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### Psychologic Markers of Stress, Anxiety, and Depression Are Associated With Indices of Vascular Impairment in Women With High Stress Levels and Advanced Coronary Artery Disease

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**Background:** Psychologic stress, anxiety, and depression have been linked in several epidemiologic studies to the development and progression of coronary artery disease (CAD). However, the mechanism of the negative impact of these psychologic factors on CAD progression remains to be fully elucidated. Recent studies have suggested that depression and negative mood may adversely impact the vascular endothelium, which may represent one link between these psychologic factors and CAD.

**Purpose:** The purpose of this study was therefore to investigate the association between psychologic markers of perceived stress, anxiety, depression, and indices of vascular health and function in women with high stress levels and advanced CAD. We hypothesized that there would be significant associations between psychologic markers of mood and impaired vascular health and function.

**Methods:** Twenty-two non-Hispanic white female patients (mean age = 64.8 years), who were stressed per Holmes and Rahe Life Change, or Perceived Stress Scales, with advanced CAD

(> 50% stenosis) underwent assessment of vascular endothelial function via brachial artery reactive hyperemia following 5 minutes of forearm occlusion using Doppler ultrasound (FMD) and concurrent assessment of peripheral arterial tone (RHI-PAT) in the second digit. Other indices of vascular health included carotid intima media thickness, carotid compliance (internal elastic modulus), high sensitivity C-reactive protein (CRP), and pro-brain natriuretic peptide hormone. Psychologic markers included depression (Center for Epidemiological Studies Depression Scale), perceived stress (Perceived Stress Scale [PSS-14]), 12-Item Short-Form Health Survey Mental Component, social support (Enhancing Recovery in Coronary Heart Disease [ENRICH]) intervention, control, and anxiety. Spearman's rho was used to assess associations between variables.

**Results:** Statistically significant moderate associations were found between indices of vascular health and psychologic measures of anxiety, perceived stress, and depression (**Table**). RHI-PAT was associated with social support (ENRICH),  $r_s = .51$ ,  $P = .02$ , but it was not associated with other markers or indices although a trend for an inverse association was observed with perceived stress ( $r_s = -.40$ ,  $P = .076$ ). CRP was associated with the SF-12 Mental Component ( $r_s = -.48$ ,  $P = .04$ ).

**Conclusions:** Results suggest that depression is a major factor associated with impaired vascular endothelial function and arterial health in women with high levels of stress and advanced CAD. This study supports the need to consider depression in CAD risk factor profiling, and underscores the need to investigate interventions that target depression to attenuate its putative adverse effects on vascular health and function. Moreover, the presence of increased stress and anxiety may pose an additional CAD risk burden that should be investigated further.

**TABLE**  
ASSOCIATION BETWEEN SELECTED INDICES OF VASCULAR HEALTH AND PSYCHOLOGICAL MARKERS

Variables (n = 22)	Peak % FMD	TP FMD	FMD-AUC	Pro-BNP	CRP	CIMT	CIEM
Mean (SD)	4.3 (2.7)%	84 (59)	421 (340)	248 (244)	1.9 (1.5)	0.68 (0.16)	.092 (.039)
Depression 8.8 (6.9)	$r_s = -.61$ $P = < .01$	$r_s = .61$ $P = < .01$	$r_s = -.51$ $P = .03$	$r_s = .59$ $P = < .01$	$r_s = .57$ $P = .01$	$r_s = .07$ $P = .71$	$r_s = -.44$ $P = .06$
Perceived stress 23.2 (6.1)	$r_s = -.03$ $P = .88$	$r_s = .08$ $P = .72$	$r_s = -.01$ $P = .98$	$r_s = .43$ $P = .05$	$r_s = .41$ $P = .06$	$r_s = -.51$ $P = .02$	$r_s = .01$ $P = .95$
Anxiety 0.61 (0.48)	$r_s = -.18$ $P = .44$	$r_s = .47$ $P = .04$	$r_s = -.12$ $P = .60$	$r_s = -.10$ $P = .69$	$r_s = -.64$ $P = < .01$	$r_s = -.22$ $P = .35$	$r_s = .27$ $P = .25$

CIEM = carotid internal elastic modulus; CIMT = carotid intima media thickness (mm); CRP = C-reactive protein (mg/dL); FMD = flow mediated vasodilation (percent); FMD-AUC = flow mediated vasodilation area under the curve (percent × seconds); pro-BNP = pro-brain natriuretic peptide hormone (pg/mL); TP FMD = time to peak flow mediated vasodilation (seconds)