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TRAIT ANTAGONISM AND THE PROGRESSION OF ARTERIAL THICKENING: WOMEN WITH ANTAGONISTIC TRAITS HAVE SIMILAR CAROTID ARTERIAL THICKNESS AS MEN

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Abstract

A large body of evidence links antagonism-related traits with cardiovascular outcomes, but less is known about how psychological traits are associated with intermediate markers of cardiovascular disease. Using a large, community-based sample from Sardinia, Italy ($N=5,614$), this study examined how trait antagonism (low Agreeableness) and its facets are associated with carotid artery intima-media thickness (IMT), a measure of arterial thickening. Controlling for demographic and cardiovascular risk factors, low Agreeableness, and in particular low Straightforwardness and low Compliance, were associated with greater carotid thickening, measured concurrently and prospectively, and with increases in IMT over three years. Indeed, those in the bottom 10% of Agreeableness had a 40% increase in risk for elevated IMT. Although men have thicker arterial walls, women with antagonistic traits had similar carotid thickening as antagonistic men. Antagonistic individuals, especially those who are manipulative and aggressive, have greater increases in arterial thickening, independent of traditional cardiovascular risk factors.

Keywords

Intima-media thickness; Antagonism; Anger; atherosclerosis; Personality

When the Type A behavioral pattern was dissected into its constituent parts, hostility emerged as the dominant predictor of coronary heart disease (CHD) 1–3. Subsequent work demonstrated that the interpersonal aspects of hostility, such as the expression of anger in interpersonal contexts, were particularly predictive of CHD 4–5. Within the framework of the Five-Factor Model (FFM) of personality, trait Agreeableness captures individual differences in this interpersonal orientation towards others. In contrast to agreeable individuals, who tend to be trusting, straightforward, and show concern for others, individuals who score high on antagonism (low Agreeableness) tend to be cynical, manipulative, self-centered, arrogant, and quick to express their anger 6. A substantial literature now shows how individual differences in these antagonism-related traits predict a variety of cardiovascular outcomes, including

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stroke, fatal and non-fatal coronary events, silent myocardial infarctions, and cardiac revascularization procedures 7, 8 (see 9 for a review).

Much of this work has necessarily focused on the clinical manifestations of coronary heart disease. Advances in noninvasive technology, however, have made it possible to assess potential markers of atherosclerosis, a preclinical state of CHD. Specifically, carotid artery intima-media thickness (IMT) is a measure of arterial wall thickness, measured via ultrasound, which can be used to assess healthy people who do not yet clinically manifest the disease. Arterial thickness increases with age, but is sensitive to elevated blood pressure and chronic hypertension 10 and tends to be accelerated in the presence of cardiovascular disease, and is an independent predictor of stroke and future myocardial infarction (see 11 and 12 for reviews).

Evidence for the role of antagonism in arterial thickening primarily comes from cross-sectional studies on specific populations. Measures of anger and hostility, for example, have been associated with concurrent measures of IMT among untreated hypertensive men¹³, elderly women¹⁴, women transitioning to menopause¹⁵, and young adults who grew up in low socioeconomic environments¹⁶. Among post-menopausal women, these traits are also associated with IMT measured prospectively¹⁷ and with increases in IMT over time¹⁸. With few exceptions (e.g., 19), the antagonism-IMT associations have been examined using specific populations; large, population-based samples are needed to test whether these associations hold across different demographic groups (i.e., men, women; younger, older). Further, at least two assessments of IMT are needed to test whether antagonism predicts the progression of arterial thickening.

In the present study, we examine the concurrent and prospective associations between six facets of trait antagonism (Agreeableness) and IMT in a large, population-based sample. In addition, with two measures of IMT taken approximately three years apart, we test whether these traits predict increases in arterial thickening. Finally, several studies have looked at these relations separately for men and women; few have the power to directly test sex as a moderator. The large sample size in the present study provides sufficient power to test demographic moderators of the antagonism-IMT relations.

Method

Participants

Participants were drawn from the SardiNIA project, a large, on-going multidisciplinary study of the genetic and environmental basis of complex traits and age-related processes²⁰. Approximately 62% of the population ($N = 6,148$ individuals; 57% female), aged 14 to 102 years, from a cluster of four towns in the Lanusei Valley enrolled in the study. The current study includes 5,614 participants (58% female; mean age = 42.51; $SD = 16.86$, range = 14–94) who had valid personality and IMT measurements at Wave 1. A total of 4,634 participants (59% female; mean age = 45.77; $SD = 16.22$, range = 18–98) had a second valid assessment of IMT approximately three years later. The project was approved by institutional review boards in Italy and the US, and all subjects gave informed consent.

Personality Assessment

Agreeableness was assessed using the Italian version²¹ of the Revised NEO Personality Inventory (NEO-PI-R)⁶. The 48-item Agreeableness scale assesses six facets of this trait: A1: Trust, A2: Straightforwardness, A3: Altruism, A4: Compliance, A5: Modesty, and A6: Tender-mindedness. All items are answered on a five-point Likert scale, from *strongly disagree* to *strongly agree*; scales are roughly balanced to control for the effects of acquiescence. Participants filled out the self-report questionnaire (89%) or chose to have the questionnaire

read by a trained Sardinian psychologist (11%). A variable (test administration) that indicated this difference in the administration of the NEO-PI-R was used as a covariate in the analyses. In this sample, the NEO-PI-R showed good psychometric properties and the factor structure replicated the American normative structure²⁰. Raw scores were converted to T-scores ($M=5$, $SD=1$) using American combined-sex norms⁶. Thus, every one T-score increase corresponds to an approximately 1 SD increase in Agreeableness.

IMT

As described previously^{22, 23}, high-resolution B-mode carotid ultrasonography was performed by use of a linear-array 5–7.5 MHz transducer (HDI 3500, ATL Ultramark Inc.). The subject lay in the supine position in a dark, quiet room. The stabilized BP after 15 min from the onset of testing was used for subsequent analyses. A region 1.5 cm proximal to the carotid bifurcation was identified, and the intima–media thickness (IMT) of the far wall was evaluated as the distance between the luminal–intimal and the medial–adventitial interfaces. Intima–media thickness was measured on the frozen frame of a suitable longitudinal image with the image magnified to achieve a higher resolution of detail in areas without plaques or calcification (at least 1 mm distance from the plaque shoulder, if plaque was present). The IMT measurement was obtained from five contiguous sites at 1 mm intervals, and the average of the five measurements was used for analyses. Consistent with previous research, IMT was measured in millimeters^{10, 23}, and had a mean of .54 ($SD = .11$; range = .33 to 1.34) at baseline and a mean of .55 ($SD = .11$; range = .31 to 1.33) at follow-up.

Covariates

In addition to age, sex, education, and test administration, we controlled for several major cardiovascular risk factors: waist circumference, systolic and diastolic blood pressure, LDL and HDL cholesterol, triglycerides, fasting glucose and insulin, smoking, and antihypertensive, statin, and diabetes medication use (see Table 1 for descriptive statistics). Waist circumference was measured in centimeters. Blood pressure was measured three times after a five-minute resting period; we used the average of the second and third measurements of systolic and diastolic blood pressure. Blood was drawn from the antecubital vein between 7 and 8 a.m. after an overnight fast. Participants were asked not to smoke, engage in significant physical activity, or take medications prior to the blood collection. Standard enzymatic methods were used on fasting lipid measurements to determine serum HDL cholesterol and triglycerides. LDL cholesterol was derived using the Friedewald equation²⁴: $LDL\ cholesterol = Total\ cholesterol - HDL\ cholesterol - triglycerides/5$. The glucose oxidase method (Beckman Instruments Inc., Fullerton, CA, USA) was used to determine fasting plasma glucose concentration. Solid-phase, two-site chemiluminescent immunometric assay (Immulite 1000; SR1 Insulin - Biochem ImmunoSystems) was used to determine insulin concentration. Smoking was a binary variable, as were antihypertensive, statin, and diabetes medication use.

Statistical Overview

To determine the associations between Agreeableness and IMT, we ran a series of linear regressions predicting concurrent and prospective IMT from Agreeableness and its facets. We ran these analyses first with the basic demographic covariates and then added the cardiovascular risk factors as covariates. To examine change in IMT, we predicted prospective IMT controlling for concurrent IMT in addition to all of the other covariates. Using Aiken and West's²⁵ methodology for testing interactions, we tested whether sex or age (entered as a continuous variable) moderated the personality-IMT associations. We focus on moderators that replicated across both the concurrent and prospective analyses. Finally, we used logistic regression to test whether Agreeableness increased risk for having IMT in the top quartile of the distribution. Due to missing values on some of the cardiovascular risk factor covariates,

the sample size varied for the analyses that included these variables ($n = 5,460$ for concurrent IMT, $n = 4,516$ for prospective IMT, and $n = 4,478$ for change in IMT). Unless otherwise specified, all coefficients reported below are standardized beta coefficients.

Results

Table 2 shows the results of the linear regressions for concurrent IMT, prospective IMT, and change in IMT. Controlling for the basic demographic covariates, domain-level Agreeableness, A2: Straightforwardness, and A5: Modesty were negatively associated with IMT, indicating that those who were antagonistic, manipulative, and arrogant had greater carotid thickening. The negative associations between IMT and Agreeableness and A2: Straightforwardness were unchanged when we added the full list of cardiovascular risk factors as covariates; A5: Modesty, however, was reduced to non-significance. Although modest, the effect size of Agreeableness on IMT, by comparison, was similar in magnitude to that of other major risk factors for carotid thickening, including smoking ($\beta = .04, p < .01$), use of antihypertensive medication ($\beta = .03, p < .01$) and HDL Cholesterol ($\beta = -.04, p < .01$).

Replicating the concurrent analyses, domain-level Agreeableness and A2: Straightforwardness were both negative predictors of IMT measured approximately three years later. In addition, A1: Trust and A4: Compliance also prospectively predicted carotid thickening. Although the effect size did not change, A1: Trust was reduced to non-significance when all of the cardiovascular covariates were included in the analyses; the other three predictors remained significant. Age-adjusted mean-level differences in concurrent and prospective IMT for high and low Agreeableness are shown in Table 3. It is of note that the difference in IMT between high and low Agreeableness is roughly similar to the difference between individuals with metabolic syndrome and controls²³.

Trait antagonism was associated with the progression of carotid artery thickening: Agreeableness, A2: Straightforwardness, and A4: Compliance predicted change in IMT between Time 1 and Time 2. Specifically, participants who scored higher on antagonism (low Agreeableness), especially those who were manipulative (low A2: Straightforwardness) and quick to express their anger (low A4: Compliance), had greater thickening, controlling for their previous IMT levels, than participants who scored lower on these traits. The same associations were found when either the basic covariates or all of the cardiovascular covariates were included in the analyses. In addition, all of the findings above held after accounting for the presence or absence of plaque, when controlling for carotid artery diastolic diameter, and when we excluded participants who had had a stroke.

Although age was not a consistent moderator both concurrently and prospectively, it did moderate the association between Agreeableness and change in IMT: Older participants who were disagreeable had greater progression of IMT over three years than older participants who were more agreeable; this association did not hold for younger participants ($\beta_{A \times \text{age}} = -.04, p < .01$). The same moderating effect of age was found for four of the facets: A1: Trust ($\beta_{A1 \times \text{age}} = -.03, p < .01$), A2: Straightforwardness ($\beta_{A2 \times \text{age}} = -.04, p < .01$), A4: Compliance ($\beta_{A4 \times \text{age}} = -.02, p < .05$), and A6: Tender-mindedness ($\beta_{A6 \times \text{age}} = -.02, p < .05$). That is, among older adults, the IMT of those who tended to be cynical, deceitful, express anger, and less concerned for others increased over time.

Both concurrently and prospectively, sex moderated the association between IMT and Agreeableness and three of its facets. Women who scored low on Agreeableness ($\beta_{A \times \text{sex}} = .04, p < .01$ and $\beta_{A \times \text{sex}} = .04, p < .05$, respectively), A2: Straightforwardness ($\beta_{A2 \times \text{sex}} = .05, p < .01$ and $\beta_{A2 \times \text{sex}} = .03, p < .05$, respectively), A4: Compliance ($\beta_{A4 \times \text{sex}} = .03, p < .05$ and $\beta_{A4 \times \text{sex}} = .03, p = .06$, respectively), or A5: Modesty ($\beta_{A5 \times \text{sex}} = .06, p < .01$ and $\beta_{A5 \times \text{sex}} = .$

04, $p < .01$, respectively) had more carotid thickening than women who scored low on these traits; these associations were not as strong for men. Although there was a main effect of sex ($\beta = .07, p < .01$), such that men had greater carotid thickening than women, antagonism-related traits tended to close that gap among the most antagonistic participants in the sample (see Figure 1). That is, antagonistic women tended to have IMT values more similar to men. Finally, sex only moderated one of the associations between the traits and change in IMT: Women high in A6: Tender-mindedness increased the least over the three year period, whereas men high in this trait increased the most ($\beta_{A6 \times \text{sex}} = .03, p < .01$).

Finally, we tested whether Agreeableness increased risk for IMT levels in the top quartile of the distribution ($IMT \geq .59$). Controlling for the demographic variables and all cardiovascular risk factors, Agreeableness was associated with an approximately 16% reduction in risk (see Table 4). To determine whether this effect was driven by one end of the distribution of Agreeableness or the other, we compared the top and bottom 10% of Agreeableness. Participants who scored in the lower 10% of the distribution of Agreeableness, compared to the rest of the distribution, had a 40% increase in risk for elevated IMT (OR = 1.40, 95% CI = 1.04 – 1.87); the top 10% of the distribution of Agreeableness, compared to the rest of the distribution, did not significantly reduce risk (OR = .88, 95% CI = .68–1.13, *ns*). At the facet level, A1: Trust, A2: Straightforwardness, A3: Altruism, and A6: Tender-mindedness increased risk concurrently, A1: Trust, A2: Straightforwardness, and A4: Compliance increased risk prospectively.

Discussion

Intima-media thickness, a measure of arterial wall thickness, is an independent predictor of stroke and future myocardial infarction that is sensitive to elevated blood pressure and chronic hypertension¹⁰. In the present study, participants who scored high on trait antagonism, and in particular those who were manipulative (low A2: Straightforwardness) and aggressive (low A4: Compliance), had greater carotid thickening, measured both concurrently and prospectively. Indeed, those who scored in the bottom 10% of Agreeableness (i.e., those who were the most antagonistic) had an approximately 40% increase in risk for elevated IMT. Perhaps most notable, these traits also predicted greater progression of arterial thickening across the three years of the study.

Several hypotheses have been advanced that speculate on the mechanisms linking antagonistic-related traits with atherosclerosis. Key candidates include metabolic, behavioral, and social risk factors. Individuals high on antagonism-related traits, for example, are more likely to have metabolic syndrome, a constellation of metabolic risk factors¹⁸. Among postmenopausal women, metabolic syndrome has been found to partially mediate the association between interpersonal anger and arterial thickening¹⁸. In the present research, however, even after controlling for the components of metabolic syndrome, such as blood pressure and triglycerides, the association between antagonism and arterial thickening persisted. This result suggests that other mediators need to be considered.

Lifestyle factors, such as smoking and exercise, have also been hypothesized to mediate this relation²⁶. As with the metabolic risk factors, however, the association between antagonism and IMT persisted after controlling for smoking. Although we were unable to control for physical activity, antagonism is typically not associated with exercise behavior²⁷, and thus physical activity is unlikely to be a mediator. Antagonism is, however, associated with increases in adiposity over time²⁸, which may contribute to IMT. Although controlling for waist circumference did not reduce the antagonism-IMT relation to non-significance, antagonistic individuals may be at greater risk for the progression of atherosclerosis because they tend to gain weight at a more rapid pace over time.

Finally, other social and psychological factors associated with antagonism may link this trait with the progression of atherosclerosis. Antagonistic individuals tend to have a more competitive and conflictual style of social interaction that undermines interpersonal relations. Even when social support systems are in place, they do not benefit physiologically from such support^{29, 30}. Over time, deficits in social support may culminate in greater cardiovascular risk³¹. In addition to social isolation, their attitudes may also increase risk. Antagonistic individuals tend to hold negative beliefs about groups other than their own³² and are thus more prone to stereotyping. Interestingly, such stereotyping is associated with cardiovascular outcomes: Younger adults who hold negative stereotypes about aging are more likely to experience a cardiovascular event themselves over the next four decades³³. Antagonistic individuals may be at greater cardiovascular risk, in part, because they tend to hold negative stereotypes.

In the present study, both sex and age moderated some of the associations between the antagonistic traits and IMT. Men tend to have thicker arterial walls than women, making sex a strong risk factor for CHD³⁴. Antagonism-related traits among women appear to close this gap: Antagonistic women have similar carotid thickening to that of antagonistic men. Antagonism, particularly anger, has been related to greater cortisol reactivity³⁵ and such reactivity in women has been linked to a faster progression of atherosclerosis³⁶. In addition, hormonal exposure (especially during critical phases) or other physiological differences may have effects that lead women to express more masculine traits, both physiologically (arterial thickness) and psychologically (antagonism); that is, the same influences that lead to the expression of more masculine psychological traits may also lead to greater arterial thickness. Finally, although the association between antagonism and IMT was similar across all age groups at any given time (i.e., age did not moderate the concurrent or prospective associations between antagonism and IMT), antagonism predicted greater progression of arterial thickening only among the older participants in our sample.

The present study used a large sample size, two assessments of IMT approximately three years apart, and a comprehensive measure of trait antagonism to show that antagonism predicts the progression of carotid artery thickening. Further, our effects were independent of traditional demographic and cardiovascular risk factors. These strengths, however, need to be qualified. For example, there may be confounding variables that we did not assess. Further, our sample was from a rural population in Sardinia, Italy. Despite demographic differences, our findings were consistent with research on more cosmopolitan populations. Although they may appear small, the effect sizes found in the present study need to be considered within a broader context. As noted above, our associations were of similar magnitude to those of other major risk factors, including smoking, HDL cholesterol, and antihypertensive medication use, both in the current study and in others (e.g.,³⁷). By comparison, antagonism ranks alongside many of the other major behavioral and physiological risk factors for cardiovascular disease. In addition, the associations were consistent across the concurrent, prospective, and progression analyses, indicating that these effects are unlikely to be random fluctuations. The findings were also consistent with the literature on antagonism-related traits and IMT and other cardiovascular outcomes, which, with our community-based sample, nicely complements the findings from more circumscribed samples. Finally, we did not test for any genetic mediators or moderators of the Agreeableness-IMT relations. Genome wide association analyses are currently underway in the SardiNIA and other cohorts to individuate replicable genetic variants associated with IMT. Once such variants are identified, it would be worthwhile to add a genetic component to this line of research.

Perspectives

The present research showed that interpersonal antagonism, particularly the disposition to be manipulative and aggressive toward others, was associated with carotid arterial thickening cross-sectionally and prospectively, and predicted increases in arterial thickening over time. These associations persisted even after accounting for traditional cardiovascular risk factors, such as hypertension and weight. Of note, the difference in IMT between those who score low and high in antagonism was roughly similar to the difference between individuals with metabolic syndrome and controls. Further, women with antagonistic traits had similar arterial thickening as men with antagonistic traits, indicating that the effect of sex on IMT was diminished among those high in antagonism.

Clinicians have long noted that those who suffer cardiovascular events tend to manifest anger and hostility-related traits. Research has supported this observation: Individual differences in antagonism-related traits predict a variety of cardiovascular outcomes, including stroke, fatal and non-fatal coronary events, silent myocardial infarctions, and cardiac revascularization procedures^{7, 8,9}. We extend these associations to an intermediate phenotype, carotid artery intima-media thickness. In particular, trait antagonism predicts the progression of arterial thickening, and may be one potential mechanism through which antagonism leads to the development of cardiovascular disease. While personality traits, such as antagonism, are basic tendencies that are resistant to change, the expression of these traits, or their characteristic adaptations, is modifiable. Determining which personality traits contribute to arterial thickening will help to identify who is most at-risk and who would benefit most from targeted interventions. Interventions aimed at modifying coping mechanisms, improving anger management, as well other behavioral, emotional, and cognitive expressions of trait Antagonism (including unhealthy lifestyles), can play an important role in clinical practice.

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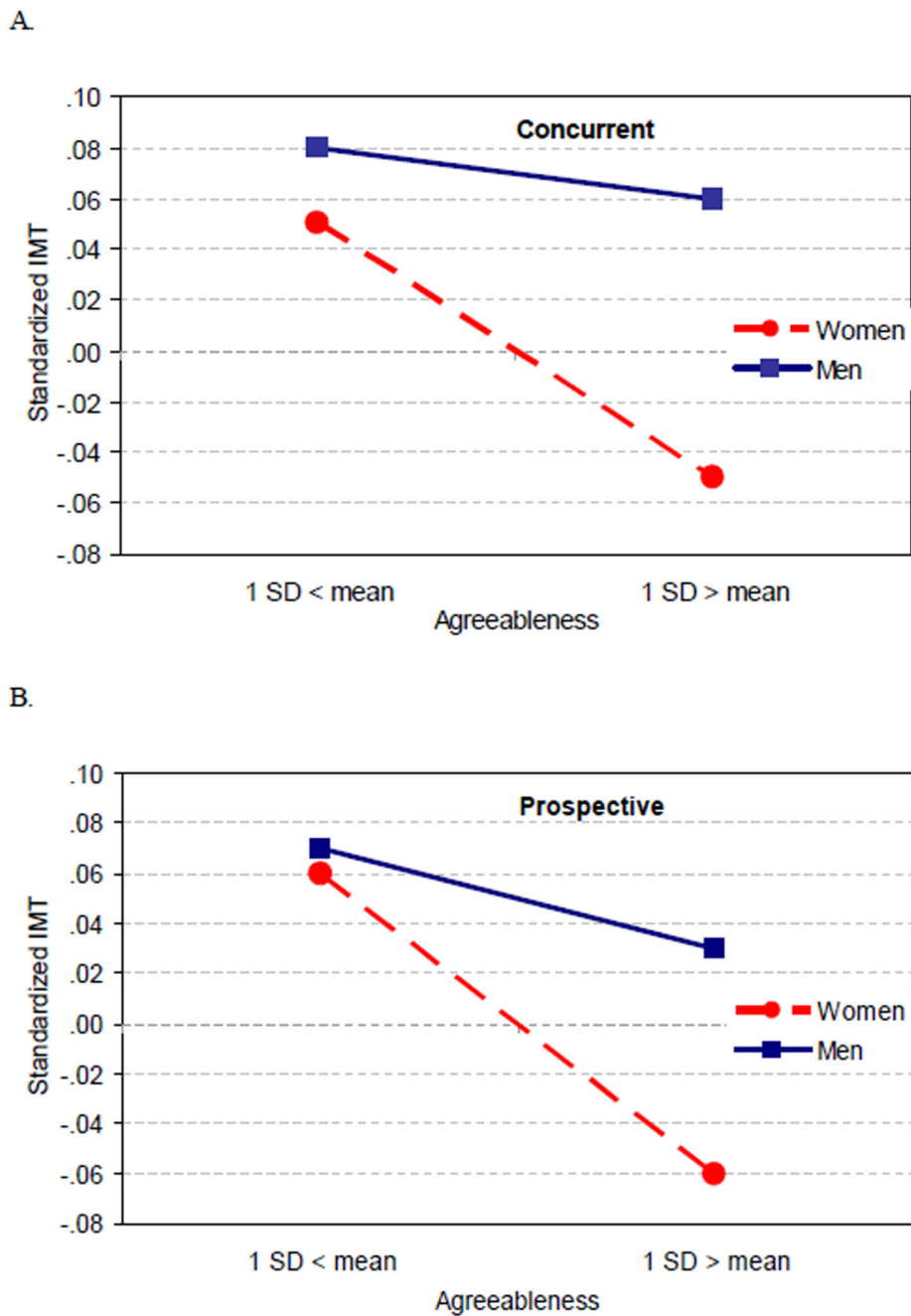


Figure. Predicted standardized intima-media thickness values as a function of Agreeableness and sex. The Agreeableness \times sex interactions are plotted from standardized regression coefficients from the concurrent (A) and prospective (B) analyses.

Table 1

Sample Descriptive Statistics for Demographic and Cardiovascular Covariates and IMT

Variable	Full Sample	Men	Women
IMT (Baseline)	.54 (.11)	.56 (.12)	.53 (.10)
IMT (Follow-up)	.55 (.11)	.56 (.13)	.54 (.10)
Sex (male)	42%	--	--
Age	42.51 (16.86)	42.63 (17.17)	42.42 (16.64)
Education?			
Waist circumference	84.20 (12.86)	89.78 (11.12)	80.14 (12.51)
Systolic blood pressure	125.08 (18.28)	129.89 (17.01)	121.57 (18.37)
Diastolic blood pressure	76.76 (10.82)	79.21 (11.08)	74.97 (10.26)
LDL cholesterol	126.70 (34.87)	128.68 (36.09)	125.26 (33.88)
HDL cholesterol	64.12 (14.80)	58.37 (12.90)	68.31 (14.69)
Triglycerides	87.69 (68.42)	103.56 (88.68)	76.11 (45.20)
Glucose	89.49 (22.56)	93.42 (24.69)	86.62 (20.41)
Insulin	8.44 (7.89)	8.41 (7.01)	8.46 (8.49)
Current smokers	21%	28%	15%
Antihypertensive	9%	9%	9%
Statin	2%	3%	2%
Diabetes	2%	2%	2%

Note. Means (Standard deviation) or percentage. Due to missing data on some of the covariates, *ns* range from 5460 to 5614.

Table 2

Linear Regressions Predicting IMT from Agreeableness and its Facets

Personality	IMT		
	Concurrent	Prospective	Change
	<u>Basic Model</u>		
Agreeableness	-.03 [†]	-.04 [†]	-.03*
A1: Trust	-.01	-.02*	-.01
A2: Straightforwardness	-.04 [†]	-.04 [†]	-.02 [‡]
A3: Altruism	-.01	-.01	.00
A4: Compliance	-.02	-.04 [†]	-.03 [†]
A5: Modesty	-.02*	-.02	-.01
A6: Tender-Mindedness	.00	.00	.00
	<u>Full Model</u>		
Agreeableness	-.03*	-.04 [†]	-.03*
A1: Trust	-.01	-.02	-.01
A2: Straightforwardness	-.03 [†]	-.03 [†]	-.02*
A3: Altruism	-.01	-.02	-.01
A4: Compliance	-.01	-.03 [†]	-.03 [†]
A5: Modesty	-.02	-.01	-.01
A6: Tender-Mindedness	.00	-.01	-.01

Note. Standardized betas controlling for covariates. The basic model includes age, sex, education, and test administration as covariates. The full model includes these demographic variables and cardiovascular risk factors as covariates (waist circumference, systolic and diastolic blood pressure, LDL and HDL cholesterol, triglycerides, fasting glucose and insulin, smoking, and antihypertensive, statin, and diabetes medication use). For the basic model, $n = 5,614$ for concurrent IMT, $n = 4,634$ for prospective IMT, and $n = 4,593$ for change in IMT. For the full model, $n = 5,460$ for concurrent IMT, $n = 4,516$ for prospective and $n = 4,478$ for change in IMT.

* $p < .05$.

[†] $p < .01$.

[‡] = .05.

Table 3

Age-adjusted Mean-Level Differences in IMT between the Lowest 10% and Highest 10% of Agreeableness, A2: Straightforwardness, and A4: Compliance

IMT	Agreeableness		<i>p</i> -value
	Lowest 10%	Highest 10%	
Domain Level			
Concurrent IMT	.56 (.01)	.53 (.01)	<.01
Prospective IMT	.56 (.01)	.53 (.01)	<.01
A2: Straightforwardness			
Concurrent IMT	.55 (.003)	.53 (.003)	<.01
Prospective IMT	.56 (.01)	.53 (.01)	<.01
A4: Compliance			
Concurrent IMT	.56 (.01)	.54 (.01)	<.01
Prospective IMT	.57 (.01)	.53 (.01)	<.01

Note. Estimated marginal mean (standard errors) of IMT.

Table 4Logistic Regressions Predicting the 75th percentile of IMT from Agreeableness and its Facets

Personality	IMT	
	Concurrent	Prospective
Agreeableness	.84 (.77–.93) [†]	.86 (.78–.95) [†]
A1: Trust	.91 (.84–.99) [*]	.92 (.85–.1.00) [‡]
A2: Straightforwardness	.88 (.81–.96) [†]	.90 (.82–.99) [*]
A3: Altruism	.89 (.82–.96) [†]	.95 (.87–1.04)
A4: Compliance	.95 (.88–1.03)	.91 (.84–.98) [*]
A5: Modesty	.94 (.86–1.03)	.95 (.87–1.05)
A6: Tender-Mindedness	.92 (.85–.99) [*]	.94 (.86–1.02)

Note. Odds Ratios (95% Confidence Interval) controlling for age, sex, education, test administration, waist circumference, systolic and diastolic blood pressure, LDL and HDL cholesterol, triglycerides, fasting glucose and insulin, smoking, and antihypertensive, statin, and diabetes medication use.

N = 5,460 for concurrent IMT. *N* = 4,516 for prospective IMT.

^{*} *p* < .05.

[†] *p* < .01.

[‡] *p* = .06.