Depressive Symptoms, Cardiovascular Disease Severity, and Functional Status in Older Adults with Coronary Heart Disease: The Heart and Soul Study

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OBJECTIVES: To compare the contributions of depressive symptoms and cardiovascular disease (CVD) severity to functional decline in individuals with coronary heart disease.

DESIGN: Longitudinal.

SETTING: Twelve outpatient clinics in the San Francisco Bay area.

PARTICIPANTS: Older adults (N = 960; mean age 67) with stable coronary heart disease recruited between September 2000 and December 2002.

MEASUREMENTS: At baseline, depressive symptoms and angina pectoris were assessed according to self-report, and left ventricular ejection fraction (LVEF) and exercise capacity were evaluated using echocardiography and exercise treadmill testing. Difficulty performing activities of daily living and instrumental activities of daily living was assessed at baseline and annually for the next 5 years. Covariates included demographic characteristics, comorbid conditions, cognitive function, social support, and health behaviors. Five years later, 658 participants returned for follow-up assessments.

RESULTS: Higher baseline depressive symptoms predicted greater risk of functional decline over 5 years, whereas higher baseline exercise capacity was associated with lower risk of functional decline. In 658 participants who returned for follow-up, 5-year changes in depressive symptoms and exercise capacity were associated with 5-year changes in functional status. Angina pectoris frequency and LVEF were not associated with functional decline or change in functional status, after adjusting for covariates and other predictors.

CONCLUSION: In older adults with coronary heart disease, depressive symptoms and lower exercise capacity predicted functional decline over 5 years. In contrast, other traditional measures of CVD severity (LVEF and angina pectoris) were not independently predictive of subsequent functional status. These findings suggest that efforts to ameliorate depressive symptoms may be as important as treating CVD severity to enhance functional status. **J Am Geriatr Soc 63:8–15, 2015.**

Key words: depression; coronary heart disease; functional status; aging

Individuals with cardiovascular disease (CVD) are living longer, but the burden of disease remains high, particularly in older adults.[1] Conventional CVD therapies are based on randomized trials that have excluded individuals with multiple comorbid conditions and frailty that are common with advanced age.[2] These trials typically focus on reducing mortality or recurrent cardiovascular events, but people are concerned not only with prolonging event-free survival, but also with maximizing their functional status and quality of life.[3] As longevity improves in older adults with CVD, the promotion of long-term functional independence has become a critical goal of clinical disease management.

To improve and maximize long-term functional status among individuals with CVD, its critical determinants must first be understood. Previous studies have found only minimal or no association between CVD severity and functional status,[4–6] indicating that other predictors of functional status may be as or more important than objective measures of CVD severity. For example, depression has consistently been shown to be a strong predictor of physical limitation and difficulty performing activities of daily living (ADLs) in community-dwelling adults[7–9] and in individuals with heart failure[4,10,11] or coronary heart disease (CHD).[12–17] One study found that the difference in functional status between individuals with and without depression was similar in magnitude to the increase in functional status after successful coronary angioplasty.[14]

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Nearly all prospective cohort studies examining the link between depression and subsequent functional status in individuals with CHD have had short follow-up assessments, and few have adjusted for CVD severity.[18] These studies have primarily relied on a single baseline measure of depression, so it is unclear whether long-term changes in depressive symptoms and in CVD severity are linked with concomitant changes in functional status. It has previously been reported that depressive symptoms are more strongly associated with worse functional status and health-related quality of life than objective measures of CVD severity,[19] but the cross-sectional design of that study precluded any assessment of longitudinal associations.

Despite the importance of functional status to older adults with CHD, the extent to which depressive symptoms rather than CVD severity determine long-term functional status is unknown. The current study compared the contributions of depressive symptoms with those of CVD severity (left ventricular ejection fraction (LVEF), exercise capacity, and angina frequency) for predicting subsequent functional decline in 960 older adults with stable CHD.

METHODS

Design and Participants

Participants were enrolled in the Heart and Soul Study, a prospective cohort study designed to examine how psychosocial factors influence clinical outcomes in individuals with CHD.[20] Administrative databases were used to identify outpatients with documented CHD from two Veterans Affairs Medical Centers (San Francisco and Palo Alto), one university medical center (University of California at San Francisco), and nine public health clinics in the Community Health Network of San Francisco. Individuals were eligible to participate if they had a history of myocardial infarction or coronary revascularization, angiographic evidence of 50% or greater stenosis in one or more coronary vessels, or prior evidence of inducible ischemia according to treadmill or nuclear testing. Individuals were excluded if they had a history of myocardial infarction in the past 6 months, deemed themselves unable to walk one block (treadmill test not useful), or were planning to move from the area within 3 years.

Between September 2000 and December 2002, 1,024 participants completed a baseline examination that included a comprehensive health interview, psychosocial assessment, and exercise treadmill testing with stress echocardiography. Additional research funding was obtained to assess self-reported functional status annually. However, 30% of participants had already completed the baseline examination when funding became available, so baseline functional status was measured only in the remaining 710 participants at their study appointment. For the analyses, the sample comprised 960 participants who provided functional status data in the second year of the study. Missing data were imputed for baseline functional status (imputation procedure is described below); 95% of participants provided at least 2 years of follow-up functional status data. After 5 years, 805 participants (of 960) were alive, and 658 returned to the clinic for a follow-up physical examination. Institutional review boards at each of the sites approved the protocol, and all participants provided written informed consent.

Measures

Depressive Symptoms

The severity of depressive symptoms was assessed at baseline and at the 5-year follow-up using the nine-item Patient Health Questionnaire (PHQ),[21] which has been widely used in primary care and has demonstrated excellent validity.[22] Participants indicated how often they had experienced each depressive symptom in the past 2 weeks: not at all (0), several days (1), more than half the days (2), or nearly every day (3). PHQ scores were summed across all items, with a range of 0 to 27 points. Because the PHQ scores were not normally distributed, established cut-points were used to create categories of increasing severity for baseline scores: minimal (0–4 points), mild (5–9 points), moderate (10–14 points), and severe (≥15 points).[21]

CVD Severity

Assessments of CVD severity were obtained at baseline and 5 years later. Resting echocardiography was performed using a Doppler ultrasound examination with a 3.5-MHz transducer. Standard two-dimensional parasternal short-axis, and apical two- and four-chamber views were obtained during held inspiration, and planimetry was performed using a computerized digitization system to determine LVEF.[23] The following categories were created for baseline LVEF: normal (≥55%), low (36–54%), and severely low (≤35%).

Participants completed a symptom-limited, graded exercise treadmill test according to the standard Bruce protocol. Those unable to continue the standard Bruce protocol were switched to lower settings and encouraged to exercise for as long as possible. Exercise capacity was defined as the total number of metabolic equivalents (METs) achieved. Baseline exercise capacity was categorized as low (<5 METs), moderate (5–8 METs), or high (>8 METs).[24]

Self-reported frequency of angina pectoris symptoms was assessed using two items from the Seattle Angina Questionnaire, which asked about the frequency of chest pain, chest tightness, or angina pectoris and the frequency of nitroglycerin use for angina pectoris over the past 4 weeks.[25] Participants chose from six response options, ranging from none to four or more times per day. Scores were transformed to a 0 to 100 scale, with higher scores indicating less-frequent angina. Only six participants reported experiencing daily angina pectoris, so the following categories were used based on prior research:[26] daily or weekly (0–60 points), monthly (61–90 points), and no (91–100 points) angina.

Functional Status

Independence in performing ADLs and instrumental ADLs (IADLs) were assessed according to self-report scales at the baseline study examination and annually over the tele-

phone for the next 5 years. ADL score[27] was calculated as the sum of responses to eight items: six items asking whether the participant received assistance with bathing, dressing, toileting, getting in and out of a bed or chair, eating, or walking (possible responses were receive no assistance (0), receive some assistance (1), and unable to do alone (2)), the average of two items regarding bowel and bladder incontinence (never (0), sometimes (1), often (2)), and one item regarding house confinement in the past 2 weeks (have been outside the house on at least 3 days (0), 1 or 2 days (1), 0 days (2)). IADL score[28] was the sum of responses to eight items asking whether participants needed assistance with using the telephone, driving or using public transit, shopping, preparing meals, doing light housework, doing laundry, managing medications, and handling money. Response choices were receive no assistance (0), receive some assistance (1), and unable to do alone (2). ADL and IADL scores each ranged from 0 to 16. For ease of interpretation, scores were reverse-coded so that higher scores indicated better functional status.

Two approaches to evaluating change in functional status were used. Functional decline, defined as a decrease of at least 1 point between any 2 consecutive years during the 5-year follow-up period, was first examined. A 1-point decrease corresponds to requiring assistance with an additional activity (or becoming completely dependent in an activity that previously required only some assistance). This approach maximized the use of annual functional status data for all 960 participants, including those who died or dropped out during the study. Second, 5-year change in functional status was examined by calculating change scores (follow-up minus baseline) for 658 participants who completed the follow-up assessment; more-negative change scores referred to steeper 5-year declines in functional status.

Covariates

Demographic characteristics and medical history were determined according to a self-report questionnaire at baseline. Height (m) and weight (kg) were measured at the baseline assessment to calculate body mass index (BMI; kg/m^2). Participants brought their current medications to the study appointment, and study personnel recorded all medications. Cognitive function was determined using the Short Portable Mental Status Questionnaire, with possible scores of 0 (intact cognitive function) to 10 (severe cognitive impairment).[29] Social support was measured using a 12-item version of the Interpersonal Support Evaluation List;[30,31] scores ranged from 12 to 48, with higher scores indicating greater perceived social support. Smoking and regular alcohol use were assessed according to self-report questionnaires.[32,33] Medication nonadherence was assessed using the question, "In the past month, how often did you take your medications as prescribed?" Response choices were all of the time (100%), nearly all of the time (90%), most of the time (75%), about half the time (50%), or less than half the time (<50%). Medication nonadherence was defined as taking prescribed medications 75% or less of the time.[34] The frequency of physical activity (e.g., 15–20 minutes of brisk walking, swimming, general conditioning, or recreational sports) in the past month was assessed according to self-report. Possible responses included not at all active, a little active, fairly active, quite active, very active, and extremely active. Physical inactivity was defined as not at all active or a little active.[20]

Statistical Analysis

Multiple imputation was used to account for missing data at baseline. As described in the Design and Participants section, baseline functional status data were not collected for 295 (30%) of the 960 participants. Baseline data were also missing for 72 participants (7.5%) for exercise capacity, 25 participants (2.6%) for LVEF, and one participant for angina frequency. To obtain valid estimates, all longitudinal assessments of the predictors, covariates, ADLs, IADL, and other variables likely to be associated with data missingness (e.g., comorbid conditions, days to myocardial infarction, days to death) were included in the imputation procedure. Thirty data sets were imputed using PROC MI in SAS version 9.3 (SAS Institute, Inc., Cary, NC), and results from analyses were combined using PROC MIANALYZE.

For the descriptive analyses, participants were grouped based on ADL and IADL decline. Associations between functional decline and demographic, clinical, psychosocial, and behavioral covariates were computed using *t*-tests for continuous variables and chi-square tests for categorical variables. Age, sex, marital status, race, income, education, BMI, diabetes mellitus, hypertension, stroke, cognitive function, social support, alcohol use, medication nonadherence, smoking, and physical inactivity were included as covariates in the subsequent regression analyses, based on prior research demonstrating their associations with functional status or depression.[35,36]

Logistic regression models were used to test the association between each predictor at baseline (depressive symptoms, exercise capacity, LVEF, angina frequency) and subsequent functional decline. Each predictor was tested separately in unadjusted models and in models that adjusted for covariates. Fully adjusted models that included all predictors and covariates simultaneously were then run. Interactions between depressive symptoms and each index of CVD severity were also tested. Because odds ratios overestimate risk of common outcomes, the odds ratios from logistic regression were corrected by converting them to risk ratios.[37]

Linear regression models were run to test 5-year change scores (follow-up score minus baseline score) in depressive symptoms and CVD severity as predictors of ADL and IADL change scores. Only participants who provided follow-up data (n = 658) were included in this analysis. Each predictor was tested in separate models before and after covariate adjustment, and a fully adjusted model was used to test all predictors and covariates simultaneously.

RESULTS

Participant Characteristics

Over 5 years of follow-up, 362 participants (38%) experienced ADL decline, and 616 (64%) experienced IADL decline (Table 1). Participants who were older, female,

and lower income and did not have a high school degree were relatively more likely to experience ADL decline. ADL decline was also associated with diabetes mellitus, history of stroke, physical inactivity, greater cognitive impairment, smoking, and lower levels of social support and alcohol use. Similarly, participants with IADL decline were relatively more likely to be older and non-high school graduates and to have higher rates of stroke, diabetes mellitus, and hypertension. IADL decline was also associated with being married and non-white, physical inactivity, greater cognitive impairment, and lower levels of social support and alcohol use. Participants with ADL or IADL decline tended to have lower exercise capacity, more-frequent angina, and more-severe depressive symptoms than those without functional decline. LVEF was not associated with ADL or IADL decline.

Table 1. Baseline Characteristics of 960 Participants with Coronary Heart Disease According to Subsequent Functional Decline

Characteristic	Activities of Daily Living			Instrumental Activities of Daily Living		
	Decline,[a] n = 362	No Decline, n = 598	*P*-Value	Decline,[a] n = 616	No Decline, n = 344	*P*-Value
Demographic						
Age, mean ± SD	67.8 ± 11.6	66.4 ± 10.2	.06	68.8 ± 10.7	63.8 ± 10.0	<.001
Female, n (%)	85 (23)	94 (16)	.003	121 (20)	58 (17)	.29
Married, n (%)	152 (42)	266 (44)	.45	306 (50)	112 (33)	<.001
White, n (%)	209 (58)	373 (62)	.15	358 (58)	224 (65)	.03
High school graduate, n (%)	297 (82)	537 (90)	<.001	521 (85)	313 (91)	.005
Income <$20,000/year, n (%)	200 (55)	266 (44)	.001	306 (50)	160 (47)	.35
Body mass index, kg/m^2, mean ± SD	28.9 ± 5.7	28.4 ± 5.1	.18	28.6 ± 5.3	28.5 ± 5.5	.67
Medical history, n (%)						
Hypertension	261 (72)	420 (70)	.54	461 (75)	220 (64)	<.001
Atrial fibrillation	12 (3)	26 (4)	.43	25 (4)	13 (4)	.83
Myocardial infarction	203 (56)	313 (52)	.26	329 (53)	187 (54)	.78
Stroke	66 (18)	70 (12)	.005	105 (17)	31 (9)	<.001
Diabetes mellitus	120 (33)	127 (21)	<.001	185 (30)	62 (18)	<.001
Cardiovascular disease severity, n (%)						
Exercise capacity (metabolic equivalents)						
High (>8)	73 (20)	239 (40)	<.001	139 (23)	173 (50)	<.001
Moderate (5–8)	156 (43)	248 (41)		284 (46)	120 (35)	
Low (<5)	133 (37)	111 (19)		193 (31)	51 (15)	
Left ventricular ejection fraction (%)						
Normal (≥55)	300 (83)	498 (83)	.89	509 (83)	289 (84)	.28
Low (36–54)	56 (15)	88 (15)		98 (16)	46 (13)	
Severely low (≤35)	6 (2)	12 (2)		9 (1)	9 (3)	
Angina pectoris frequency (Seattle Angina Questionnaire score)[b]						
Absent (91–100)	207 (57)	391 (65)	.003	358 (58)	240 (70)	.001
Monthly (61–90)	103 (28)	159 (27)		183 (30)	79 (23)	
Daily or weekly (0–60)	52 (14)	48 (8)		75 (12)	25 (7)	
Psychosocial factors						
Depressive symptoms (Patient Health Questionnaire score), n (%)[c]						
Minimal (0–4)	162 (45)	397 (66)	<.001	335 (54)	224 (65)	<.001
Mild (5–9)	92 (25)	126 (21)		137 (22)	81 (24)	
Moderate (10–14)	63 (17)	45 (8)		86 (14)	22 (6)	
Severe (15–27)	45 (13)	30 (5)		58 (10)	17 (5)	
Short Portable Mental Status Questionnaire score, mean ± SD[d]	0.63 ± 0.90	0.36 ± 0.69	<.001	0.54 ± 0.87	0.31 ± 0.57	<.001
Social support, mean ± SD[e]	36.3 ± 7.5	38.2 ± 7.2	<.001	37.1 ± 7.4	38.2 ± 7.3	.03
Health behaviors, n (%)						
Regular alcohol use	88 (24)	193 (32)	.009	159 (26)	122 (35)	.002
Current smoking	83 (23)	93 (16)	.004	114 (19)	62 (18)	.85
Medication nonadherence	35 (10)	46 (8)	.29	56 (9)	25 (7)	.33
Physical inactivity	158 (44)	181 (30)	<.001	239 (39)	100 (29)	.002

SD = standard deviation.

[a]Functional decline was defined as a decrease in functional independence (requiring more assistance with activities of daily living or instrumental activities of daily living) between any 2 consecutive years during 5 years of follow-up.

[b]Range 0 to 100, higher scores referring to less-frequent angina.

[c]Range 0 (no depressive symptoms) to 27 (severe depressive symptoms).

[d]Range 0 (intact cognitive functioning) to 10 (severe cognitive impairment).

[e]Range 12 (less support) to 48 (more support).

Functional Decline During 5 Years of Follow-Up (N = 960)

In models that tested each predictor separately, baseline depressive symptoms and angina pectoris frequency were associated with greater risk of ADL and IADL decline during the 5-year period, whereas higher baseline exercise capacity predicted lower risk of ADL and IADL decline ($P < .001$; Table 2). These associations persisted after adjusting for covariates, although in fully adjusted models that included all predictors and covariates simultaneously, only depressive symptoms and exercise capacity independently predicted ADL and IADL decline. Each category increase in depressive symptoms (e.g., from minimal to mild) was associated with 28% greater risk of ADL decline (risk ratio (RR) = 1.28, 95% confidence interval (CI) = 1.14–1.43; $P < .001$) and 12% greater risk of IADL decline (RR = 1.12, 95% CI = 1.05–1.19; $P = .002$). Each category increase in exercise capacity (e.g., from low to moderate) was associated with 32% lower risk of ADL decline (RR = 0.68, 95% CI = 0.55–0.84; $P < .001$) and 28% lower risk of IADL decline (RR = 0.72, 95% CI = 0.60–0.86; $P < .001$). There was a significant interaction between depressive symptoms and angina pectoris frequency in predicting ADL decline (Figure 1), such that depressive symptoms had a greater influence on ADL decline in participants without angina pectoris than in those with more-frequent angina pectoris ($P = .03$, adjusting for all predictors and covariates). Baseline LVEF did not predict subsequent functional decline in any models.

Five-Year Change in Predictors and Functional Status (N = 658)

Table 3 shows the results of linear regression analyses for 5-year change in depressive symptoms and CVD severity predicting 5-year change in functional status. In a fully adjusted model, increases in depressive symptoms predicted decreases in ADL (unstandardized $B = -0.025$, standard error (SE) = 0.010; $P = .01$), whereas increases in exercise capacity were associated with improvements in ADL (unstandardized $B = 0.077$, SE = 0.033; $P = .02$). Five-year increases in exercise capacity also predicted improvements in IADLs (unstandardized $B = 0.163$, SE = 0.060; $P = .008$), but changes in depressive symptoms, angina frequency, and LVEF were not associated with changes in IADLs.

DISCUSSION

Little is known regarding the extent to which mental versus physical health determines the long-term functional status of older adults with CVD. In 960 individuals with CHD followed for 5 years, more-severe depressive symptoms and lower exercise capacity at baseline contributed to greater risk of functional decline. Furthermore, 5-year changes in depressive symptoms and exercise capacity co-occurred with changes in functional status. In contrast, two measures of CVD severity—LVEF and angina pectoris—were not independently predictive of change in functional status. These findings underscore the importance of considering mental and physical health in predicting functional status.

The finding that depressive symptoms independently predicted future functional decline, after accounting for CVD severity, expands on previous studies in several ways.[14–17] First, no existing study has compared the contributions of depressive symptoms and CVD severity to ADL and IADL decline in individuals with stable CHD. This comparison is important for understanding the possible causes of functional decline and suggests that depressive symptoms are as critical as CVD severity in determining functional decline. Second, this work fills a gap in the literature on the long-term associations between depression and functional status in CHD. The only existing long-term (5-year) study on this topic found that baseline depression severity predicted functional status in 111 individuals undergoing cardiac catheterization after adjusting for the number of coronary arteries with more

Table 2. Baseline Depressive Symptoms and Cardiovascular Disease Severity Predicting Subsequent Functional Decline (N = 960)

	Unadjusted (Separate Model for Each Predictor)	Adjusted for Covariates (Separate Model for Each Predictor)[a]	Fully Adjusted Model with All Predictors and Covariates[a]
Predictor (Per 1-Category Increase)	**RR (95% Confidence Interval) *P*-Value**		
Activities of daily living			
Depressive symptoms	1.37 (1.25 – 1.49) <.001	1.32 (1.18 – 1.47) <.001	1.28 (1.14 – 1.43) <.001
Angina pectoris frequency	1.24 (1.10 – 1.38) <.001	1.20 (1.03 – 1.39) .02	1.11 (0.95 – 1.27) .17
Exercise capacity	0.55 (0.46 – 0.65) <.001	0.67 (0.54 – 0.81) <.001	0.68 (0.55 – 0.84) <.001
Left ventricular ejection fraction	0.99 (0.80 – 1.19) .91	1.03 (0.82 – 1.25) .81	0.94 (0.74 – 1.17) .62
Instrumental activities of daily living			
Depressive symptoms	1.13 (1.07 – 1.18) <.001	1.14 (1.07 – 1.21) <.001	1.12 (1.05 – 1.19) .002
Angina pectoris frequency	1.14 (1.06 – 1.21) <.001	1.12 (1.03 – 1.20) .01	1.09 (0.99 – 1.18) .07
Exercise capacity	0.60 (0.51 – 0.69) <.001	0.70 (0.59 – 0.83) <.001	0.72 (0.60 – 0.86) <.001
Left ventricular ejection fraction	1.02 (0.90 – 1.12) .78	1.06 (0.94 – 1.17) .30	1.02 (0.89 – 1.14) .74

Risk ratios (RRs) represent change in risk of functional decline per category increase in the predictor.

[a]Age, sex, marital status, race, income, education, body mass index, diabetes mellitus, hypertension, stroke, cognitive function, social support, alcohol use, medication nonadherence, smoking, and physical inactivity were included in the models as covariates.

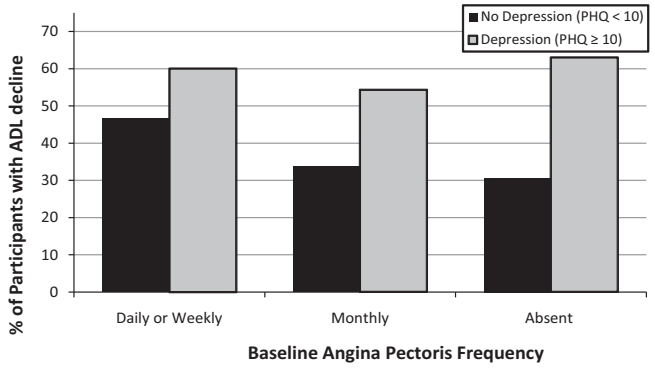

Figure 1. Interaction of depressive symptoms and angina pectoris frequency. The association between baseline depressive symptoms and subsequent decline in activities of daily living (ADLs) was more pronounced in participants without angina pectoris than in those with more-frequent angina pectoris ($P = .03$ for interaction). The figure depicts the percentage of participants in each cell who experienced ADL decline; for illustrative purposes, depression was defined as a nine-item Patient Health Questionnaire (PHQ) score of 10 or greater.

than 70% stenosis at baseline.[16] The current study extends these findings because of its larger sample size of participants with established CHD, analysis of changes in the predictors, and inclusion of several measures of objective and self-reported CVD severity. Third, unlike other related studies of people with CVD, functional status was measured every year rather than relying solely on baseline and one follow-up assessment. This approach allowed all available functional status data to be used, even from participants who died or dropped out before the 5-year examination.

A number of mechanisms or confounding variables may have been responsible for the association between depressive symptoms and functional decline, although demographic characteristics, BMI, comorbid conditions, and health behaviors were adjusted for, suggesting that these variables did not explain the relationship between depressive symptoms and functional status. Although cognitive function is strongly linked to depressive symptoms and functional status,[8,35,38] it did not attenuate the association between depressive symptoms and functional decline. It is also unlikely that depressive symptoms were simply a marker of clinical severity because CVD severity was adjusted for. Participants with depression may have had more-negative perceptions of their health and thus underestimated their functional abilities.[39,40] Additional studies are needed to examine potential biological mechanisms and changes in health behaviors and attitudes that may contribute to functional decline.[41]

The results of the current study suggest that efforts to ameliorate depressive symptoms may be as important as treating CVD severity to enhance functional status. In one observational study, short-term improvements in depression were associated with improvements in functional status in participants with CHD,[14] but randomized controlled trials have had mixed findings for the effect of depression treatment on functional status. The ENhancing Recovery in Coronary Heart Disease trial demonstrated that cognitive–behavioral therapy improved depression in individuals with acute myocardial infarction but had no effect on physical functioning,[42] and the Sertraline Antidepressant Heart Attack Randomized Trial showed that sertraline led to improvements in mental health but not physical functioning in individuals with depression and acute coronary syndrome.[43] In contrast, collaborative care for late-life depression was shown to be effective for alleviating depression and improving physical functioning.[44] Further research should address how best to incorporate depression treatment into the management of CHD to improve functional status.

This study has several limitations that should be considered. First, causal conclusions cannot be drawn because of the observational nature of this study. Second, depressive symptoms and CVD severity probably have bidirectional and interactive relationships with functional status, but this was not the primary focus. Although an interaction was found between depressive symptoms and angina

Table 3. Five-Year Change in Depressive Symptoms and Cardiovascular Disease Severity Predicting 5-Year Change in Functional Status (n = 658)

	Unadjusted (Separate Model for Each Predictor)	Adjusted for Covariates (Separate Model for Each Predictor)[a]	Fully Adjusted Model with All Predictors and Covariates[a]
Predictor (Per 1-Point Increase)	**Unstandardized B (Standard Error) *P*-Value**		
Activities of daily living			
Depressive symptoms	−0.031 (0.010) .002	−0.029 (0.010) .005	−0.025 (0.010) .01
Angina pectoris frequency	0.001 (0.003) .87	0.000 (0.003) .95	−0.000 (0.003) .90
Exercise capacity	0.078 (0.033) .02	0.082 (0.033) .02	0.077 (0.033) .02
Left ventricular ejection fraction	−0.008 (0.005) .14	−0.007 (0.005) .18	−0.007 (0.005) .20
Instrumental activities of daily living			
Depressive symptoms	−0.035 (0.022) .10	−0.037 (0.022) .08	−0.031 (0.022) .16
Angina pectoris frequency	−0.010 (0.007) .14	−0.008 (0.007) .20	−0.009 (0.007) .16
Exercise capacity	0.154 (0.058) .01	0.169 (0.059) .005	0.163 (0.060) .008
Left ventricular ejection fraction	−0.019 (0.012) .11	−0.020 (0.012) .09	−0.020 (0.012) .09

[a]Age, sex, marital status, race, income, education, body mass index, diabetes mellitus, hypertension, stroke, cognitive function, social support, alcohol use, medication nonadherence, smoking, and physical inactivity were included in the models as covariates.

pectoris—demonstrating that the influence of depressive symptoms on ADL decline was weaker in participants with frequent angina—the interactive effects of depressive symptoms and cardiac function deserve further study. Third, it is unknown whether the results would differ if more-frequently assessed, short-term relationships, such as associations between changes in angina pectoris and functional status every 6 months, were examined. It is also unknown whether the results would persist beyond 5 years, although findings from the Health and Retirement Study show that baseline depressive symptoms predicted ADL and mobility difficulty over 12 years.[7] Fourth, the measures of functional status were self-reported and therefore susceptible to bias. Additional work is needed to evaluate whether depressive symptoms predict objective measures of functional capacity, such as the 6-minute walk test. Finally, some characteristics of the sample may limit the generalizability of the findings. The sample was "young-old," with an average age of 67. It is unknown whether the findings could be generalized to older populations, such as those aged 75 and older. The sample was also largely male, and many were veterans, although other characteristics of the sample were representative of individuals with CHD, including ethnic diversity (40% were nonwhite) and a wide range of diagnoses.

In summary, depressive symptoms predicted functional decline over 5 years of follow-up in older adults with stable CHD, independent of CVD severity. Lower exercise capacity was also strongly related to future functional decline, but ejection fraction and angina pectoris frequency were not. Efforts to improve functional status in cardiac patients should not overlook the importance of effectively treating depressive symptoms.

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