Invasive coronary procedure use and outcomes among veterans with posttraumatic stress disorder: Insights from the Veterans Affairs Clinical Assessment, Reporting, and Tracking Program

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Background Posttraumatic stress disorder (PTSD) is prevalent in the general population and US veterans in particular and is associated with an increased risk of developing coronary artery disease (CAD). We compared the patient characteristics and postprocedural outcomes of veterans with and without PTSD undergoing coronary angiography.

Methods This is a multicenter observational study of patients who underwent coronary angiography in Veterans Affairs hospitals nationally from October 2007 to September 2011. We described patient characteristics at angiography, angiographic results, and after coronary angiography, we compared risk-adjusted 1-year rates of all-cause mortality, myocardial infarction (MI), and revascularization by the presence or absence of PTSD.

Results Overall, of 116,488 patients undergoing angiography, 14,918 (12.8%) had PTSD. Compared with those without PTSD, patients with PTSD were younger (median age 61.9 vs 63.7; $P < .001$), had higher rates of cardiovascular risk factors, and were more likely to have had a prior MI (26.4% vs 24.7%; $P < .001$). Patients with PTSD were more likely to present for stable angina (22.4% vs 17.0%) or atypical chest pain (58.5% vs 48.6%) and less likely to have obstructive CAD identified at angiography (55.9% vs 62.2%; $P < .001$). After coronary angiography, PTSD was associated with lower unadjusted 1-year rates of MI (hazard ratio (HR), 0.86; 95% CI [0.75-1.00]; $P = 0.04$), revascularization (HR, 0.88; 95% CI [0.83-0.93]; $P < .001$), and all-cause mortality (HR, 0.66; 95% CI [0.60-0.71]; $P < .001$). After adjustment for cardiovascular risk, PTSD was no longer associated with 1-year rates of MI or revascularization but remained associated with lower 1-year all-cause mortality (HR, 0.91; 95% CI [0.84-0.99]; $P = .03$). Findings were similar after further adjustment for depression, anxiety, alcohol or substance use disorders, and frequency of outpatient follow-up.

Conclusions Among veterans undergoing coronary angiography in the Veterans Affairs, those with PTSD were more likely to present with elective indications and less likely to have obstructive CAD. After coronary angiography, PTSD was not associated with adverse 1-year outcomes of MI, revascularization, or all-cause mortality. (Am Heart J 2014;168:381-390.e6.)

Posttraumatic stress disorder (PTSD) is thought to affect 7% of the US population, with a higher prevalence among combat veterans.[1-3] The disorder is a cause of substantial mental and physical health burden.[4,5] One contributor to this burden is coronary artery disease (CAD). Studies have consistently demonstrated that patients with PTSD are at increased risk for developing and dying of CAD, relative to patients without PTSD.[6-14]

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However, the diagnosis and management of CAD among patients with PTSD, with its consequent effects on cardiac outcomes, are poorly described.

In the diagnosis and management of CAD, coronary angiography has an important role. The clinical decision to proceed with coronary angiography is based upon patient symptoms, risk of CAD, and the implications of possible angiographic findings. Among patients with PTSD, consideration for coronary angiography may be complicated by somatic symptoms, including chest pain as well as a higher prevalence of cardiovascular risk factors.[15-17] Thus, providers may be more likely to refer patients with PTSD for coronary angiography. Alternatively, ischemic symptoms may be incorrectly attributed to somatic symptoms of PTSD, either by the provider or by the patient, leading to delays in referral to coronary angiography. To date, the results of coronary angiography have not been described among patients with PTSD.

In addition to implications for patient selection, PTSD may impact patient outcomes after coronary angiography.[6,9,11] Not only is PTSD independently associated with cardiovascular mortality, PTSD is also strongly associated with concurrent depression and anxiety, both of which are associated with cardiovascular mortality.[18-24] Furthermore, PTSD is associated with alcohol and substance use as well as differences in frequency of outpatient follow-up that may contribute to postprocedural outcomes.[25-29] However, outcomes after coronary angiography among patients with PTSD have not been studied.

The VA Clinical Assessment, Reporting, and Tracking (CART) Program provides a unique opportunity to evaluate the patient characteristics, procedural indications, and results of coronary angiography among patients with and without PTSD as well as their longitudinal outcomes. The CART Program collects patient and procedural data from all veterans undergoing coronary angiography. Using these data, we described the characteristics and angiographic results of patients diagnosed with PTSD who have undergone coronary angiography. We then evaluated risk-adjusted 1-year outcomes of patients after coronary angiography, comparing them by the presence or absence of PTSD diagnosis. Finally, we determined whether concurrent depression or anxiety, alcohol or substance use disorders, or frequency of postprocedural follow-up explained differences in risk-adjusted outcomes among patients with versus without PTSD.

Methods

Data source

The VA CART Program uses a software application embedded in the VA electronic health record (EHR) for medical record documentation and concurrent collection of patient and procedural data for all coronary procedures conducted in VA nationwide. These data are linked to other VA data repositories, allowing assessment of longitudinal mortality, hospitalization, outpatient visits, pharmacy prescription, and laboratory data. In addition, CART data are linked to fee-based data for hospitalizations at non-VA centers, where VA pays for the veterans' care. Details on CART and the validity, completeness, and timeliness of CART data have been previously described.[30-32]

Study population and setting study population

We evaluated all 127,981 veterans undergoing coronary angiography in VA between October 1, 2007, and September 30, 2011. We excluded 11,493 (9.0%) patients with a recent history of severe mental illness (ie, psychotic disorders, bipolar disorders, or organic psychotic disorders) as evidenced by *International Classification of Diseases, Ninth Revision* (*ICD-9*) codes (see Online Supplement) associated with any visit to a VA facility in the year before the coronary angiogram. Our final cohort consisted of 116,488 veterans undergoing coronary angiography.

Measures

History of PTSD. Posttraumatic stress disorder status was determined from documentation in the EHR at the time of coronary angiography or *ICD-9* codes for PTSD (309.81) associated with any visit to a VA facility in the year before angiography.[33] The assessment of *ICD-9* codes was limited to the year preceding angiography to increase the likelihood of an active PTSD diagnosis at the time of the coronary angiogram.

Outcome measures. The primary 1-year postprocedural outcome was the composite of all-cause mortality, myocardial infarction (MI), and revascularization (both percutaneous coronary intervention [PCI] and coronary artery bypass surgery [CABG]). Secondary outcomes included individual 1-year all-cause mortality, MI, and revascularization. We excluded MI codes occurring within the 14-day period after the index PCI based on prior work demonstrating that these reflect the index presentation and coronary procedure, rather than representing a de novo MI.[34] We considered revascularization procedures occurring within 30 days of angiography to reflect initial treatment, and these procedures were not counted in revascularization outcomes.[35]

Explanatory variables. We anticipated that concurrent depression or anxiety, alcohol and substance abuse disorders, and frequency of follow-up in the health care system would explain differences in outcomes among patients with PTSD. We determined the presence of depression, anxiety, alcohol dependence or abuse, and substance dependence or abuse from *ICD-9* codes (see Online Supplement) associated with any visit to a VA facility in the year before the coronary angiogram. For each patient, we defined the frequency of outpatient follow-up as the number of outpatient visits to a VA facility in the year after angiography.

Covariates. We assessed patient demographics, clinical risk factors, Framingham risk score, preprocedural stress testing, acuity of presentation/indication, and coronary angiographic results. Patient demographics, risk factors, and acuity of presentation/indication were determined from the EHR using standard definitions.[36] Framingham risk scores were calculated using patient demographics, blood pressure at presentation, and cholesterol data obtained within 6 months before angiography.[37] For patients with missing cholesterol data (5%), data were imputed using multivariate sequential regression (IVEware, Ann Arbor, Michigan).[38] Framingham scores were categorized by 10-year coronary heart disease risk (<10%, low; 10%-20%, intermediate; and >20%, high).[39,40] Performance of a preprocedural stress test (exercise treadmill testing, stress echocardiography, or stress nuclear perfusion imaging) was determined from patient data in CART or VA EHR data documenting that a stress test was performed in the preceding 90 days. Stress test results were categorized as positive, negative, equivocal, or unknown from provider documentation. Coronary angiographic results were determined from documentation in CART procedure reports. Obstructive CAD was defined as stenosis of >50% in the left main coronary artery or any stenosis >70% in any other coronary vessel.[41] Angiographically, normal coronaries were defined as angiographic findings of stenosis <20% in all vessels from coronary segment-specific data and normal coronaries by summary descriptive data.[42]

Statistical analysis

In descriptive analyses, we first compared demographic and clinical characteristics, Framingham risk scores, preprocedural stress test findings, indications for coronary angiography, and angiographic findings by the presence or absence of the diagnosis of PTSD. We also compared the characteristics and angiographic findings of patients by mental health diagnostic status, dividing patients into the following 4 groups: (1) patients with depression, anxiety, or PTSD; (2) patients with PTSD alone; (3) patients with depression or anxiety alone; and (4) patients with both PTSD and depression or anxiety. To further understand differences in patient selection for coronary angiography, we performed analyses limited to patients undergoing coronary angiography for elective indications that have been associated with greater variation in patient selection in prior studies.[42,43] In this analysis, we excluded patients with emergent or urgent indications for coronary angiography (acute coronary syndromes, acute MI, or cardiogenic shock) and coronary angiography performed in consideration of transplantation, valvular surgery, or cardiomyopathy/heart failure evaluations. To be consistent with prior studies, we also excluded patients with a prior history of MI, PCI, CABG, cardiac transplantation, or valvular surgery.[42,43] Comparisons were conducted using χ^2 tests for categorical variables and Mann-Whitney-Wilcoxon nonparametric tests for continuous variables.

To compare postprocedural outcomes by PTSD diagnosis, we constructed a series of Cox proportional hazards models with PTSD diagnosis as the independent predictor. The null model was used to assess the unadjusted association between PTSD diagnosis and postprocedural outcomes. We then determined the cardiovascular and nonmental health comorbidity risk-adjusted association between PTSD and 1-year outcomes with covariates selected based on clinical reasoning and prior studies.[6-9] This model included covariates for age, race, tobacco use, diabetes, hypertension, hyperlipidemia, peripheral vascular disease, cerebrovascular disease, congestive heart failure, chronic obstructive pulmonary disease, obese or overweight, renal function (modeled by estimated glomerular filtration rate (eGFR) mL/min >90, 60-90, 30-60, and <30), prior MI, prior PCI, prior CABG, coronary disease severity (1-vessel, 2-vessel, or 3-vessel/left main disease), status (elective, emergent, and salvage), indication (ST-segment elevation MI, non–ST-segment elevation MI, unstable angina, stable ischemic heart disease, or valvular/cardiomyopathy/other), and initial treatment of obstructive CAD (PCI, CABG, or medical therapy only). We repeated analyses to adjust for preprocedural hemoglobin level among the 102,121 (87%) patients with data for this covariate.

To determine whether depression or anxiety, alcohol or substance dependence or abuse, or outpatient follow-up mediated the association between PTSD and 1-year outcomes, covariates were added sequentially to the previous model in the following order: (1) depression or anxiety, (2) alcohol or substance dependence or abuse, and (3) frequency of outpatient follow-up. To determine the association between each category of PTSD and depression or anxiety diagnosis with outcomes, all models were repeated with independent variables for the 4 mental health diagnostic status groups described above. We then conducted subgroup analyses stratified on the presence or absence of obstructive CAD identified at the time of angiography. We evaluated for violation of the assumption of proportional hazards through plots of survival and log(-log(survival)) (Online Supplement). All tests for statistical significance were 2-tailed, and $P < .05$ was considered statistically significant. All statistical analyses were performed by the CART Coordinating Center at the Denver VA Medical Center using SAS version 9.2 (SAS Institute Inc, Cary, NC). This study was approved by the Colorado Multiple Institutional Review Board. No extramural funding was used to support this work, and the authors are solely responsible for the design and conduct of this study, all study analyses, the drafting and editing of the paper, and its final contents.

Sensitivity analysis

In sensitivity analysis, we excluded patients without a prior year PTSD diagnosis who were observed to have an *ICD-9* code for PTSD associated with any visit to a VA facility in the year after the coronary angiogram.

Table I. Patient characteristics, clinical presentation, and angiographic results of all patients undergoing diagnostic angiography by PTSD status

Characteristic	All patients, n = 116488	No PTSD, n = 101571 (87.2%)	PTSD, n = 14917 (12.8%)	*P* value
Demographics				
Age, median (IQR)	63.3 (59, 69.9)	63.7 (58.9, 71.1)	61.9 (59.4, 64.3)	<.001
Male	113314 (97.3)	98864 (97.3)	14450 (96.9)	.001
White	96587 (82.9)	84515 (83.2)	12072 (80.9)	<.001
Prior coronary history				
Prior MI	29019 (24.9)	25086 (24.7)	3933 (26.4)	<.001
Prior PCI	34982 (30.0)	30354 (29.9)	4628 (31.0)	.005
Prior CABG	25273 (21.7)	22435 (22.1)	2838 (19.0)	<.001
Risk factors and comorbidities				
History of smoking	68605 (58.9)	58593 (57.7)	10012 (67.1)	<.001
Diabetes	51773 (44.4)	44548 (43.9)	7225 (48.4)	<.001
Hypertension	101752 (87.4)	88466 (87.1)	13286 (89.1)	<.001
Hyperlipidemia	98633 (84.7)	85415 (84.1)	13218 (88.6)	<.001
Total cholesterol, mg/dL, median (IQR)	164 (140, 192)	163 (140, 192)	166 (143, 195)	<.001
LDL	93 (73, 117)	93 (73, 117)	93 (74, 118)	.02
HDL	38 (32, 45)	38 (32, 45)	37 (32, 44)	<.001
Peripheral vascular disease	22836 (19.6)	20137 (19.8)	2699 (18.1)	<.001
Cerebrovascular disease	18013 (15.5)	15810 (15.6)	2203 (14.8)	.01
Congestive heart failure	29423 (25.3)	26171 (25.8)	3252 (21.8)	<.001
COPD	25580 (22.0)	21764 (21.4)	3816 (25.6)	<.001
Obese	51307 (44.0)	43458 (42.8)	7849 (52.6)	<.001
Overweight	23643 (31.5)	20644 (32.2)	2999 (27.6)	<.001
GFR, mL/min, median (IQR)	77 (61, 89)	77 (61, 89)	77 (65, 91)	<.001
Renal failure	12508 (10.7)	11137 (11.0)	1371 (9.2)	<.001
Dialysis	2805 (2.4)	2514 (2.5)	291 (2.0)	<.001
Depression	31059 (26.7)	21094 (20.8)	9965 (66.8)	<.001
Anxiety	11138 (9.6)	8127 (8.0)	3011 (20.2)	<.001
Alcohol abuse or dependence	8123 (7.0)	6223 (6.1)	1900 (12.7)	<.001
Other substance abuse or dependence	4664 (4.0)	3429 (3.4)	1235 (8.3)	<.001
Framingham Risk				
Low	24102 (20.7)	20900 (20.6)	3202 (21.5)	
Intermediate	63618 (54.6)	55322 (54.5)	8296 (55.6)	<.001
High	28768 (24.7)	25349 (25.0)	3419 (22.9)	
Procedural indication*				
STEMI	2293 (2.0)	2085 (2.1)	208 (1.4)	<.001
NSTEMI	8251 (7.1)	7402 (7.3)	849 (5.7)	<.001
Unstable angina	12968 (11.1)	11028 (10.9)	1940 (13.0)	<.001
Stable angina	20573 (17.7)	17233 (17.0)	3340 (22.4)	<.001
Atypical chest pain	58065 (49.8)	49335 (48.6)	8730 (58.5)	<.001
Ischemic heart disease	20991 (18.0)	18424 (18.1)	2567 (17.2)	.006
Positive functional study	39972 (34.3)	34388 (33.9)	5584 (37.4)	<.001
Cardiomyopathy/CHF	11615 (10.0)	10459 (10.3)	1156 (7.7)	<.001
Valvular disease	7962 (6.8)	7254 (7.1)	708 (4.7)	<.001
Noninvasive test performed	49750 (42.7)	42963 (42.3)	6787 (45.5)	<.001
Noninvasive result when performed				
Positive	18027 (36.2)	15305 (35.6)	2722 (40.1)	
Negative	1573 (3.2)	1309 (3.0)	264 (3.9)	<.001
Equivocal	1260 (2.5)	1023 (2.4)	237 (3.5)	
Unknown	28890 (58.1)	25326 (58.9)	3564 (52.5)	
Medications at presentation				
β-blockers	89992 (77.3)	78560 (77.3)	11432 (76.6)	.05
Nitrates	24851 (21.3)	21568 (21.2)	3283 (22.0)	.03
Calcium-channel blockers	35199 (30.2)	30671 (30.2)	4528 (30.4)	.69
Statins	89062 (76.5)	77431 (76.2)	11631 (78.0)	<.001
Angiographic findings				
Normal	12935 (11.1)	10856 (10.7)	2079 (13.9)	<.001
Obstructive CAD	71477 (61.4)	63139 (62.2)	8338 (55.9)	<.001
1-vessel CAD	19996 (17.2)	17310 (17.0)	2686 (18.0)	
2-vessel CAD	17101 (14.7)	15038 (14.8)	2063 (13.8)	<.001
3-vessel CAD or left main	34380 (29.5)	30791 (30.3)	3589 (24.1)	
Unknown	10841 (9.3)	9541 (9.4)	1300 (8.7)	<.001

Abbreviations: *IQR*, interquartile range; *LDL*, low-density lipoprotein; *HDL*, high-density lipoprotein; *COPD*, chronic obstructive pulmonary disease; *GFR*, glomerular filtration rate; *STEMI*, ST-segment elevation myocardial infarction; *NSTEMI*, non–ST-segment elevation myocardial infarction; *CHF*, congestive heart failure.
Reported as n (%) unless otherwise specified.
*Procedural indication categories are not mutually exclusive, and percentages may exceed 100.

Table I (*continued*)

No PTSD or depression or anxiety, n = 76706 (65.8%)	PTSD alone, n = 4241 (3.6%)	Depression or anxiety alone, n = 24865 (21.3%)	PTSD with depression or anxiety, n = 10676 (9.2%)	*P* value
64.3 (59.7, 72.2)	62.5 (60.3, 64.9)	61.8 (56.6, 67.3)	61.7 (59, 64)	<.001
75196 (98.0)	4183 (98.6)	23668 (95.2)	10267 (96.2)	<.001
63269 (82.5)	3301 (77.8)	21246 (85.4)	8771 (82.2)	<.001
18273 (23.8)	1097 (25.9)	6813 (27.4)	2836 (26.6)	<.001
22189 (28.9)	1301 (30.7)	8165 (32.8)	3327 (31.2)	<.001
16669 (21.7)	760 (17.9)	5766 (23.2)	2078 (19.5)	<.001
42815 (55.8)	2816 (66.4)	15778 (63.5)	7196 (67.4)	<.001
33264 (43.4)	2055 (48.5)	11284 (45.4)	5170 (48.4)	<.001
66537 (86.7)	3820 (90.1)	21929 (88.2)	9466 (88.7)	<.001
63976 (83.4)	3726 (87.9)	21439 (86.2)	9492 (88.9)	<.001
163 (140, 191)	164 (141, 193)	165 (142, 194)	167 (144, 196)	<.001
92 (73, 117)	92 (72, 117)	93 (74, 117)	94 (75, 118)	.002
38 (32, 45)	38 (32, 45)	37 (31, 45)	37 (31, 44)	<.001
15155 (19.8)	810 (19.1)	4982 (20.0)	1889 (17.7)	<.001
11606 (15.1)	601 (14.2)	4204 (16.9)	1602 (15.0)	<.001
19688 (25.7)	985 (23.2)	6483 (26.1)	2267 (21.2)	<.001
15340 (20.0)	1026 (24.2)	6424 (25.8)	2790 (26.1)	<.001
31730 (41.4)	2125 (50.1)	11728 (47.2)	5724 (53.6)	<.001
15783 (33.2)	916 (30.1)	4861 (29.3)	2083 (26.7)	<.001
77 (60, 88)	77 (65, 91)	77 (63, 91)	77 (65, 91)	<.001
8489 (11.1)	425 (10.0)	2648 (10.6)	946 (8.9)	<.001
1923 (2.5)	107 (2.5)	591 (2.4)	184 (1.7)	<.001
		21094 (84.8)	9965 (93.3)	<.001
		8127 (32.7)	3011 (28.2)	<.001
3901 (5.1)	482 (11.4)	2322 (9.3)	1418 (13.3)	<.001
1820 (2.4)	282 (6.6)	1609 (6.5)	953 (8.9)	<.001
14953 (19.5)	830 (19.6)	5947 (23.9)	2372 (22.2)	
41824 (54.5)	2306 (54.4)	13498 (54.3)	5990 (56.1)	
19929 (26.0)	1105 (26.1)	5420 (21.8)	2314 (21.7)	<.001
1649 (2.1)	62 (1.5)	436 (1.8)	146 (1.4)	<.001
5681 (7.4)	282 (6.6)	1721 (6.9)	567 (5.3)	<.001
7902 (10.3)	497 (11.7)	3126 (12.6)	1443 (13.5)	<.001
12693 (16.5)	936 (22.1)	4540 (18.3)	2404 (22.5)	<.001
36131 (47.1)	2357 (55.6)	13204 (53.1)	6373 (59.7)	<.001
13910 (18.1)	717 (16.9)	4514 (18.2)	1850 (17.3)	.05
26114 (34.0)	1536 (36.2)	8274 (33.3)	4048 (37.9)	<.001
8222 (10.7)	384 (9.1)	2237 (9.0)	772 (7.2)	<.001
5828 (7.6)	208 (4.9)	1426 (5.7)	500 (4.7)	<.001
32526 (42.4)	1848 (43.6)	10437 (42.0)	4939 (46.3)	<.001
11530 (35.4)	785 (42.5)	3775 (36.2)	1937 39.2)	
946 (2.9)	69 (3.7)	363 (3.5)	195 (3.9)	<.001
759 (2.3)	66 (3.6)	264 (2.5)	171 (3.5)	
19291 (59.3)	928 (50.2)	6035 (57.8)	2636 (53.4)	
59117 (77.1)	3284 (77.4)	19443 (78.2)	8148 (76.3)	<.001
15688 (20.5)	861 (20.3)	5880 (23.6)	2422 (22.7)	<.001
23123 (30.1)	1332 (31.4)	7548 (30.4)	3196 (29.9)	.30
58262 (76.0)	3263 (76.9)	19169 (77.1)	8368 (78.4)	<.001
7621 (9.9)	502 (11.8)	3235 (13.0)	1577 (14.8)	<.001
48584 (63.3)	2485 (58.6)	14555 (58.5)	5853 (54.8)	<.001
13045 (17.0)	795 (18.7)	4265 (17.2)	1891 (17.7)	
11604 (15.1)	616 (14.5)	3434 (13.8)	1447 (13.6)	<.001
23935 (31.2)	1074 (25.3)	6856 (27.6)	2515 (23.6)	
7308 (9.5)	393 (9.3)	2233 (9.0)	907 (8.5)	<.001

Results

Patient characteristics at coronary angiography

Overall, 14,917 (12.8%) patients undergoing coronary angiography had a diagnosis of PTSD (Table I). Compared with patients without PTSD, patients with PTSD were younger (median age 61.9 vs 63.7; $P < .001$), had higher rates of cardiovascular risk factors, including smoking, hypertension, hyperlipidemia, and diabetes, and were more likely to have had a prior MI (26.4% vs 24.7%; $P < .001$) or PCI (31.0% vs 29.9%; $P < .001$). However, global estimates of coronary risk were lower in patients with PTSD (high Framingham risk category 22.9% vs

Table II. Association between PTSD and 1-year outcomes after coronary angiography

Outcome	Model	HR (95% CI)	*P* value
Death, MI, or revascularization	Unadjusted	0.79 (0.75-0.83)	<.001
	CV risk	0.95 (0.90-1.00)	.03
	CV risk + depression/anxiety	0.94 (0.90-0.99)	.02
	CV risk + depression/anxiety + alcohol/substance	0.94 (0.89-0.98)	.008
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.94 (0.89-0.98)	<.001
Death	Unadjusted	0.66 (0.60-0.71)	<.001
	CV risk	0.91 (0.84-0.99)	.03
	CV risk + depression/anxiety	0.87 (0.81-0.94)	<.001
	CV risk + depression/anxiety + alcohol/substance	0.86 (0.79-0.93)	<.001
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.85 (0.78-0.92)	<.001
MI	Unadjusted	0.86 (0.75-1.00)	.04
	CV risk	1.00 (0.87-1.14)	.96
	CV risk + depression/anxiety	0.97 (0.83-1.12)	.64
	CV risk + depression/anxiety + alcohol/substance	0.95 (0.82-1.10)	.51
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.95 (0.82-1.10)	.49
Revascularization	Unadjusted	0.88 (0.83-0.93)	<.001
	CV risk	0.98 (0.92-1.04)	.49
	CV risk + depression/anxiety	1.00 (0.94-1.07)	.99
	CV risk + depression/anxiety + alcohol/substance	1.00 (0.93-1.07)	.97
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.99 (0.93-1.06)	.83

Abbreviation: *CV*, cardiovascular.

25.0%; $P < .001$). Patients with PTSD had much higher rates of concurrent depression and anxiety as compared with patients without PTSD. Patients with PTSD were also more likely to have a diagnosis of alcohol abuse or dependence or substance abuse or dependence. Patients with PTSD were more likely to undergo angiography for elective indications of stable angina (22.4% vs 17.0%) or atypical chest pain (58.5% vs 48.6%). The results of coronary angiography were less likely to demonstrate obstructive CAD in patients with PTSD (55.9% vs 62.2%; $P < .001$).

In analyses stratified on the presence or absence of depression or anxiety in addition to PTSD, patients with PTSD and/or depression or anxiety were younger, more likely to have cardiovascular risk factors, have a history of prior MI or PCI, and have diagnoses of substance or alcohol dependence or abuse, relative to patients without PTSD, depression, or anxiety (Table I). Furthermore, patients with PTSD and/or depression or anxiety were more likely to undergo angiography for elective indications and less likely to have obstructive CAD identified at angiography. In analyses restricted to patients undergoing coronary angiography for elective indications, patients with PTSD were also less likely to have angiographic findings of obstructive CAD (41.0% vs 49.4%; $P < .001$) (see online Appendix Supplementary Table I in the Online Supplement).

Outcomes after coronary angiography

Within 1-year of coronary angiography, 1,990 patients (1.71%) had an MI; 9,574 (8.22%) coronary revascularization; and 6,952 patients (5.97%) died. In unadjusted analyses, PTSD was associated with lower 1-year rates of MI (HR, 0.86; 95% CI [0.75-1.00]; $P = .04$), revascularization (HR, 0.88; 95% CI [0.83-0.93]; $P < .001$), and all-cause mortality (HR, 0.66; 95% CI [0.60-0.71]; $P < .001$). After adjustment for cardiovascular and nonpsychiatric comorbidities, PTSD was associated with lower risk-adjusted 1-year combined outcome (HR, 0.95; 95% CI [0.90-1.00]; $P = 0.03$) and all-cause mortality (HR, 0.91; 95% CI [0.84-0.99]; $P = .03$) but not with 1-year MI or revascularization outcomes (Table II). This association was not changed by further adjustment for depression and anxiety, substance or alcohol use, or outpatient follow-up frequency. In sensitivity analysis, the exclusion of patients without a prior year diagnosis of PTSD who were seen for PTSD in the year subsequent to the diagnosis of obstructive CAD did not influence our findings (see online Appendix Supplementary Table II in the Online Supplement). In addition, analyses that adjusted for preprocedural hemoglobin level among patients with available data for this covariate did not alter our results (see online Appendix Supplementary Table III in the Online Supplement).

Analyses stratified on the presence or absence of depression or anxiety and PTSD demonstrated are shown in Table III. Compared with patients without PTSD, depression, or anxiety, this analysis demonstrated that patients with PTSD had similar or lower risk-adjusted outcomes regardless of the presence or absence of concurrent depression or anxiety. In contrast, patients with depression or anxiety in the absence of PTSD appeared to have worse fully risk-adjusted 1-year all-cause mortality (HR, 1.14, 95% CI [1.08-1.20s; $P < .001$), similar MI rates (HR, 1.02; 95% [CI 0.93-1.13]; $P = .63$), and lower rates of revascularization at 1-year (HR, 0.92; 95% [CI 0.87-0.97]; $P = .004$).

Table III. Association between PTSD and/or depression or anxiety with one-year outcomes following coronary angiography

		PTSD alone		Depression or anxiety alone		PTSD with depression or anxiety	
Outcome	**Model**	**HR (95% CI)**	***P***	**HR (95% CI)**	***P***	**HR (95% CI)**	***P***
Death, MI, or revascularization	Unadjusted	0.81 (0.73-0.89)	<.001	0.91 (0.87-0.95)	<.001	0.76 (0.71-0.80)	<.001
	CV risk	0.93 (0.84-1.02)	.14	1.01 (0.97-1.05)	.64	0.96 (0.90-1.02)	.19
	CV risk + alcohol/substance	0.92 (0.83-1.01)	.09	1.00 (0.96-1.04)	.93	0.95 (0.89-1.01)	.07
	CV risk + alcohol/substance + follow-up frequency	0.92 (0.83-1.01)	.08	1.01 (0.97-1.05)	.72	0.95 (0.90-1.01)	.13
Death	Unadjusted	0.71 (0.61-0.82)	<.001	0.97 (0.91-1.02)	.23	0.63 (0.56-0.70)	<.001
	CV risk	0.91 (0.79-1.05)	.19	1.12 (1.06-1.18)	<.001	0.96 (0.86-1.06)	.41
	CV risk + alcohol/substance	0.89 (0.77-1.03)	.11	1.11 (1.04-1.17)	<.001	0.93 (0.84-1.03)	.18
	CV risk + alcohol/substance + follow-up frequency	0.85 (0.73-0.98)	.02	1.14 (1.08-1.20)	<.001	0.97 (0.87-1.07)	.51
MI	Unadjusted	0.74 (0.57-0.96)	.03	1.04 (0.94-1.14)	.47	0.92 (0.78-1.08)	.33
	CV risk	0.82 (0.63-1.07)	.14	1.05 (0.95-1.15)	.35	1.09 (0.93-1.28)	.29
	CV risk + alcohol/substance	0.81 (0.62-1.04)	.10	1.04 (0.94-1.14)	.48	1.06 (0.91-1.25)	.45
	CV risk + alcohol/substance + follow-up frequency	0.81 (0.63-1.05)	.11	1.02 (0.93-1.13)	.63	1.05 (0.89-1.23)	0.60
Revascularization	Unadjusted	0.89 (0.79-1.01)	.07	0.87 (0.82-0.92)	<.001	0.83 (0.78-0.89)	<.001
	CV risk	0.97 (0.86-1.09)	.64	0.94 (0.89-1.00)	.04	0.96 (0.89-1.03)	.27
	CV risk + alcohol/substance	0.97 (0.86-1.09)	.61	0.94 (0.89-1.00)	.03	0.96 (0.89-1.03)	.22
	CV risk + alcohol/substance + follow-up frequency	0.98 (0.86-1.10)	.68	0.92 (0.87-0.97)	.004	0.92 (0.86-0.99)	.03

In subgroup analyses stratified on the presence or absence of obstructive CAD identified at angiography, PTSD was not associated with 1-year combined or individual outcomes after all levels of risk adjustment among patients without obstructive CAD (online Appendix Supplementary Table IV). In patients with obstructive CAD, PTSD was not associated with 1-year outcomes after adjustment for cardiovascular and nonpsychiatric comorbidities (online Appendix Supplementary Table IV). After further adjustment for depression and anxiety, PTSD was not associated with 1-year MI or revascularization but was associated with lower risk-adjusted 1-year all-cause mortality (HR, 0.89; 95% CI [0.80-0.99]; $P = .03$). This association was not changed by additional risk adjustment for substance or alcohol use or frequency of outpatient follow-up.

Discussion

We sought to describe the characteristics and outcomes of patients with PTSD undergoing coronary angiography in the VA health care system. Among more than 115,000 patients undergoing coronary angiography nationally in the VA, nearly 13% had a diagnosis of PTSD. Patients with PTSD were more likely to undergo angiography for elective indications and less likely to have obstructive CAD, compared with patients without PTSD. Nonetheless, PTSD patients had similar 1-year rates of MI, revascularization, and lower rates of all-cause mortality after coronary angiography compared with non-PTSD patients, after adjusting for cardiovascular risk and nonpsychiatric comorbidity. After further adjustment for concurrent depression, anxiety, and alcohol or substance use disorders and frequency of outpatient follow-up, PTSD diagnosis remained associated with lower risk-adjusted 1-year all-cause mortality (HR, 0.85; 95% CI [0.78-0.92]) but not outcomes of MI or revascularization.

To our knowledge, our study is the first to describe the characteristics of patients with PTSD undergoing coronary angiography. We observed a higher prevalence of prior MI, PCI, or CABG among patients with PTSD undergoing angiography, despite PTSD patients being younger than those without the disorder. These findings are consistent with prior studies demonstrating a higher risk of incident coronary disease among patients with PTSD.[6-14] We observed a higher prevalence of cardiovascular risk factors among patients with PTSD as a potential contributory factor to increased CAD risk among PTSD patients. However, given the importance of age in estimating CAD risk, patients with PTSD had a lower global estimate of coronary risk given their younger age in comparison with patients without PTSD.

Our descriptive analysis of patients undergoing angiography also suggests challenges in selecting patients for the procedure when PTSD is present. Indeed, there are several potential explanations for our findings that are consistent with more frequent use of angiography for elective indications among patients diagnosed with PTSD. Patients with PTSD experience a range of somatic symptoms, including chest pain and shortness of breath, which may overlap with symptoms of coronary artery disease.[8,15-17] In addition, given the higher prevalence of individual

cardiovascular risk factors and prior coronary disease in patients with PTSD, providers may be more likely to pursue coronary angiography among patients with PTSD, even when symptoms are atypical for coronary disease.

Our study is also unique in evaluating the association of PTSD diagnosis with postprocedural outcomes after coronary angiography. Patients diagnosed with PTSD were not at increased risk for subsequent cardiovascular events or death in 1-year of follow-up. It is important to note that patients with a PTSD diagnosis in our cohort were younger than patients without a PTSD diagnosis. Given the importance of age in the risk of cardiovascular events and death, our observations may reflect the younger age of PTSD patients with obstructive CAD. Concurrent depression, anxiety, and disordered alcohol and substance use have been suggested as contributing to adverse outcomes in patients with PTSD.[44] In our study, adjusting for comorbid depression or anxiety did not influence the association between PTSD and postprocedural cardiovascular outcomes or all-cause mortality. In addition, this association was not further influenced by consideration of alcohol or substance abuse and dependence. Furthermore, analyses stratified on the presence or absence of concurrent depression or anxiety did not demonstrate increased risk among patients with both disorders. Finally, a prior study suggests that patients with PTSD more frequently use the medical system.[29] In contrast with this study, we observed that PTSD patients were seen similarly in follow-up from the diagnosis of obstructive CAD. The addition of follow-up frequency to our risk-adjusted models for postprocedural outcomes did not influence the association between PTSD and outcomes.

Although the emphasis of our analysis was on the patient characteristics and outcomes after coronary angiography by the presence or absence of PTSD, our analyses also provided insights on the patient characteristics and postprocedural outcomes of patients with depression or anxiety alone. Similar to PTSD patients, we observed a higher prevalence of prior MI, PCI, or CABG among patients with depression or anxiety. These findings are consistent with prior studies demonstrating that depression and anxiety are risk factors for the development of coronary disease.[23,45] In the present study, patients with depression or anxiety alone were at increased risk for risk-adjusted 1-year all-cause mortality, consistent with studies suggesting that depression and anxiety are associated with worse outcomes among patients with prevalent CAD.[46,47] However, in our study, lower survival among patients with depression or anxiety was not attributable to increased risk of MI at 1-year.

Limitations

Our findings should be considered in light of the following limitations. First, residual confounding is possible given the observational nature of our study, despite our inclusion of detailed clinical and administrative data. Second, our findings represent the experience of veterans with PTSD undergoing coronary procedures in the VA and may not generalize to other settings given that the VA represents an integrated, single-payer health care system that serves US veterans who are predominantly older, male, and with a high prevalence of PTSD and comorbid disease. Furthermore, the VA surveys patients with the Patient Health Questionnaire (PHQ) and the PHQ-9, screening questionnaires for mental health disorders that may contribute to identification of patients with these psychiatric disorders relative to the non-VA population. Third, the use of diagnosis codes for PTSD, comorbid depression, anxiety, and alcohol and substance use disorders may lead to patient misclassification. We sought to minimize misclassification by limiting diagnosis codes to clinical visits occurring within 1 year before the coronary procedure. However, use of clinical measures of PTSD may result in more refined assessments of the disease. For example, recent studies suggest that specific symptoms of PTSD, particularly intrusive symptoms, may be associated with increased risk for cardiovascular disease, whereas other PTSD symptoms are not.[48,49] Thus, measuring specific PTSD symptoms or symptom clusters and understanding their relationship to cardiac outcomes may provide different findings. Fourth, we did not adjust for medication use for psychiatric diagnoses given challenges of indication bias that we cannot account for in the absence of detailed clinical data on PTSD severity. Finally, as we did not have detailed data on clinicians' rationale for pursuing coronary angiography, we could not determine the exact reasons for the apparent increased use of coronary angiography for elective indications in patients with a PTSD diagnosis.

Conclusions

Among veterans undergoing coronary angiography in the VA, 13% of patients had a diagnosis of PTSD. Patients with PTSD were more likely to present with elective indications and less likely to have obstructive CAD. This may reflect the challenges of patient selection for coronary angiography among PTSD patients with somatic symptoms that mimic myocardial ischemia, a high prevalence of cardiovascular risk factors, and prior coronary events. After coronary angiography, PTSD was not associated with adverse 1-year outcomes.

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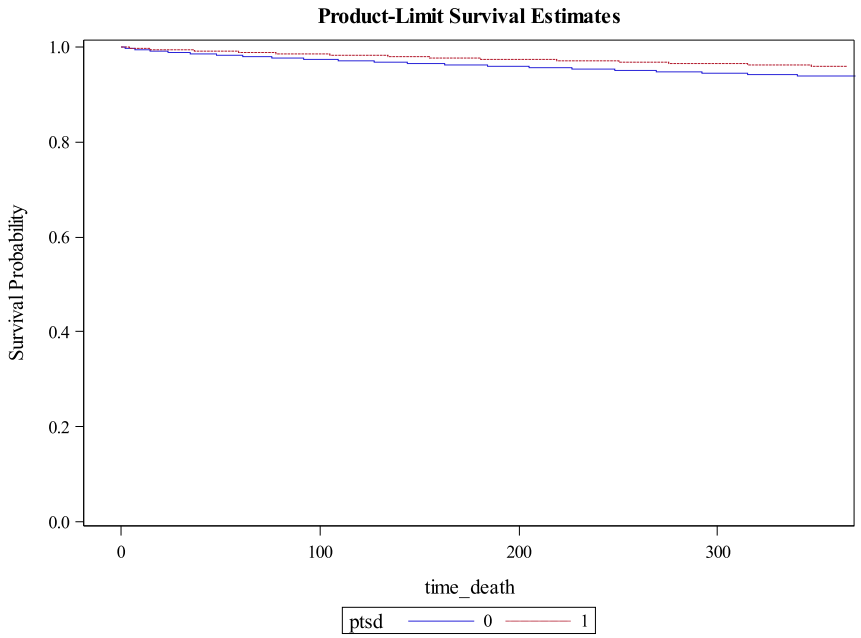
Appendix

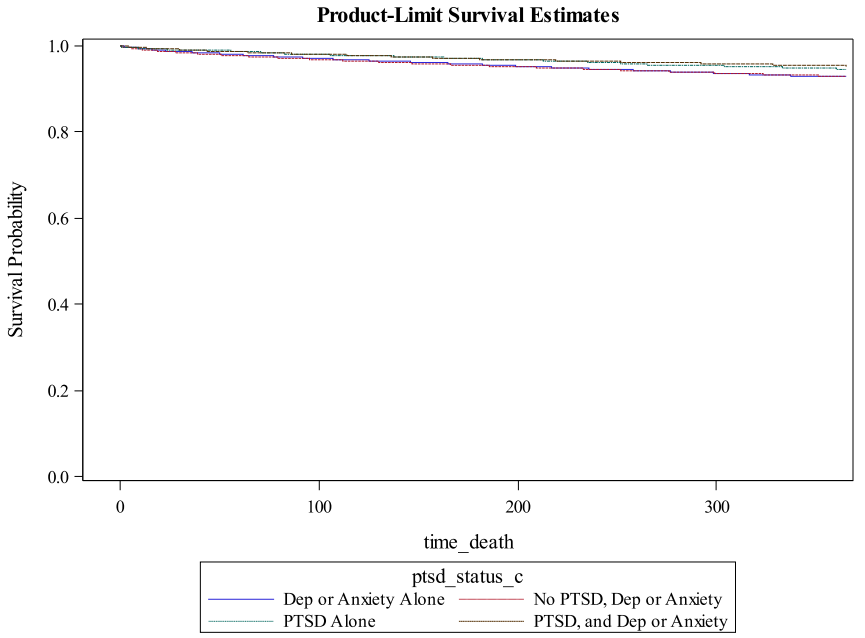
ICD-9 codes for cohort exclusions and analytic design:Severe mental illness (i.e., psychotic disorders, bipolar disorders, or organic psychotic disorders): 290.x-294.x, 295.x-297.x, or 298.9PTSD: 309.81. Depression, anxiety, alcohol dependence or abuse, and substance dependence or abuse:296.20-25, 296.30-35, 296.82, 300.0-300.4, 303.00-303.02, 303.90-303.91, 304.00-304.02, 304.10-12, 304.20-22, 304.30-32, 304.40-42, 304.50-52, 304.60-62, 304.70-72, 304.80-82, 304.90-92, 305.00-305.02, 305.20-22, 305.30-32, 305.40-42, 305.50-52, 305.60-62, 305.70-72, 305.80-82, 305.90-92, or 311

Supplementary Figure 1



Survival plot for mortality among patients with and without PTSD.

Supplementary Figure 2



Survival plot for mortality among patients with and without PTSD in the presence or absence of depression or anxiety.

Supplementary Table I. Patient characteristics, clinical presentation, and angiographic results of patients undergoing elective diagnostic angiography by PTSD status

Characteristic	All patients n = 29,780	No PTSD n = 25,301 (85.0%)	PTSD n = 4,479 (15.0%)	*P* value
Demographics				
Age, median (IQR)	62.3 (57.8, 67.1)	62.6 (57.6, 68.2)	61.6 (58.8, 63.8)	<.001
Male	28,557 (95.9)	24,280 (96.0)	4,277 (95.5)	.14
White	24,270 (81.5)	20,695 (81.8)	3,575 (79.8)	.002
Risk factors and comorbidities				
History of smoking	17,093 (57.4)	14,204 (56.1)	2,889 (64.5)	<.001
Diabetes	12,142 (40.8)	10,167 (40.2)	1,975 (44.1)	<.001
Hypertension	24,939 (83.7)	21,153 (83.6)	3,786 (84.5)	.12
Hyperlipidemia	24,310 (81.6)	20,469 (80.9)	3,841 (85.8)	<.001
Cholesterol, mg/dL, median (IQR)	173 (149, 200)	173 (149, 200)	173 (150, 201)	.70
LDL	100 (80, 124)	100 (80, 124)	100 (80, 123)	.23
HDL	39 (33, 46)	39 (33, 46)	38 (32, 45)	<.001
Peripheral vascular disease	4,116 (13.8)	3,558 (14.1)	558 (12.5)	.004
Cerebrovascular disease	3,231 (10.8)	2,747 (10.9)	484 (10.8)	.92
Congestive heart failure	2,585 (8.7)	2,256 (8.9)	329 (7.3)	<.001
COPD	5,386 (18.1)	4,447 (17.6)	939 (21.0)	<.001
Obese	13,731 (46.1)	11,277 (44.6)	2,454 (54.8)	<.001
Overweight	5,881 (30.0)	4,974 (30.6)	907 (27.0)	<.001
GFR, mL/min, median (IQR)	77 (66, 91)	77 (65, 91)	77 (67, 91)	.01
Renal failure	1,881 (6.3)	1,621 (6.4)	260 (5.8)	.13
Dialysis	459 (1.5)	406 (1.6)	53 (1.2)	.03
Depression	8,369 (28.1)	5,290 (20.9)	3,079 (68.7)	<.001
Anxiety	3,037 (10.2)	2,091 (8.3)	946 (21.1)	<.001
Alcohol abuse or dependence	2,160 (7.3)	1,578 (6.2)	582 (13.0)	<.001
Other substance abuse or dependence	1,134 (3.8)	796 (3.1)	338 (7.5)	<.001
Framingham Risk				
Low	6,613 (22.2)	5,570 (22.0)	1,043 (23.3)	
Intermediate	16,137 (54.2)	13,641 (53.9)	2,496 (55.7)	<.001
High	7,030 (23.6)	6,090 (24.1)	940 (21.0)	
Noninvasive test				
Performed	19,362 (65.0)	16,545 (65.4)	2,817 (62.9)	<.001
Noninvasive result when performed				
Positive	7,285 (37.6)	6,103 (36.9)	1,182 (42.0)	
Negative	460 (2.4)	372 (2.2)	88 (3.1)	<.001
Equivocal	536 (2.8)	425 (2.6)	111 (3.9)	
Unknown	11,081 (57.2)	9,645 (58.3)	1,436 (51.0)	
Procedural indication[a]				
Stable angina	8,242 (27.7)	6,786 (26.8)	1,456 (32.5)	<.001
Atypical chest pain	20,304 (68.2)	16,965 (67.1)	3,339 (74.5)	<.001
Ischemic heart disease	2,938 (9.9)	2,584 (10.2)	354 (7.9)	<.001
Positive functional study	19,269 (64.7)	16,464 (65.1)	2,805 (62.6)	.002
Medication use				
Beta-blocker	19,638 (65.9)	16,694 (66.0)	2,944 (65.7)	.74
Nitrates	4,254 (14.3)	3,643 (14.4)	611 (13.6)	.18
Calcium-channel blocker	8,668 (29.1)	7,386 (29.2)	1,282 (28.6)	.44
Statin	20,895 (70.2)	17,686 (69.9)	3,209 (71.6)	.02
Angiographic findings				
Normal	5,674 (19.1)	4,601 (18.2)	1,073 (24.0)	<.001
Obstructive CAD	14,331 (48.1)	12,496 (49.4)	1,835 (41.0)	<.001
1-vessel CAD	5,221 (17.5)	4,461 (17.6)	760 (17.0)	
2-vessel CAD	3,817 (12.8)	3,306 (13.1)	511 (11.4)	<.001
3-vessel CAD or left main	5,293 (17.8)	4,729 (18.7)	564 (12.6)	
Unknown	2,310 (7.8)	1,986 (7.8)	324 (7.2)	
Initial treatment of obstructive CAD				
PCI	5,525 (38.6)	4,753 (38.0)	772 (42.1)	
CABG	3,093 (21.9)	2,734 (21.9)	359 (19.6)	<.001
Medical therapy alone	5,713 (39.9)	5,009 (40.1)	704 (38.4)	

Reported as n (%) unless otherwise specified.
SI conversion factors: to convert cholesterol to mmol/L, multiply values by 0.0259.
Abbreviations: CAD, coronary artery disease; CABG, coronary artery bypass graft; CHF, congestive heart failure; GFR, glomerular filtration rate; HDL, high density lipoprotein; IQR, interquartile range; LDL, low density lipoprotein; NSTEMI, non–ST-segment elevation myocardial infarction; STEMI, ST-segment elevation myocardial infarction.
a Procedural indication categories are not mutually exclusive, and percentages may exceed 100.

Supplementary Table I (*continued*)

No PTSD or depression or anxiety n = 19,079 (64.1%)	PTSD alone n = 1,193 (4.0%)	Depression or anxiety alone n = 6,222 (20.8%)	Both PTSD and depression or anxiety n = 3,286 (11.0%)	*P* value
Demographics				
63.2 (58.7, 69.2)	62.3 (60.1, 64.3)	60.5 (54.8, 65)	61.3 (58.3, 63.6)	<.001
18,528 (97.1)	1,169 (98.0)	5,752 (92.4)	3,108 (94.6)	<.001
15,555 (81.5)	924 (77.5)	5,140 (82.6)	2,651 (80.7)	<.001
Risk factors and comorbidities				
10,351 (54.3)	769 (64.5)	3,853 (61.9)	2,120 (64.5)	<.001
7,702 (40.4)	536 (44.9)	2,465 (39.6)	1,439 (43.8)	<.001
15,968 (83.7)	1,041 (87.3)	5,185 (83.3)	2,745 (83.5)	.008
15,436 (80.9)	1,022 (85.7)	5,033 (80.9)	2,819 (85.8)	<.001
172 (148, 199)	170 (146, 198)	175 (151, 201)	174 (151, 201)	<.001
100 (80, 124)	98 (76, 120)	101 (81, 124)	100 (81, 125)	.003
39 (33, 47)	39 (33, 46)	39 (33, 46)	38 (32, 45)	<.001
2,755 (14.4)	156 (13.1)	803 (12.9)	402 (12.2)	<.001
2,048 (10.7)	127 (10.6)	699 (11.2)	357 (10.9)	.74
1,659 (8.7)	93 (7.8)	597 (9.6)	236 (7.2)	<.001
3,150 (16.5)	240 (20.1)	1,297 (20.8)	699 (21.3)	<.001
8,260 (43.3)	626 (52.5)	3,017 (48.5)	1,828 (55.6)	<.001
3,806 (31.5)	267 (29.9)	1,168 (27.9)	640 (25.9)	<.001
77 (65, 90)	77 (66, 91)	78 (67, 92)	77 (67, 91)	<.001
1,275 (6.7)	76 (6.4)	346 (5.6)	184 (5.6)	.004
326 (1.7)	17 (1.4)	80 (1.3)	36 (1.1)	.01
		5,290 (85.0)	3,079 (93.7)	<.001
		2,091 (33.6)	946 (28.8)	<.001
982 (5.1)	144 (12.1)	596 (9.6)	438 (13.3)	<.001
409 (2.1)	73 (6.1)	387 (6.2)	265 (8.1)	<.001
Framingham Risk				
3,854 (20.2)	248 (20.8)	1,716 (27.6)	795 (24.2)	
10,368 (54.3)	653 (54.7)	3,273 (52.6)	1,843 (56.1)	
4,857 (25.5)	292 (24.5)	1,233 (19.8)	648 (19.7)	<.001
Noninvasive test				
12,661 (66.4)	738 (61.9)	3,884 (62.4)	2,079 (63.3)	<.001
Noninvasive result when performed				
4,659 (36.8)	331 (44.9)	1,444 (37.2)	851 (40.9)	<.001
254 (2.0)	29 (3.9)	118 (3.0)	59 (6.9)	
301 (2.4)	32 (4.3)	124 (3.2)	79 (3.8)	
7,447 (58.8)	347 (47.0)	2,198 (56.6)	1,090 (52.4)	
Procedural indication[a]				
5,095 (26.7)	421 (35.3)	1,691 (27.2)	1,035 (31.5)	<.001
12,507 (65.6)	886 (74.3)	4,458 (71.6)	2,453 (74.7)	<.001
2,054 (10.8)	101 (8.5)	530 (8.5)	253 (7.7)	<.001
12,643 (66.3)	758 (63.5)	3,821 (61.4)	2,047 (62.3)	<.001
Medication use				
12,652 (66.3)	798 (66.9)	4,042 (65.0)	2,146 (65.3)	.18
2,701 (14.2)	159 (13.3)	942 (15.1)	452 (13.8)	.13
5,550 (29.1)	379 (31.8)	1,836 (29.5)	903 (27.5)	.03
13,369 (70.1)	842 (70.6)	4,317 (69.4)	2,367 (72.0)	.06
Angiographic findings				
3,110 (16.3)	235 (19.7)	1,491 (24.0)	838 (25.5)	<.001
9,945 (52.1)	559 (54.2)	2,551 (48.4)	1,276 (46.0)	<.001
3,432 (18.0)	235 (19.7)	1,029 (16.5)	525 (16.0)	
2,645 (13.9)	152 (12.7)	661 (10.6)	359 (10.9)	<.001
3,868 (20.3)	172 (14.4)	861 (13.8)	392 (11.9)	
1,523 (8.0)	88 (7.4)	463 (7.4)	236 (7.2)	
Initial treatment of obstructive CAD				
3,720 (37.4)	230 (41.1)	1,033 (40.5)	542 (42.5)	
2,246 (22.6)	113 (20.2)	488 (19.1)	246 (19.3)	<.001
3,979 (40.0)	216 (38.6)	1,030 (40.4)	488 (38.2)	

Supplementary Table II. Association between PTSD and one-year outcomes following coronary angiography after exclusion of patients with diagnosis of PTSD in the follow-up period

Outcome	Model	HR (95% CI)	*P* value
Death, MI, or revascularization	Unadjusted	0.79 (0.75, 0.83)	<.001
	CV risk	0.95 (0.91, 1.00)	.07
	CV risk + depression/anxiety	0.95 (0.91, 1.00)	.06
	CV risk + depression/anxiety + alcohol/substance	0.94 (0.90, 0.99)	.02
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.95 (0.90, 0.99)	.03
Death	Unadjusted	0.64 (0.59, 0.70)	<.001
	CV risk	0.90 (0.83, 0.98)	.01
	CV risk + depression/anxiety	0.86 (0.79, 0.93)	<.001
	CV risk + depression/anxiety + alcohol/substance	0.84 (0.78, 0.91)	<.001
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.84 (0.78, 0.91)	<.001
MI	Unadjusted	0.88 (0.76, 1.01)	.08
	CV risk	1.02 (0.89, 1.17)	.80
	CV risk + depression/anxiety	0.99 (0.85, 1.15)	.89
	CV risk + depression/anxiety + alcohol/substance	0.97 (0.84, 1.13)	.73
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.97 (0.83, 1.12)	.67
Revascularization	Unadjusted	0.89 (0.84, 0.95)	<.001
	CV risk	0.99 (0.93, 1.06)	.86
	CV risk + depression/anxiety	1.03 (0.96, 1.10)	.42
	CV risk + depression/anxiety + alcohol/substance	1.03 (0.96, 1.10)	.45
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	1.01 (0.95, 1.08)	.71

Abbreviation: CV, cardiovascular.

Supplementary Table III. Inclusion of preprocedural hemoglobin in evaluating the risk-adjusted association between PTSD and one-year outcomes following coronary angiography

Outcome	Model	HR (95% CI)	*P* value
Death, MI, or revascularization	Unadjusted	0.78 (0.73, 0.82)	<.001
	CV risk	0.94 (0.89, 0.99)	.02
	CV risk + depression/anxiety	0.94 (0.90, 0.99)	.02
	CV risk + depression/anxiety + alcohol/substance	0.93 (0.89, 0.98)	.01
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.93 (0.89, 0.98)	.01
Death	Unadjusted	0.64 (0.59, 0.71)	<.001
	CV risk	0.91 (0.83, 0.99)	.04
	CV risk + depression/anxiety	0.88 (0.80, 0.96)	.004
	CV risk + depression/anxiety + alcohol/substance	0.86 (0.79, 0.94)	.001
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.85 (0.77, 0.93)	<.001
MI	Unadjusted	0.84 (0.71, 0.99)	.03
	CV risk	0.98 (0.84, 1.15)	.80
	CV risk + depression/anxiety	0.94 (0.80, 1.11)	.49
	CV risk + depression/anxiety + alcohol/substance	0.93 (0.79, 1.10)	.40
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.93 (0.79, 1.10)	.39
Revascularization	Unadjusted	0.87 (0.81, 0.93)	<.001
	CV risk	0.97 (0.91, 1.04)	.35
	CV risk + depression/anxiety	0.99 (0.93, 1.07)	.86
	CV risk + depression/anxiety + alcohol/substance	0.99 (0.92, 1.07)	.82
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.99 (0.92, 1.06)	.74

Abbreviation: CV, cardiovascular.

Supplementary Table IV. Association between PTSD and one-year outcomes by the presence or absence of obstructive coronary disease identified at angiography

		No CAD		Obstructive CAD	
Outcome	**Model**	**HR (95% CI)**	***P* value**	**HR (95% CI)**	***P* value**
Death, MI, or revascularization	Unadjusted	0.75 (0.65, 0.86)	<.001	0.86 (0.81, 0.92)	<.001
	CV risk	0.95 (0.83, 1.08)	.44	0.97 (0.91, 1.03)	.28
	CV risk + depression/anxiety	0.89 (0.78, 1.02)	.09	0.97 (0.91, 1.04)	.42
	CV risk + depression/anxiety + alcohol/substance	0.88 (0.76, 1)	.06	0.97 (0.91, 1.03)	.31
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.88 (0.77, 1.01)	.07	0.97 (0.91, 1.03)	.32
Death	Unadjusted	0.71 (0.61, 0.83)	<.001	0.66 (0.59, 0.74)	<.001
	CV risk	0.95 (0.81, 1.12)	.54	0.91 (0.82, 1.02)	.10
	CV risk + depression/anxiety	0.88 (0.74, 1.04)	.14	0.89 (0.80, 0.99)	.03
	CV risk + depression/anxiety + alcohol/substance	0.87 (0.73, 1.03)	.10	0.87 (0.77, 0.97)	.01
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.87 (0.74, 1.03)	.11	0.85 (0.78, 0.95)	.003
MI	Unadjusted	0.96 (0.62, 1.47)	.84	0.93 (0.78, 1.11)	.41
	CV risk	0.93 (0.61, 1.43)	.75	1.01 (0.84, 1.20)	.94
	CV risk + depression/anxiety	0.82 (0.52, 1.27)	.37	0.99 (0.82, 1.19)	.93
	CV risk + depression/anxiety + alcohol/substance	0.76 (0.48, 1.21)	.24	0.99 (0.82, 1.19)	.88
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	0.75 (0.47, 1.19)	.22	0.98 (0.81, 1.10)	.86
Revascularization	Unadjusted	1.01 (0.77, 1.33)	.95	0.97 (0.90, 1.04)	.41
	CV risk	1.06 (0.79, 1.41)	.69	1.00 (0.93, 1.07)	.90
	CV risk + depression/anxiety	1.07 (0.79, 1.46)	.67	1.02 (0.95, 1.10)	.59
	CV risk + depression/anxiety + alcohol/substance	1.06 (0.77, 1.45)	.73	1.02 (0.94, 1.10)	.62
	CV risk + depression/anxiety + alcohol/substance + follow-up frequency	1.04 (0.76, 1.44)	.79	1.02 (0.94, 1.10)	.69

Abbreviation: CV, cardiovascular.