Facets of Openness Predict Mortality in Patients With Cardiac Disease

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Objective: To examine the NEO Personality Inventory (NEO PI) Openness to Experience (O) domain and its facets as predictors of cardiac deaths and all-cause mortality. **Methods:** The NEO PI was administered to a sample of 977 coronary catheterization patients with significant coronary artery disease. Over an average 15-year follow-up period, 266 cardiac deaths and 463 total deaths occurred. The relationships of O scores to mortality were examined with Cox proportional hazard models. Each model included age, left ventricular ejection fraction, severity of congestive heart failure, and number of diseased vessels as covariates. **Results:** The O domain score was not associated with all-cause mortality and only approached significance for decreased cardiac deaths ($p = .055$). However, a higher score for Openness to Feelings was associated with a decreased risk of cardiac death ($p < .01$) and all-cause mortality ($p < .01$). High Openness to Actions was also associated with decreased cardiac mortality ($p < .01$) and all-cause mortality ($p = .03$) risk. Higher Openness to Aesthetics and Ideas were only associated with decreased cardiac death risk (both p values $<.04$). In contrast, Openness to Fantasy and Values were not associated with longevity. Previous evidence suggested that educational achievement may account for the effects of Openness to Experience on mortality; however, controlling for educational achievement did not change the results. **Conclusion:** These findings suggest that greater emotional awareness and high curiosity, as indicated by the NEO PI Feelings and Actions facets, are associated with increased patient longevity independently of other risk factors and educational achievement. **Key words:** mortality, coronary artery disease, personality.

CAD = coronary artery disease; **FFM** = Five-Factor Model; **O** = Openness to Experience domain.

INTRODUCTION

Personality plays an important role in the survival of patients with established coronary artery disease (CAD) (1). The Five-Factor Model (FFM) of personality provides a useful framework for the study of personality and health. The FFM is a hierarchical model, positing that human personality can be captured by five broad domains—Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness—each of which is made up of more specific traits or facets (2). Of the big five personality domains, Openness to Experience (O) has received the least attention in health psychology research (3).

People who score high on O are described as being more willing to entertain novel ideas and experiences and have unconventional values. These individuals generally experience positive and negative emotions more intensely. In contrast, low scorers behave more conservatively and retain more conventional values and outlooks and experience a narrower range of emotional responses than high scorers (2). Three previous studies have found that the O domain did not predict longevity in healthy elders and patients with chronic renal insufficiency (4–6). However, these studies did not examine the facets of the O domain.

One important factor to consider in any study examining the effect of O on health outcome is that O is moderately associated with cognitive ability and academic performance (7–9). As such, it is possible that O is a proxy measure for educational attainment, which is strongly related to health outcomes and mortality (10–12). Thus, studies investigating the relationship between O and health should control for this potential confound.

The primary goal of the present study was to examine if O or any of its six facets predicted cardiac or all-cause mortality in a large sample of patients with CAD, who were followed for an average of 15 years. In addition to the domain and facet predictors, we included a measure of educational attainment to determine if that accounted for any significant relationships of O or its facets to longevity.

METHODS

Participants

Between October 1985 and April 1989, 1507 patients admitted to Duke University Medical Center underwent coronary angiography for suspected CAD. These patients did not have unstable anginal symptoms, were able to read at the sixth grade level, and were administered a battery of psychological tests including the NEO Personality Inventory (NEO PI) (13). From this sample, 977 patients who were found to have significant CAD—defined as >75% diameter narrowing of at least one coronary artery—were enrolled in a follow-up study for mortality. This prospective study was approved by the Duke University Medical Center Institutional Review Board. Of the 977 patients, three patients were excluded from analyses due to missing follow-up data. This resulted in a sample consisting of 974 (94.5% Caucasian) patients. Furthermore, due to the missing NEO PI data on various scales, numbers for Cox models predicting cardiac mortality and all-cause mortality were 930 and 935, respectively. Baseline characteristics of the total sample are shown in Table 1.

Personality Inventory

The O domain and its facets were measured by the 180-item NEO-PI (13). Participants who failed to complete >25% of the items on a scale were removed from analyses. Individuals dropped from analyses due to missing NEO PI data were similar in age and disease severity, but they had lower education ($p = .02$) than subjects included in the analyses. The domain and

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This study was supported by Grant PO1-HL36587 and Grant RO1-HL54780 from the National Heart Lung and Blood Institute and Grant RO1-HL55356 from the National Heart Lung and Blood Institute with cofunding by the National Institute on Aging. Additional support was provided by the Duke Behavioral Medicine Research Center.

A version of this paper has been presented previously: Jonassaint CR, Boyle SH, Williams RB, Siegler IC, Barefoot JC. Facets of the openness to experience domain predict cardiac death and all-cause mortality. Psychosom Med 2005:67: A90(Abstract 1304). Available at http://www.psychosomaticmedicine.org/cgi/data/67/1/DC1/1.

Received for publication September 3, 2006; revision received January 22, 2007.

DOI: 10.1097/PSY.0b013e318052e27d

0033-3174/07/6904-0319

TABLE 1. Baseline Characteristics of Participants (N = 935)

	% or Mean (SD)
Men	74.5
White	94.7
Cigarette Smokers	41.8
History of hypertension	49.9
History of hyperlipidemia	32.1
No. of coronary arteries narrowed >75% in diameter	
1	32.4
2	31.7
3	35.9
Age (Years)	59.8 (9.3)
Education (Years)	12.3 (3.5)
LV ejection fraction	50.6 (12.5)
Openness domain	41.8 (9.0)
O1 - Fantasy	46.5 (7.7)
O2 - Aesthetics	45.4 (9.4)
O3 - Feelings	48.8 (8.7)
O4 - Actions	43.1 (9.7)
O5 - Ideas	42.7 (9.6)
O6 - Values	41.6 (9.1)

Gender norms were used to calculate NEO-PI T-scores.

TABLE 2. Openness Facet Descriptions

Facet	Description
Fantasy	High scorers have vivid imaginations and an active fantasy life; and daydream not simply to escape but to creating for themselves an interesting inner world. Low scorers are more prosaic and prefer to keep their minds on the task at hand.
Aesthetics	High scorers have a deep appreciation for art and beauty; are moved by poetry, absorbed in music, and intrigued by art. Low scorers are relatively insensitive to and uninterested in art and beauty.
Feelings	High scorers experience deeper and more differentiated emotional states; and feel both happiness and unhappiness more intensely than do others. Low scorers have somewhat blunted affects and do not believe that feeling states are of much importance.
Actions	High scorers prefer novelty and variety to familiarity and routine; and overtime, may engage in a series of different hobbies. Low scorers find change difficult and prefer to stick with the tried-and-true.
Ideas	High scorers enjoy both philosophical arguments and brainteasers; this trait does not necessarily imply high intelligence, although it can contribute to the development of intellectual potential. Low scorers have limited capacity; and if highly intelligent, narrowly focus their resources on limited topics.
Values	High scorers are ready to reexamine social, political, and religious values; and may be considered the opposite of dogmatic. Low scorers tend to accept authority and honor tradition; as a consequence, they are generally conservative, regardless of political party affiliation.

facet scores used for analyses were calculated by averaging across the items to control for missing data. Simulations have suggested that averaging the available items provides unbiased estimates and is a reasonable alternative to more complex statistical approaches such as multiple imputation (14). For purposes of comparison, the gender normed T scores for the O domain and facets are presented in Table 1. Facet scales are described in Table 2.

Procedures

Follow-up of the patients was conducted at 6 months and 12 months after catheterization and annually thereafter. For these analyses, June 2002 was considered the end of follow-up. As of that date, 463 patients had died from all causes, of which 266 were cardiac deaths. Procedures for the documentation of cause of death have been described elsewhere (15). Cardiac deaths were determined on the basis of information provided by the patient's physician. Cause of death was coded as cardiac or noncardiac by two Duke Clinical Research Institute staff, who had no knowledge of the patient's scores on the O domain or facet scales. A staff physician resolved any discrepancies in the coding of cause of death between coders. Total mortality and cardiac deaths were the end points used in the present study. Cause of death had not yet been determined for five patients. The average length of follow-up for participants who did not die was 14.68 years (standard deviation = 0.87).

Analyses

The relationships of the O domain and its facets to survival were examined by Cox proportional hazard models. The O domain and each facet were modeled separately. Each model included age and measures of disease severity as covariates to control for confounding. Associations between gender and survival have varied across studies, depending on factors such as patient selection criteria, covariates, and timing of the follow-up period (16,17). Studies using methods similar to those employed in the present study have not observed gender differences in survival (18). To confirm this in the present sample, we tested the association between gender and mortality, controlling for age and clinical indicators of disease. No effect of gender was observed; therefore, it was not included in the main analyses.

Disease severity was indexed by three variables: number of diseased vessels, severity of congestive heart failure, and left ventricular ejection fraction. Effect sizes are reported as hazard ratios comparing a person at the 75th percentile of each scale with the 25th percentile. Thus, effect size is interpreted as the risk of a person in the middle of the upper half of the distribution compared with the risk of a person in the middle of the lower half of the scale's distribution. In a secondary set of analyses, education—determined by subject's report of completed years of education—was added to each model examining the relationship between O facets and survival. Due to missing education data, 143 subjects were not included in those analyses. Individuals with and without education data did not differ on O domain or facet scores.

An assumption of the proportional hazards model is that the effect of the predictor (i.e., Openness to Experience and its facets) is constant over time. To test this assumption, we included a time-dependent covariate consisting of the interaction of the predictor variable and the log of survival time in the model. The results of these tests indicated that there were no significant violations of the proportional hazards assumption (all p values $>.05$).

RESULTS

The O domain was not significantly related to cardiac deaths or all-cause mortality risk, but there was a trend for cardiac deaths, indicating that higher O was protective (Table 3). However, analysis of the facets demonstrated that, even after controlling for age and disease severity, differences between the 25th and 75th percentile scores on Openness to Feelings and Openness to Actions were associated with a 24% and 23% reduction in cardiac death risk and a 17% and 14% reduction in all-cause mortality risk, respectively (Table 3). Openness to Ideas was also protective against cardiac deaths

TABLE 3. Effect of Openness Domain and Facets on Cardiac (n = 930) and All-Cause Mortality (n = 935), Adjusted for Age and Disease Severity

Variable	Mortality Outcome	Hazard Ratio	95% Confidence Limits		p
			Lower	Upper	
Openness Domain	Cardiac	0.85	0.73	1.00	.055
	All-cause	0.93	0.82	1.05	.220
O1—Fantasy	Cardiac	1.08	0.91	1.28	.366
	All-cause	1.07	0.94	1.21	.298
O2—Aesthetics	Cardiac	0.85	0.73	0.99	.040
	All-cause	0.97	0.86	1.09	.578
O3—Feelings	Cardiac	0.76	0.63	0.91	.004
	All-cause	0.83	0.72	0.95	.007
O4—Actions	Cardiac	0.77	0.65	0.92	.005
	All-cause	0.86	0.75	0.99	.029
O5—Ideas	Cardiac	0.82	0.68	0.99	.035
	All-cause	0.88	0.76	1.01	.067
O6—Values	Cardiac	1.19	1.00	1.41	.057
	All-cause	1.10	0.97	1.25	.140

Hazard ratios represent the interquartile difference in NEO Personality Inventory scores.

(18% reduction in risk) and approached significance for total mortality. Additionally, Openness to Aesthetics was protective against cardiac deaths (15% reduction in risk). In contrast, Openness to Fantasy and Openness to Values were not significantly related to longevity. Openness to Values showed a trend in the opposite direction of the other facets and the overall domain. Higher Openness to Values tended to be associated with increased risk of cardiac deaths, suggesting that individuals who were more closed to values tended to be less likely to suffer from cardiac death during the follow-up period. As expected, all covariates were significant predictors of survival.

Educational attainment was strongly correlated with the O domain ($r_{(1,808)} = 0.42$; $p < .01$); however, educational attainment did not predict cardiac or all-cause mortality. Furthermore, when controlling for educational attainment, we found no substantial changes in the effects of the O domain and facets on cardiac or all-cause mortality.

DISCUSSION

Consistent with previous investigations (4–6), the present study showed that the overall O domain did not significantly predict all-cause mortality. This study also extends previous null findings by examining the association between O and mortality in patients with documented CAD, almost half of whom died within the follow-up period. Although not significant, a trend showed that higher O was associated with 15% decrease in cardiac death risk.

Past studies did not consider the facets of the O domain. Examination of these lower-level traits showed, independently of age and disease severity, that higher scores on Openness to Feelings and Openness to Actions were associated with longer survival. Follow-up analyses indicated that the significant associations between O facets and mortality were not the result of differences in educational attainment. Our findings that Openness to Feelings and Openness to Actions were related to survival are consistent with previous investigations reporting significant associations between similar constructs—alexithymia and curiosity—and mortality.

Alexithymia, which is characterized by blunted affect and low emotional awareness, is related to mortality risk (19). On its face, Openness to Feelings is a similar construct to Alexithymia and, in fact, is also correlated with the Toronto Alexithymia scale (20). Low emotional awareness may lead to disease via several physiological, behavioral, social, or cognitive mechanisms (21). Low scorers on Openness to Feelings experience a narrower range of affect and are less able to identify their emotions than high scorers (22). Deficits in emotional awareness have been associated with heightened physiological arousal (23) and other known behavioral risk factors such as social isolation (24) and heavy alcohol use (25). In addition, difficulty identifying feelings has been linked to negative affective states such as depression, somatic complaints, and anxiety (26,27).

High scorers on Openness to Actions are willing to explore new experiences and different aspects of self (2), a concept similar to that of curiosity—a psychological trait that has also been linked to mortality (28). Low curiosity may negatively affect health via numerous mechanisms. Individuals scoring low on Openness to Actions (i.e., low curiosity) may be unable to adapt effectively to or accept changes in their routine or environment. Under stress, they may be less likely to cope actively by seeking new friendships or new solutions to current problems (28). Furthermore, low curiosity may indicate aging of the central nervous system (29), one possible biological mechanism leading to the diminished novelty-seeking behavior in this group.

In addition to findings with the Feelings and Actions facets, Openness to Aesthetics and Ideas were also associated with decreased cardiac deaths whereas Fantasy had no association with longevity. In contrast to the protective effects of other O facets, high Openness to Values showed a trend toward increased risk for cardiac deaths. That one facet seemed to be associated with elevated mortality risk, another showed no association, and others were protective may help to explain the previous null results in relationship to the O domain (4–6). It is not clear why high scores on Aesthetics and Ideas and lower scores on Values may have been protective. However, because these effects were weaker, caution should be taken in the interpretation of these results.

The results of this study might be the product of multiple explorative tests; however, considering the significance levels for the effects of the Feelings and Actions facet on mortality, this is unlikely to be the explanation. Replications of the O facet effects on mortality in population samples are needed to determine their generality.

The results of the present study provide new ideas about how personality is related to important health outcomes such

as mortality. In addition, the present study shows that examining the lower-order facets of personality, as operationalized by the FFM, enables one to detect relationships that are not captured by higher-order constructs alone. The pattern of results obtained in the current study demonstrates the importance of this approach for future studies.

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