32%	
NON1	70	68%	
D8/LEX	25	24%	
NON2	78	76%	
Physiological Measures			*Sample Range*
Platelets	262.93	(59.14)	94 - 419
MPV	8.60	(0.94)	6.8 - 12
HDL	46.36	(12.94)	21 - 84
LDL	153.43	(35.42)	73 - 273
Risk Ratio	4.65	(1.55)	2.0 - 10.0
Systolic BP	119.69	(15.02)	90 - 160
Diastolic BP	81.47	(10.88)	58 - 110

Note. D5 = Scale 5 of the CAQ, D8 = Negative Affect from item selection, EX = Extroversion, D5/LEX = High Negative Affect from Scale 5 and Low Extroversion, D8/LEX = High Negative Affect from item selection and Low Extroversion, MPV = Mean Platelet Volume, HDL = High Density Lipoproteins, LDL = Low Density Lipoproteins/Very Low Density Lipoproteins, Risk Ratio = Total Cholesterol ÷ HDL, Systolic BP = Systolic Blood Pressure, Diastolic BP = Diastolic Blood Pressure.

Table 3

Intercorrelations among Gender, Age, Personality and Physiological Measures Using Spearman's Rank Order Correlation

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gender	-													
2. Age	-0.24*	-												
3. D5	0.31**	-0.03	-											
4. D8	-0.27**	-0.07	-0.47**	-										
5. EX	0.06	-0.16	-0.02	0.18	-									
6. D5/LEX	0.09	-0.03	0.47**	-0.26**	-0.55**	-								
7. D8/LEX	0.18	0.08	0.20*	-0.61**	-0.53**	0.47**	-							
8. Platelet	0.40**	-0.23*	0.07	-0.11	0.23*	-0.25*	-0.07	-						
9. MPV	-0.04	0.18	0.16	-0.00	-0.21*	0.15	0.15	-0.56**	-					
10. HDL	0.42**	-0.15	0.14	-0.11	0.01	0.02	0.06	0.28**	-0.05	-				
11. LDL	-0.30**	0.32**	-0.19	0.05	0.01	-0.13	-0.11	-0.02	-0.01	-0.34**	-			
12. RiskR	-0.44**	0.26**	-0.22*	0.12	0.04	-0.11	-0.13	-0.18	0.00	-0.84**	0.78**	-		
13. SysBP	-0.38**	0.30**	-0.08	-0.01	-0.04	-0.03	0.04	-0.04	-0.05	-0.27**	0.20	0.28*	-	
14. DiaBP	-0.23*	0.26*	-0.20	0.11	-0.03	-0.04	0.04	-0.03	-0.06	-0.40**	0.20	0.38**	0.80**	-

Note. Gender = Male (1) and Female (2), D5 = Scale 5 of the CAQ, D8 = Negative Affect from item selection, EX = Extroversion, D5/LEX = High Negative Affect from Scale 5 and Low Extroversion, D8/LEX = High Negative Affect from item selection and Low Extroversion, MPV = Mean platelet volume, HDL = High Density Lipoproteins, LDL/VLDL = Low Density Lipoproteins/Very Low Density Lipoproteins, RiskR = Total Cholesterol ÷ HDL, SysBP = Systolic Blood Pressure, DiaBP = Diastolic Blood Pressure.
*$p < .05$. **$p < .01$.

Table 4

Group Differences between High D5/LowEX on Physiological Measures using Non-Parametric Analyses

	N		Mean Rank			
Measure	NON1	D5/LEX	NON1	D5/LEX	Z	Significance
1. Plate	65	32	53.94	38.97	-2.46	0.01*
2. MPV	65	32	44.86	57.54	-2.07	0.04*
2. HDL	65	32	48.55	49.92	-0.23	0.82
3. LDL	65	32	51.64	44.53	-1.32	0.19
4. RiskR	65	32	51.20	44.53	-1.10	0.27
5. SysBP	52	22	37.96	36.41	-0.29	0.78
6. DiaBP	52	22	38.00	36.32	-0.31	0.76

Note. NON1 = Participants who were not High in Negative Affect and Low in Extroversion, D5/LEX = High Negative Affect from Scale 5 and Low Extroversion, Plate = Platelet Count, MPV = Mean Platelet Volume, HDL = High Density Lipoproteins, LDL/VLDL = Low Density Lipoproteins/Very Low Density Lipoproteins, RiskR = Total Cholesterol ÷ HDL, SysBP = Systolic Blood Pressure, DiaBP = Diastolic Blood Pressure. *$p < .05$.

Table 5

Group Differences between High D8/LowEX on Physiological Measures using Non-

Parametric Analyses

	N		Mean Rank			
Measure	NON2	D8/LEX	NON2	D8/LEX	Z	Significance
1. Plate	76	25	52.1	47.7	-0.65	0.52
2. MPV	76	25	48.4	58.9	-1.55	0.12
3. HDL	76	25	50.0	54.1	-0.62	0.54
4. LDL	76	25	52.8	45.6	-1.06	0.29
5. RiskR	76	25	53.2	44.4	-1.31	0.19
6. SysBP	59	18	38.5	40.6	-0.35	0.73
7. DiaBP	59	18	38.5	40.5	-0.33	0.75

Note. NON2 = Participants who were not High in Negative Affect and Low in Extroversion, D8/LEX = High Negative Affect and Low Extroversion, Plate = Platelet, MPV = Mean Platelet Volume, HDL = High Density Lipoproteins, LDL/VLDL = Low Density Lipoproteins/Very Low Density Lipoproteins, RiskR = Total Cholesterol ÷ HDL, SysBP = Systolic Blood Pressure, DiaBP = Diastolic Blood Pressure. *p < .05.

Table 6

Group Differences among Categorical Blood Pressures using Chi-Square Analyses

	N (%)			
Measure	NON1	D5/LEX	Value	Significance
SysBP > 120	44 (42.7%)	18 (17.5%)		
SysBP ≤120	26 (25.2%)	15 (14.6%)	0.35	0.52
DiaBP > 80	44 (42.7%)	23 (22.3%)		
DiaBP ≤ 80	26 (25.2%)	10 (9.7%)	0.21	0.66
	NON2	D8/LEX		
SysBP > 120	32 (29.1%)	52 (47.3%)		
SysBP ≤120	11 (10.0%)	15 (13.6%)	0.02	0.88
DiaBP > 80	29 (26.4%)	55 (50.0%)		
DiaBP ≤ 80	9 (8.2%)	17 (15.5%)	0.00	1.00

Note. NON = Participants who were not High in Negative Affect and Low in Extroversion, D5/LEX = High Negative Affect using Scale 5 and Low Extroversion, SysBP > 120 = Systolic Blood Pressure above 120, SysBP ≤120 = Systolic Blood Pressure less than or equal to 120, DiaBP > 80 = Diastolic Blood Pressure greater than 80, DiaBP ≤ 80 = Diastolic Blood Pressure less than or equal to 80, D8/LEX = High Negative Affect using item selection and Low Extroversion. *p < .05.

APPENDIX A

EXPERT PANEL REVIEW: TOTAL MEASURE

An expert panel made up of 18 graduate and undergraduate psychology students were asked to select the scale on the CAQ that appeared to be the best match to the NA subscale of the DS14 (Denollet, 2005). The NA subscale was presented at the top of the handout and the seven depression subscales of the CAQ were presented below. The order of presentation of the CAQ scales was altered to control for bias. Panel members were contacted by email and instructed as follows: "I would like you to look at the first measure and then choose the scale that you think best matches it. None of the measures will match perfectly, but I am looking for the best match." Eighty-three percent (15/18) of the students selected Scale 5 (Low Energy Depression), while 6% (1/18) selected Scale 2, 6% selected Scale 6, and 6% selected Scale 7. Scale 5 was chosen as the best match based on the percentage of respondents.

APPENDIX B

EXPERT PANEL REVIEW: INDIVIDUAL ITEMS

Twelve members of the panel were asked to select the items of the seven depression scales of the CAQ that best matched the seven items of the NA subscale of the DS14 (Denollet, 2005). Each member was asked to assign a number corresponding to each of the depression items of the CAQ that best matched the seven items of the NA subscale. A "does not fit" option was available for CAQ items that did not match any of the NA items. The following instructions were used: "The goal of this procedure is to come up with the best selection of items that match the theoretical/conceptual nature of the "gold standard" measure. As many of you noticed, none of the organized scales match perfectly, so I plan to create my own scale, based on your selections. Please look at the "gold standard" measure. Notice, there are 7 items and 1 "does not fit" option. Please write/type the item number that best matches each of the "depression" items below. Also notice that some of the items are reverse scored, so rate it based on how it would be scored (in the depressed direction). Let me know if you have any questions."

Seven CAQ items were chosen to match each of the items of the NA subscale by examining the percentage of item match. If more than one item received the same percentage selection, the item that had the least number of "does not fit" selections was chosen. Although some of the items had a low match percentage, all of the selected CAQ items had a low percentage of "does not fit" options, suggesting that they do fit one of the items of the NA subscale despite lack of agreement on which item was the best match.

Table B1

Statistics for Item Selection of D8 Scale using CAQ Items to Match the DS14 NA

Subscale

DS14	% Selected	Ratio	% DNF	Ratio	CAQ
1	50%	6/12	8%	1/12	112
2	67%	8/12	0%	0/12	2
3	55%	6/11	0%	0/11	57
4	75%	9/12	0%	0/12	91
5	33%	4/12	8%	1/12	55
6	100%	12/12	0%	0/12	133
7	58%	7/12	0%	0/12	28

Note. DS14 = Item number from the Type D Scale, % Selected = percent of expert panel members who selected the CAQ item, %DNF = the percent of panel members who selected "does not fit" for the CAQ item, CAQ Item = the CAQ depression item that was chose as the best match for each DS14 item.

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