

# Is there any association of personality traits with vascular endothelial function or systemic inflammation?

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## Abstract

**Background:** Evidences showed association of some personality traits with increased risk of cardiovascular diseases, but mediated mechanisms are not entirely described. In this study, we investigated the association of different personality traits with systemic inflammation and endothelial function as probable mediators.

**Methods:** This cross-sectional study was conducted in 2011 on 40-60 years old employees of an industrial company located in Isfahan city (central Iran). Participants were selected through simple random sampling. Personality types were evaluated using the neuroticism-extroversion-openness personality inventory and systemic inflammatory status was determined with high sensitive C-reactive protein (hs-CRP) level. To evaluate endothelial function flow mediated dilation (FMD) were measured. The obtained data were analyzed with univariate correlation and multiple linear regression tests.

**Results:** A total of 254 cases with mean age of  $51.4 \pm 6.1$  years were evaluated. There was no significant relationship between hs-CRP level and FMD with the personality traits in univariate analysis. In multivariate analysis, no association was found between the scores of personality traits and FMD with controlling the factors such as age, body mass index dyslipidemia, hypertension and diabetes. Only there was an inverse association between conscientiousness score and hs-CRP ( $\beta = -0.241$ ,  $P = 0.013$ ).

**Conclusions:** In our population who were the employees of an industrial company, no relationship was found between specific personality trait and endothelial dysfunction. However, we found that the personality trait of responsibility (conscientiousness) is negatively associated with inflammation. Further multi-center studies and also cohort studies are recommended in this regard.

**Key Words:** Cardiovascular disease, endothelial function, personality traits, psychological factors, systemic inflammation

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## INTRODUCTION

Despite major advances in treatment strategies and preventive programs, cardiovascular diseases (CVD) remain the leading cause of morbidity and mortality

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throughout the world. Many studies are performed on the effects of psychosocial and behavioral factors in the etiology, physiopathology and progression of cardiovascular disorders. Epidemiological studies in the last half century have conspicuously shown associations between psychological factors, related to social environment and personality traits, with the increased risk of CVD and progression of these diseases.<sup>[1-3]</sup> Previous studies has shown some type of personality as a psychological risk factor for CVD as well as more complications and reduced quality of life in such patients.<sup>[3-6]</sup> However, the mechanisms through which personality traits can be a risk-factor for CVD is not yet completely described.

Considering the effects of psychological factors on the immune system and the role of immune system and systemic inflammation in CVD, it is possible that at least a part of the effects of personality characteristics on the cardiovascular system occur through the immune system and systemic inflammation.<sup>[7,8]</sup> Studies have shown an inverse correlation between extroversion and CD4/CD8 ratio, also subjects with higher extraversion and social support have had higher levels of natural killer cells.<sup>[9]</sup> Harm avoidance (avoiding risk) temperamental trait and self-directionless (leadership) personality trait have been associated with serum C-reactive protein (CRP, marker of systemic inflammation) and this relationship between personality traits and CRP might be mediated by depression.<sup>[10]</sup> Furthermore, the relationship between personality traits and CRP in women, who denied persistent depression, suggests that personality traits *per se* are associated with mild systemic inflammation.<sup>[10]</sup> Increased CRP is an important risk factor of coronary artery disease that can induce atherosclerosis and endothelial inflammatory processes.<sup>[10-12]</sup> Endothelial function plays a key role in determining the clinical feature of atherosclerosis; endothelial dysfunction is involved in the creation of atherosclerosis process and is seen before the apparent CVD.<sup>[13]</sup>

Some studies in recent years have reported endothelial dysfunction associated with clinical depression and anxiety and subclinical mood disorders such as hostility and anger.<sup>[14]</sup> Other studies have also shown that autonomic dysfunction is induced by psychological factors and can cause endothelial dysfunction.<sup>[15]</sup> Schott *et al.* showed the association between anger/hostility and subclinical CVD.<sup>[16]</sup> Another study has shown a reverse relationship between violence and flow mediated dilation (FMD), a marker of endothelial function.<sup>[17]</sup> Other studies found that women with more anger and men with more violence have reduced vasodilatation<sup>[18,19]</sup> and increased coronary calcification,<sup>[20]</sup> and thus an increase in cardiovascular events and mortality.<sup>[21,22]</sup>

Personality traits are different from other psychological factors such as depression and anxiety as they are usually stable through life and are mediators between life events and consequent negative emotions.<sup>[23]</sup> Despite the studies conducted on different psychological factors associated with CVD, association between personality traits and endothelial function and possible mechanisms of this association are less investigated and previous studies have mostly inflammation as predisposing factors kinds of personality types such as type A and D.<sup>[3-6]</sup>

Therefore, in the present study, we investigated the relationship between various personality traits and endothelial dysfunction as well as mild systemic inflammation as predisposing factors of cardiovascular events.

## METHODS

### Participants and setting

This cross-sectional study was conducted in 2011 on male employees aged 40-60 years in a major industrial service company located in Isfahan city (central Iran). Among 879 employees, about 25% of all male employees who consecutively referred for annual health status screen examinations by simple random sampling. It was tried to select participants from all different parts of the company.

Participants with a history of ischemic heart disease, chronic renal failure, advanced liver disease, cerebrovascular accidents, any proven cancer, multiple sclerosis and major psychiatric disorders (including major depression disorder, bipolar disorder and psychotic disorders) were not included. To check for exclusion criteria detailed history of all individuals were taken by a trained resident of psychiatry. The design of this study was confirmed by research council of Behavioral Sciences Research Center and Medical Ethics Committee of Isfahan University of Medical Sciences and written consent was obtained from participants after explaining the objectives and methods of the study.

### Assessments

During an interview with each participant, the following data were gathered. For laboratory tests, participants were referred to a single clinical laboratory and for measuring the FMD, participants were referred to a single trained physician.

### Personality traits

Five traits of neuroticism, extraversion and openness to experiences, agreeableness, and conscientiousness were evaluated by responding to the Persian version of the 60-item neuroticism-extroversion-openness (NEO)

personality inventory. Persian version of this questionnaire has been assessed in a sample of Iranian population and has an appropriate validity and reliability (Cronbach's alpha = 42.0-79.0 and internal correlation coefficient of 65.0-86.0).<sup>[24]</sup>

**Systemic inflammation and endothelial function:** To check the status of systemic inflammation, high sensitive C-reactive protein (hs-CRP) was measured by venous blood samples. For the evaluation of vascular endothelial function, Doppler ultrasound was used and brachial arterial diameter was measured during the blockage of artery (with the inflation of sphygmomanometer cuff to at least 50 mm Hg above the systolic blood pressure) and after the removal of blockage, FMD was measured by calculating the increased percentage of the arterial diameter after the removal of blockage comparing with the blockage state.

Other gathered data were included weight, height and body mass index (BMI), subjective socio-economic status (SES; class I to class III), blood pressures and laboratory tests including fasting blood sugar (FBS), lipid profile (including Triglyceride, Chol, high-density lipoprotein and low-density lipoprotein) to control the possible confounding factors of these indices on FMD and systemic inflammation.

### Data analyses

The obtained data were analyzed using SPSS software for windows version 16.0. Pearson test and when data were not normally distributed, the Spearman test were used to investigate the correlation between variables. Furthermore, multiple linear regression tests were used to evaluate the independent relationship of CRP and FMD on each of the personality characteristics while controlling the other factors. A  $P < 0.05$  was considered significant in all analyses.

## RESULTS

From 293 invited personnel, 254 participated (response rate = 86.6%); aged 40-60 years ( $51.4 \pm 6.1$  years). Considered demographic variables and some cardiovascular risk factors are reported in Table 1 and range, mean and standard deviation of FMD, serum hs-CRP levels and scores on each personality dimension are summarized in Table 2.

There was no significant relationship between hs-CRP and FMD with any of the personality traits' scores. Furthermore, no association was found between serum hs-CRP level and FMD ( $r = -0.065$ ,  $P = 0.315$ ). Among the known risk factors of CVD, BMI was directly associated with serum

**Table 1: Cardiovascular risk factors among participants**

Risk factors	Percent of participants	Risk factors	Mean(Range)
Hypertension	22	SBP, mmHg	117.4±14.4 (90-160)
Diabetes	9.1	DBP, mmHg	76.6±9.0 (50-100)
Dyslipidemia	19.8	BMI (kg/m <sup>2</sup> )	26.4±3.4 (15.9-36.1)
Smoking	25.4	TG (mg/dL)	136.4±63.6 (31-590)
SES class one	10	Cholesterol (mg/dL)	173.5±36.4 (76-337)
SES class two	65.4	LDL (mg/dL)	109.4±28.8 (27-205)
SES class three	24.6	HDL (mg/dL)	37.2±7.3 (23-67)

SES: Socio-economic status, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, BMI: Body mass index, TG: Triglyceride, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, Data are presented as % or mean±SD (range)

**Table 2: Personality traits scores, hs-CRP level, and FMD in participants**

Neuroticism	30.2±6.9 (14-60)
Extraversion	36.1±5.1 (17-50)
Openness	36.9±4.5 (29-60)
Agreeableness	44.0±5.0 (30-60)
Conscientiousness	49.2±5.5 (30-60)
hs-CRP (mg/l)	2.3±2.8 (0.1-37)
FMD (%)	8.5±5.2 (0.0-27.2)

Data are presented as mean±SD (range), HS-CRP: High sensitive C-reactive protein, FMD: Flow mediated dilation

hs-CRP ( $r = 0.180$ ,  $P = 0.005$ ). Furthermore, patients with hypertension had lower scores in dimension of conscientiousness, which represent responsibility ( $P < 0.001$ ) while they had higher scores in dimension of neuroticism ( $P = 0.063$ ). In multiple regression analysis, no significant association was found between different dimensions of personality and FMD after controlling of age, BMI, SES, smoking, dyslipidemia, hypertension, diabetes, FBS and lipid profile. There was only a significant association of conscientiousness score with serum hs-CRP level ( $\beta = -0.241$ ,  $P = 0.013$ ) [Table 3].

## DISCUSSION

Recent studies have shown the role of psychosocial factors in the pathogenesis and progression of CVD.<sup>[1,25]</sup> These evidences have been mostly on the five underlying psychosocial fields, including depression, anxiety, personality characteristics and emotional characters, social isolation and chronic stress. However, fewer studies have been done on the association of different personality traits with cardiovascular function and plausible mechanisms. Most previous studies have been concentrated on a particular personality type (type A and D personality).<sup>[3-6]</sup> More comprehensive understanding of the associations between different personality traits and cardiovascular function as well as involved mechanisms in this association, would be helpful to develop further preventive programs.

**Table 3: Summary results of multiple regression models analysis**

	HS-CRP			FMD		
	<i>B</i>	Standardized <i>B</i>	<i>P</i>	<i>B</i>	Standardized <i>B</i>	<i>P</i>
Neuroticism	-0.01	-0.088	0.288	-0.092	-0.124	0.136
Extraversion	0.009	0.059	0.547	-0.040	-0.039	0.674
Openness	0.004	0.022	0.782	-0.082	-0.072	0.358
Agreeableness	0.007	0.041	0.663	0.044	0.042	0.658
Conscientiousness	-0.035	-0.241	0.013	-0.007	-0.008	0.935
Age	0.016	0.123	0.110	0.007	0.009	0.909
SES class	-0.199	0.142	0.059	0.358	0.040	0.599
Hypertension	0.045	0.023	0.763	1.58	0.127	0.102
Smoking	-0.038	-0.019	0.793	1.10	0.087	0.242
Dyslipidemia	0.045	0.022	0.774	2.54	0.190	0.014
BMI	0.035	0.146	0.057	-0.128	-0.083	0.280
FBS	-0.002	-0.040	0.601	-0.028	-0.113	0.139
TG	0.002	0.148	0.126	-0.001	-0.009	0.927
LDL	0.000	-0.016	0.842	0.031	0.157	0.055
HDL	-0.01	-0.086	0.278	-0.049	-0.069	0.386
HLP	-0.32	-0.146	0.139	-0.53	-0.038	0.705

Collinearity statistics for all variables 0 <tolerance <1; SES: Socio-economic status, BMI: Body mass index, TG: Triglyceride, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, FBS: Fasting blood sugar, HLP: Hyperlipoproteinaemia, HS-CRP: High sensitive C-reactive protein, FMD: Flow mediated dilation

Although the mechanisms responsible for this association is not yet completely described,<sup>[25]</sup> possible mechanisms are classified in to two general categories; behavioral mechanisms through which psychosocial factors is associated with unhealthy life-style behaviors (poor health, low adherence to recommended health, diet and smoking); and direct pathophysiological disorders.<sup>[26]</sup> The last one includes changes in the hypothalamic-pituitary-adrenal axis and autonomic dysfunction and consequently the endothelial dysfunction, inflammation and pre-thrombotic states.<sup>[27]</sup> Considering the bidirectional interaction of the immune system with behavior and emotions,<sup>[28-30]</sup> and increased risk of CVD due to systemic inflammation,<sup>[31-33]</sup> it is possible that a part of the effect of psychological factors on increased risk of CVD is due to increased pre-inflammatory and systemic inflammatory factors.<sup>[1]</sup> Therefore, we aimed to determine the personality traits as an early indicator of CVD and systemic inflammation and endothelial dysfunction as probable mediating mechanisms. Although our results showed that the personality trait of responsibility (conscientiousness) has a reverse association and the personality trait of neuroticism has a direct association with hypertension, we found no significant correlation between personality traits and endothelial function (FMD). The only association with controlling of the other factors was a reverse association between the personality trait of responsibility (conscientiousness) and serum level of hs-CRP (indicator of systemic inflammation).

Most of the previous studies have been carried out on type D personality which is associated with social

isolation and negative affect. In a study on 5000 European individuals aged 35-74, 22.2% had type D personality and this personality type was associated with lower SES, being unmarried and increased depression and anxiety. In the aforementioned study, type D personality was associated independently with CVD (odds ratio = 1.54).<sup>[5]</sup> In another study, type A personality was associated with endothelial dysfunction (less FMD).<sup>[34]</sup> Another study on patients with borderline personality disorder showed that the intima-media thickness (IMT), is one of the early markers of atherosclerosis, is greater in these patients than in healthy individuals. In the multivariate analyzes, personality disorder and physical activity was associated with IMT, independent from BMI.<sup>[35]</sup> Another study showed that personality characteristics of openness to new experiences and rewards dependent trait are associated with pre-clinical atherosclerosis (IMT).<sup>[36]</sup> In the study of Schott *et al.* on healthy subjects, endothelial dysfunction (less FMD) was associated with social isolation and suppressed anger.<sup>[16]</sup> These studies show that there are effects of specific personality characteristics on endothelial function; though, the results of our study did not confirm this association completely.

Regarding the direct pathophysiological mechanisms that may mediate the effect of personality traits on the cardiovascular system, a study examined the number of endothelial progenitor cells (EPC) in heart failure patients with and without type D personality. These patients underwent cardiopulmonary stress test and EPC were measured before and after the test. Results showed that reducing the number of EPC can illustrate the association between type D personality and poor

prognosis of CVD.<sup>[37]</sup> Also, another study demonstrated dysregulation of angiogenesis factors vascular endothelial growth factor in patients with borderline personality.<sup>[38]</sup>

Regarding the association of personality traits and inflammatory markers, the study on patients with atrial fibrillation showed an increased serum level of hs-CRP in patients with type D personality, also it was an independent relationship between this personality type and patients quality-of-life with the serum hs-CRP levels.<sup>[39]</sup> In another study on healthy subjects, after 40 min of mental stress, the effect of personality trait of desire for new experiences on serum CRP level was investigated. The results of this study showed that the association of personality characteristics with CRP levels is significant in dependent on the race (black vs. white participants).<sup>[40]</sup> Furthermore, in a study on healthy women the personality traits of harm avoidance and self-directedness have been associated with higher levels of CRP.<sup>[10]</sup> In elderly individuals who ranged in age from approximately 70-73 years, Möttus *et al.* found evidence for low conscientiousness and low openness associated with higher levels of inflammation (CRP).<sup>[41]</sup> In another study, Sutin *et al.* reported high neuroticism and low conscientiousness associated with higher levels of interleukin -6.<sup>[42]</sup> These studies as well as ours show that there are effects of specific personality characteristics on systemic inflammation (serum CRP levels).

No relationship of personality characteristics with FMD in our study could be influenced by several factors; (1) in most previous studies type D personality has been studied and there are few reports using the NEO Personality Inventory to assess personality characteristics. (2) As a limitation for our study, study population was the employees of a single industrial company and our results are not generalizable to other populations. (3) As it was mentioned the race can be an effective factor in the association of personality traits and endothelial function<sup>[40]</sup> and it is possible that our society is different with other societies in this regard. (4) Finally, the possibility of publishing bias should not be far from the minds, as some studies showed the association of psychological factors such as anxiety/depression,<sup>[43-48]</sup> and others showed no association between mood disorders and systemic inflammation or endothelial dysfunction.<sup>[49-52]</sup> It seems that more studies are required to demonstrate the relationships between personality characteristics and endothelial function as well as inflammation.

## CONCLUSIONS

According to the results of our study, in our population who were the employees of an industrial company,

no relationship was found between personality characteristics measured by the NEO Personality test and endothelial dysfunction. However, similar to previous studies, we found that the personality trait of responsibility (conscientiousness) is negatively associated with inflammation (hs-CRP level). More multi-center studies with a larger sample size and also cohort studies are recommended in this regard.

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