Title

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Journal

Journal of the American Geriatrics Society, 63(1)

ISSN

0002-8614

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Publication Date

2015

DOI

10.1111/jgs.13188

Peer reviewed

Published in final edited form as:
J Am Geriatr Soc. 2015 January ; 63(1): 8–15. doi:10.1111/jgs.13188.

Depressive Symptoms, Cardiac Disease Severity, and Functional Status Among Older Patients with Coronary Heart Disease: The Heart and Soul Study

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Abstract

Objectives—To compare the relative contributions of depressive symptoms and cardiac disease severity to functional decline among patients 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 9/2000 and 12/2002.

Measurements—At baseline, depressive symptoms and angina were assessed by self-report, and left ventricular ejection fraction (LVEF) and exercise capacity were evaluated by echocardiography and exercise treadmill testing. We assessed difficulty performing Activities of Daily Living and Instrumental Activities of Daily Living at baseline and annually for the next 5 years. Covariates included demographics, 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 across 5 years, whereas higher baseline exercise capacity was associated with lower risk of

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Conflict of Interest: The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper.

Dr. Yaffe has served on data safety monitoring boards for the National Institute on Aging and Takeda Inc and has served as a consultant for Novartis Inc and Pfizer.

Author Contributions: *Study concept and design*: Whooley, Sin
Acquisition of the data: Whooley
Analysis and interpretation of data: Sin, Whooley, Yaffe
Drafting of the manuscript: Sin
Critical revision of the manuscript for important intellectual content: Sin, Whooley, Yaffe

Sponsor's Role: The funding organizations had no role in the design or methodology of the study; recruitment of subjects; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the paper.

functional decline. Among 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 frequency and LVEF were not associated with functional decline or change in functional status, after adjusting for covariates and other predictors.

Conclusion—Among older adults with coronary heart disease, depressive symptoms and lower exercise capacity predicted functional decline across 5 years. In contrast, other traditional measures of cardiac disease severity (LVEF and angina) were not independently predictive of subsequent functional status. These findings suggest that efforts to ameliorate depressive symptoms may be as important as treating cardiac disease severity to enhance functional status.

Keywords

Depression; coronary heart disease; functional status; aging

Introduction

Patients with cardiovascular(CV) disease are living longer, but the burden of disease remains high, particularly among older adults[1]. Conventional CV therapies are based on randomized trials that have excluded patients with multiple comorbid conditions and frailtythat are common with advanced age[2]. These trials typically focus on reducing mortality or recurrent CV events. However, patients are concerned not only with prolonging event-free survival but also with maximizing their functional status and quality of life[3]. As longevity improves among older patients with CV disease, 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 patients with CV disease, we must first understand its key determinants. Previous studies have found only minimal or no association between cardiac disease severity and functional status[4–6], indicating that other predictors of functional status may be as or more important than objective measures of cardiac disease severity. For example, depression has consistently been shown to be a strong predictor of physical limitation and difficulty performing activities of daily living in community-dwelling adults[7–9] and in patients with heart failure[4,10,11] or coronary heart disease (CHD)[12–17]. One study found that the difference in functional status between patients with and without depression was similar in magnitude to the increase in functional status following successful coronary angioplasty[14].

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

Despite the importance of functional status to older patients with CHD, the extent to which long-term functional status is determined by depressive symptoms versus cardiac disease severity remains unknown. In the current study, we compared the relative contributions of depressive symptoms with measures of cardiac disease severity (i.e., left ventricular ejection fraction, exercise capacity, and angina frequency) for predicting subsequent functional decline among 960 older patients 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 patients with CHD[20]. We used administrative databases to identify outpatients with documented CHD from two Veterans Affairs Medical Centers (San Francisco and Palo Alto), one University medical center (University of California, San Francisco), and nine public health clinics in the Community Health Network of San Francisco. Patients were eligible to participate if they had a history of myocardial infarction or coronary revascularization, angiographic evidence of ≥ 50% stenosis in one or more coronary vessels, or prior evidence of inducible ischemia by treadmill or nuclear testing. Patients were excluded if they had a history of myocardial infarction in the past six months, deemed themselves unable to walk one block (treadmill test not useful), or were planning to move from the local area within three years.

Between September 2000 and December 2002, 1024 participants completed a baseline exam 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 exam when funding became available; therefore, baseline functional status was only measured among the remaining 710 participants at their study appointment. For our analyses, the sample was comprised of 960 participants who provided functional status data in the second year of the study. We imputed missing data 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 exam. The protocol was approved by Institutional Review Boards at each of the sites, 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 9-item Patient Health Questionnaire (PHQ)[21]. The PHQ has been widely used in primary care and has demonstrated excellent validity[22]. Participants indicated how often they experienced each depressive symptom in the past two weeks: 0 (not at all), 1 (several days), 2 (more than half the days), or 3 (nearly every day). PHQ scores were summed across all items, with a range of 0 to 27 points. Because the distribution of PHQ scores was not normally distributed, we used established cut-points 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].

Cardiac disease severity—Assessments of cardiac disease severity were obtained at baseline and 5 years later. Resting echocardiography was performed using an Acuson Sequoia Ultrasound System (Mountain View, CA) with a 3.5-MHz transducer and Doppler ultrasound examination. Standard 2-dimensional parasternal short-axis and apical 2-chamber and 4-chamber views obtained during held inspiration were planimetered to determine left ventricular ejection fraction (LVEF)[23]. The following categories were created for baseline LVEF: Normal (≥ 55%), Decreased (36 – 54%), and Severely Decreased (≤ 35%).

Participants completed a symptom-limited, graded exercise treadmill test according to 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 (MET) achieved. Baseline exercise capacity was categorized as Low (<5 MET), Moderate (5 – 8 MET), or High (>8 MET) [24].

Self-reported frequency of angina symptoms was assessed using 2 items from the Seattle Angina Questionnaire (SAQ), which asked about the frequency of chest pain, chest tightness, or angina, and the frequency of nitroglycerin use for angina over the past 4 weeks[25]. Participants chose from 6 response options, ranging from “none” to “4 or more times per day.” Scores were transformed to a 0–100 scale, with higher scores indicating better quality of life (i.e., less frequent angina). Only 6 participants reported experiencing daily angina; we therefore used the following categories based on prior research [26]: daily or weekly angina (0 – 60 points), monthly angina (61 – 90 points), and absent angina (91 – 100 points).

Functional status—Independence in performing Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) were both assessed with self-report scales at the baseline study examination and annually by telephone for the next 5 years. The ADL score[27] was calculated as the sum of responses to 8 items, including 6 items asking whether the participant receives assistance with bathing, dressing, toileting, getting in and out of a bed or chair, eating, or walking (possible responses were 0 = *receive no assistance*, 1 = *receive some assistance*, and 2 = *unable to do alone*); the average of 2 items regarding bowel and bladder incontinence (0 = *never*, 1 = *sometimes*, 2 = *often*); and 1 item on house confinement in the past 2 weeks (0 = *have been outside the house on at least three days*, 1 = *have been outside one or two days*, 2 = *have been outside zero days*). The IADL score[28] was the sum of responses to 8 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 0 = *receive no assistance*, 1 = *receive some assistance*, and 2 = *unable to do alone*. The 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.

We used 2 approaches for evaluating change in functional status. We first examined functional decline, defined as a decrease of at least 1 point between any two consecutive years during the 5-year follow-up period. 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, we examined 5-year change in functional status 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

Demographics and medical history were determined by self-report questionnaire at baseline. Height and weight were measured at the baseline assessment to calculate body mass index (BMI). 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 with 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 with 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%). We defined medication nonadherence 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 by 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 was not collected for 295 (30%) of the 960 participants. Baseline data were also missing from 72 participants (7.5%) for exercise capacity, 25 participants (2.6%) for LVEF, and from 1 participant for angina frequency. To obtain valid estimates, we included in the imputation procedure all longitudinal assessments of the predictors, covariates, and ADL/IADL, as well as other variables likely to be associated with data missingness (e.g., comorbid conditions, days to myocardial infarction, days to death). Thirty datasets 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 decline and IADL decline. Associations of functional decline with demographic, clinical, psychosocial, and

behavioral covariates were computed using t-tests for continuous variables and chi-squared tests for categorical variables. The following covariates were included in the subsequent regression analyses: age, gender, marital status, White race, low income, high school graduate, BMI, diabetes mellitus, hypertension, stroke, cognitive function, social support, regular alcohol use, medication nonadherence, smoking, and physical inactivity. These covariates were selected based on prior research demonstrating their associations with functional status or depression[35,36].

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

Linear regression models were run to test 5-year change scores (i.e., follow-up score minus baseline score) in depressive symptoms and cardiac disease 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 tested all predictors and covariates simultaneously.

Results

Patient Characteristics

Across 5 years of follow-up, 362 participants (38%) experienced ADL decline and 616 (64%) experienced IADL decline (Table 1). Participants who were older, female, low income, and who did not have a high school degree were relatively more likely to experience ADL decline. ADL decline was also associated with diabetes and history of stroke, physical inactivity, more cognitive impairment and smoking, and lower levels of social support and alcohol use. Similarly, participants with IADL decline were relatively more likely to be older, non-high school graduates, and to have higher rates of stroke, diabetes, and hypertension. IADL decline was also associated with being married and non-White, physical inactivity, more cognitive impairment, and lower levels of social support and alcohol use. Compared to participants without functional decline, those with ADL or IADL decline tended to have lower exercise capacity, more frequent angina, and more severe depressive symptoms. Of note, LVEF was not associated with ADL or IADL decline.

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

In models that tested each predictor separately, baseline depressive symptoms and angina 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-values < 0.001; Table 2). These associations persisted after adjusting for

covariates. However, 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 was associated with 28% increased risk of ADL decline (risk ratio [RR] = 1.28; 95% confidence interval [CI] = 1.14, 1.43; $p < 0.001$) and 12% increased risk of IADL decline (RR = 1.12; 95% CI = 1.05, 1.19; $p = 0.002$). Each category increase in exercise capacity was associated with 32% lower risk of ADL decline (RR = 0.68; 95% CI = 0.55, 0.84; $p < 0.001$) and 28% lower risk of IADL decline (RR = 0.72; 95% CI = 0.60, 0.86; $p < 0.001$). Furthermore, there was a significant interaction between depressive symptoms and angina frequency in predicting ADL decline (Figure 1), such that depressive symptoms had a greater influence on ADL decline among participants without angina than for those with more frequent angina ($p = 0.03$, adjusting for all predictors and covariates). Baseline LVEF did not predict subsequent functional decline in any models.

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

Table 3 shows the results of linear regression analyses for 5-year change in depressive symptoms and cardiac disease 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, SE = 0.010; $p = 0.01$), whereas increases in exercise capacity were associated with improvements in ADL (unstandardized B = 0.077, SE = 0.033; $p = 0.02$). Five-year increases in exercise capacity also predicted improvements in IADL (unstandardized B = 0.163, SE = 0.060; $p = 0.008$), but changes in depressive symptoms, angina frequency, and LVEF were not associated with change in IADL.

Discussion

Little is known regarding the extent to which long-term functional status of older patients with CV disease is determined by mental versus physical health. Among 960 patients with CHD followed for 5 years, we found that 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 cardiac disease severity—LVEF and angina—were not independently predictive of change in functional status. These findings underscore the importance of considering both mental and physical health for predicting functional status.

Our finding that depressive symptoms independently predicted future functional decline, after accounting for cardiac disease severity, expands on previous studies in several ways[14–17]. First, no existing study has compared the relative contributions of depressive symptoms and cardiac disease severity to ADL and IADL decline among patients with stable CHD. This comparison is important for understanding the possible causes of functional decline and suggests that depressive symptoms are as critical as cardiac disease 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 worse functional status among 111 patients undergoing cardiac catheterization, after adjusting for the number of coronary arteries stenosed >70% at baseline[16]. Our study extends these findings due to our larger sample size of patients with established CHD, analysis of changes in the predictors, and the inclusion of several measures of both objective and self-reported CV disease severity. Third, unlike other related studies of cardiac patients, we measured functional status every year, rather than relying solely on baseline and one follow-up assessment. This approach allowed us to use all available functional status data, even from participants who died or dropped out before the 5-year exam.

A number of mechanisms or confounding variables may have been responsible for the association between depressive symptoms and functional decline. However, we adjusted for demographics, BMI, comorbid conditions, and health behaviors, suggesting that these variables did not explain the relationship between depressive symptoms and functional status. Although cognitive function is strongly linked to both 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 we adjusted for cardiac disease severity. Patients 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, as well as changes in health behaviors and attitudes that may contribute to functional decline [41].

Our results suggest that efforts to ameliorate depressive symptoms may be as important as treating cardiac disease severity to enhance functional status. In one observational study, short-term improvements in depression were associated with improvements in functional status among patients with CHD[14]. However, randomized controlled trials have shown mixed findings for the impact of depression treatment on functional status. The ENhancing Recovery in Coronary Heart Disease (ENRICHD) trial emonstrated that cognitive-behavioral therapy improved depression among patients with acute myocardial infarction but had no effect on physical functioning[42], and the Sertraline Antidepressant Heart Attack Randomized Trial (SADHART) investigation showed that sertraline led to improvements in mental health but not physical functioning for depressed patients with acute coronary syndrome[43]. In contrast, collaborative care for late-life depression was shown to be effective for both alleviating depression and improving physical functioning[44]. Further research should address how to best 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 due to the observational nature of this study. Second, depressive symptoms and cardiac disease severity probably have bidirectional and interactive relationships with functional status, but this was not our primary focus. Although we found an interaction between depressive symptoms and angina—demonstrating that the influence of depressive symptoms on ADL decline was relatively weaker among 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 we examined more frequently-assessed, short-term relationships, such as associations between changes in angina and

functional status every 6 months. We also do not know if our results would persist beyond 5 years, although findings from the Health and Retirement Study show that baseline depressive symptoms predicted ADL and mobility difficulty across 12 years[7]. Fourth, the measures of functional status were self-reported and therefore susceptible to biases. Additional work is needed to evaluate whether depressive symptoms predict objective measures of functional capacity, such as the six-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 or older. The sample was also largely male and many were Veterans; however, other characteristics of the sample are representative of typical office patients with CHD, including ethnic diversity (40% were non-White) and a wide range of diagnoses.

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

Acknowledgments

Funding/Support: Dr. Sin was supported by Institutional Training Grant T32AG000212-20 from the National Institute on Aging. Sin is now affiliated with The Pennsylvania State University. Dr. Yaffe was supported in part by National Institute on Aging grant K24AG031155. The Heart and Soul Study was funded by the Department of Veteran Affairs (Epidemiology Merit Review Program), Washington, DC; grant R01 HL-079235 from the National Heart, Lung, and Blood Institute, Bethesda, Maryland; the Robert Wood Johnson Foundation (Generalist Physician Faculty Scholars Program), Princeton, New Jersey; the American Federation for Aging Research (Paul Beeson Faculty Scholars in Aging Research Program), New York, New York; and the Ischemia Research and Education Foundation, South San Francisco, California.

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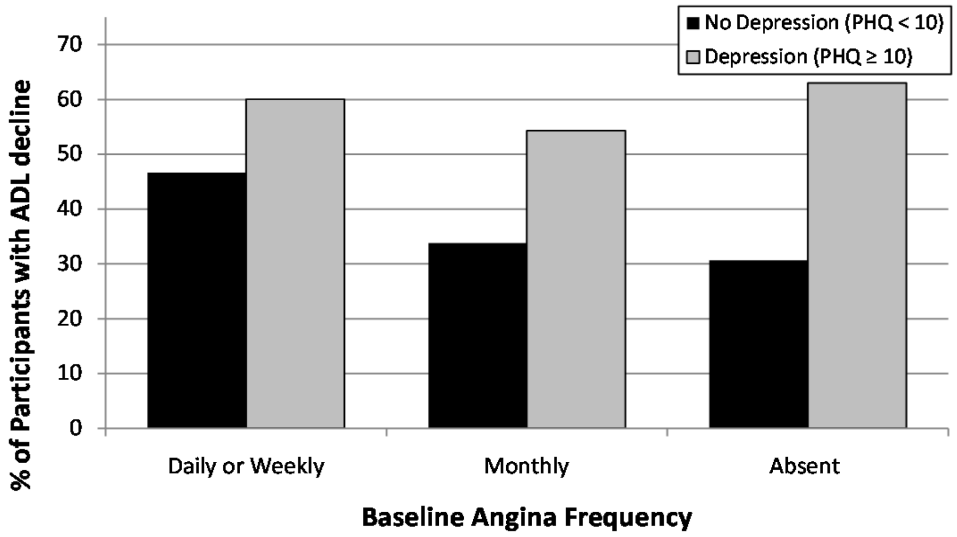

Figure 1. Depressive Symptoms x Angina Frequency Interaction

The association of baseline depressive symptoms with subsequent decline in Activities of Daily Living (ADL) was more pronounced among participants without angina than for those with more frequent angina ($p = 0.03$ for interaction). The figure depicts the percent of participants in each cell who experienced ADL decline; for illustrative purposes, depression was defined as PHQ-9 score ≥ 10.

Table 1

Baseline Characteristics of 960 Participants with Coronary Heart Disease, Divided by Subsequent Functional Decline

	Activities of Daily Living			Instrumental Activities of Daily Living		
Variable	**Decline[a] (N = 362)**	**No Decline (N = 598)**	***p* value**	**Decline[a] (N = 616)**	**No Decline (N = 344)**	***p* value**
Demographics						
Age, mean (± SD)	67.8 (11.6)	66.4(10.2)	0.06	68.8 (10.7)	63.8 (10.0)	<0.001
Female, No. (%)	85 (23%)	94 (16%)	0.003	121 (20%)	58 (17%)	0.29
Married, No. (%)	152 (42%)	266 (44%)	0.45	306 (50%)	112 (33%)	<0.001
White, No. (%)	209 (58%)	373 (62%)	0.15	358 (58%)	224 (65%)	0.03
High school graduate, No. (%)	297 (82%)	537 (90%)	<0.001	521 (85%)	313 (91%)	0.005
Income <$20,000/year, No. (%)	200 (55%)	266 (44%)	0.001	306 (50%)	160 (47%)	0.35
Body Mass Index and Medical History						
Body mass index, mean (± SD)	28.9 (5.7)	28.4 (5.1)	0.18	28.6 (5.3)	28.5 (5.5)	0.67
Hypertension, No. (%)	261 (72%)	420 (70%)	0.54	461 (75%)	220 (64%)	<0.001
Atrial fibrillation, No. (%)	12 (3%)	26 (4%)	0.43	25 (4%)	13 (4%)	0.83
Myocardial infarction, No. (%)	203 (56%)	313 (52%)	0.26	329 (53%)	187 (54%)	0.78
Stroke, No. (%)	66 (18%)	70 (12%)	0.005	105 (17%)	31 (9%)	<0.001
Diabetes mellitus, No. (%)	120 (33%)	127 (21%)	<0.001	185 (30%)	62 (18%)	<0.001
Cardiac Disease Severity						
Exercise capacity (MET)						
High (>8 MET)	73 (20%)	239 (40%)	<0.001	139 (23%)	173 (50%)	<0.001
Moderate (5 – 8 MET)	156 (43%)	248 (41%)		284 (46%)	120 (35%)	
Low (<5 MET)	133 (37%)	111 (19%)		193 (31%)	51 (15%)	
Left ventricular ejection fraction						
Normal (≥ 55%)	300 (83%)	498 (83%)	0.89	509 (83%)	289 (84%)	0.28
Decreased (36 – 54%)	56 (15%)	88 (15%)		98 (16%)	46 (13%)	
Severely decreased (≤ 35%)	6 (2%)	12 (2%)		9 (1%)	9 (3%)	
Angina frequency (SAQ score)[b]						
Absent (91 – 100)	207 (57%)	391 (65%)	0.003	358 (58%)	240 (70%)	0.001
Monthly (61 – 90)	103 (28%)	159 (27%)		183 (30%)	79 (23%)	
Daily or weekly (0 – 60)	52 (14%)	48 (8%)		75 (12%)	25 (7%)	

	Activities of Daily Living			Instrumental Activities of Daily Living		
Variable	**Decline[a] (N = 362)**	**No Decline (N = 598)**	***p* value**	**Decline[a] (N = 616)**	**No Decline (N = 344)**	***p* value**
Psychosocial Factors						
Depressive symptoms (PHQ score)[c]						
Minimal (0 – 4)	162 (45%)	397 (66%)	<0.001	335 (54%)	224 (65%)	<0.001
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%)	
Cognitive function, mean (± SD)[d]	0.63 (0.90)	0.36 (0.69)	<0.001	0.54 (0.87)	0.31 (0.57)	<0.001
Social support, mean(± SD)[e]	36.3 (7.5)	38.2 (7.2)	<0.001	37.1 (7.4)	38.2 (7.3)	0.03
Health Behaviors						
Regular alcohol use, No. (%)	88 (24%)	193 (32%)	0.009	159 (26%)	122 (35%)	0.002
Current smoking, No. (%)	83 (23%)	93 (16%)	0.004	114 (19%)	62 (18%)	0.85
Medication nonadherence, No. (%)	35 (10%)	46 (8%)	0.29	56 (9%)	25 (7%)	0.33
Physical inactivity, No. (%)	158 (44%)	181 (30%)	<0.001	239 (39%)	100 (29%)	0.002

[a] Functional decline was defined as an decrease in functional independence (i.e., requiring more assistance with ADL or IADL) between any 2 consecutive years during 5 years of follow-up.

[b] Angina frequency scores (Seattle Angina Questionnaire) range from 0 to 100, with higher scores referring to better quality of life (less frequent angina).

[c] Depressive symptoms scores (Patient Health Questionnaire-9) range from 0 (no depressive symptoms) to 27 (severe depressive symptoms).

[d] Cognitive function scores (Short Portable Mental Status Questionnaire) can range from 0 (intact cognitive functioning) to 10 (severe cognitive impairment).

[e] Social support scores range from 12 (less support) to 48 (more support).

Table 2

Baseline Depressive Symptoms and Cardiac Disease Severity Predicting Subsequent Functional Decline (N = 960)

Predictor (Per 1-Category Increase)	Unadjusted (Separate model for each predictor)		Adjusted for covariates(Separate model for each predictor)[a]		Fully adjusted model with all predictors and covariates[a]	
	RR (95% CI)[b]	*p* value	RR (95% CI)[b]	*p* value	RR (95% CI)[b]	*p* value
Activities of Daily Living						
Depressive symptoms	**1.37 (1.25, 1.49)**	**<0.001**	**1.32 (1.18, 1.47)**	**<0.001**	**1.28 (1.14, 1.43)**	**<0.001**
Angina frequency	**1.24 (1.10, 1.38)**	**<0.001**	**1.20 (1.03, 1.39)**	**0.02**	1.11 (0.95, 1.27)	0.17
Exercise capacity	**0.55 (0.46, 0.65)**	**<0.001**	**0.67 (0.54, 0.81)**	**<0.001**	**0.68 (0.55, 0.84)**	**<0.001**
Left ventricular ejection fraction	0.99 (0.80, 1.19)	0.91	1.03 (0.82, 1.25)	0.81	0.94 (0.74, 1.17)	0.62
Instrumental Activities of Daily Living						
Depressive symptoms	**1.13 (1.07, 1.18)**	**<0.001**	**1.14 (1.07, 1.21)**	**<0.001**	**1.12 (1.05, 1.19)**	**0.002**
Angina frequency	**1.14 (1.06, 1.21)**	**<0.001**	**1.12 (1.03, 1.20)**	**0.01**	1.09 (0.99, 1.18)	0.07
Exercise capacity	**0.60 (0.51, 0.69)**	**<0.001**	**0.70 (0.59, 0.83)**	**<0.001**	**0.72 (0.60, 0.86)**	**<0.001**
Left ventricular ejection fraction	1.02 (0.90, 1.12)	0.78	1.06 (0.94, 1.17)	0.30	1.02 (0.89, 1.14)	0.74

[a] The following covariates were included in the models: age, gender, marital status, White race, low income, high school graduate, BMI, diabetes mellitus, hypertension, stroke, cognitive function, social support, regular alcohol use, medication nonadherence, smoking, and physical inactivity.

[b] Risk ratios represent change in risk of functional decline per 1-category increase in the predictor.

Table 3

Five-Year Change in Depressive Symptoms and Cardiac 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)	**Unstand. B (SE)**	***p* value**	**Unstand. B (SE)**	***p* value**	**Unstand. B (SE)**	***p* value**
Activities of Daily Living						
Depressive symptoms	**-0.031 (0.010)**	**0.002**	**-0.029 (0.010)**	**0.005**	**-0.025 (0.010)**	**0.01**
Angina frequency	0.001 (0.003)	0.87	0.000 (0.003)	0.95	-0.000 (0.003)	0.90
Exercise capacity	**0.078 (0.033)**	**0.02**	**0.082 (0.033)**	**0.02**	**0.077 (0.033)**	**0.02**
Left ventricular ejection fraction	-0.008 (0.005)	0.14	-0.007 (0.005)	0.18	-0.007 (0.005)	0.20
Instrumental Activities of Daily Living						
Depressive symptoms	-0.035 (0.022)	0.10	-0.037 (0.022)	0.08	-0.031 (0.022)	0.16
Angina frequency	-0.010 (0.007)	0.14	-0.008 (0.007)	0.20	-0.009 (0.007)	0.16
Exercise capacity	**0.154 (0.058)**	**0.01**	**0.169 (0.059)**	**0.005**	**0.163 (0.060)**	**0.008**
Left ventricular ejection fraction	-0.019 (0.012)	0.11	-0.020 (0.012)	0.09	-0.020 (0.012)	0.09

[a]The following covariates were included in the models: age, gender, marital status, White race, low income, high school graduate, BMI, diabetes mellitus, hypertension, stroke, cognitive function, social support, regular alcohol use, medication nonadherence, smoking, and physical inactivity.