Journal of the American Heart Association

ORIGINAL RESEARCH

Impact of Mental Health Treatment on Outcomes in Patients With Heart Failure and Ischemic Heart Disease

Cheryl N. Carmin, PhD; Raymond L. Ownby, MD, PhD; Cynthia Fontanella, PhD; Danielle Steelesmith, PhD, MPH; Philip F. Binkley, MD, MPH

BACKGROUND: There is conflicting evidence as to the impact of mental health treatment on outcomes in patients with heart disease. The aim of this study was to examine whether individuals who received mental health treatment for anxiety or depression after being hospitalized for ischemic disorders or heart failure had a reduced frequency of rehospitalizations, emergency department visits, or mortality compared with those who did not receive treatment.

METHODS AND RESULTS: A population-based, retrospective, cohort design was used to examine the association between psychotherapy or antidepressant medication prescription and health service utilization and mortality in patients with coronary artery disease or heart failure and comorbid anxiety or depression. Those receiving versus not receiving mental health treatment were compared based on the frequency of rehospitalization, emergency department visits, and mortality. The study sample included 1563 patients who had a mean age of 50.1 years. Individuals who received both forms of mental health treatment for anxiety or depression were 75% less likely to be rehospitalized, 74% less likely to have an emergency department visit, and 66% less likely to die from any cause.

CONCLUSIONS: Mental health treatment for anxiety or depression has a significant impact on outcomes in patients with cardiovascular disease consisting of reduced hospitalizations, emergency department visits, and in some conditions improved survival.

Key Words: anxiety ■ depression ■ heart failure ■ ischemic heart disease

Heart disease is a leading cause of death and an important cause of increasing health care costs in industrialized nations.[1] Among the most prevalent forms of heart disease, projections suggest that heart failure (HF) will increase 48% by 2030, resulting in over 8 million adults with this condition, with costs reaching $30.7 billion. By 2030, HF-related costs are estimated to increase by 127%.[2] Multiple studies have demonstrated that depression is common in those with HF and has a significant impact on morbidity and mortality.[3–8] Similarly, depression has a major impact on outcomes in patients with coronary artery disease (CAD). Following the landmark study by Frasure-Smith and colleagues[9] on depression and cardiovascular disease (CVD), multiple studies have addressed the relationship between depression and CAD, and more recently anxiety has similarly been studied.[10–12] Research regarding the relationship between anxiety, CAD, and HF is not as extensive as that on depression, although one early study showed that phobic anxiety was a risk factor.[13] A meta-analysis found that generalized anxiety disorder independently predicted CAD while controlling for depression.[14] Another study found that anxiety was associated with a 41% increased risk of both CAD

Correspondence to: Philip F. Binkley, MD, MPH, Department of Internal Medicine, Division of Cardiovascular Medicine, The Ohio State University Dorothy Dave Heart and Lung Research Institute, 473 West 12th Avenue, Columbus, OH 43210. Email: philip.binkley@osumc.edu

This article was sent to Sula Mazimba, MD, MPH, Associate Editor, for review by expert referees, editorial decision, and final disposition.

Preprint posted on MedRxiv May 28, 2023. doi: https://doi.org/10.1101/2023.05.23.23290426.

For Sources of Funding and Disclosures, see page 8.

JAHA is available at: www.ahajournals.org/journal/jaha

CLINICAL PERSPECTIVE

What Is New?

- Treatment of anxiety and depression significantly reduces hospital readmission and emergency department visits in those with heart disease who have been admitted to the hospital.
- The impact of any mental health treatment on heart disease outcomes has not previously been clearly demonstrated.
- The treatment of anxiety and depression has a significant impact on heart disease outcomes.

What Are the Clinical Implications?

- Patients with heart disease should be screened for anxiety and depression.
- Those identified through screening for anxiety and depression should undergo further diagnostic evaluation for these disorders.
- Patients with a definitive diagnosis of anxiety or depression should undergo appropriate treatment to improve cardiovascular outcomes as well as to treat the primary mental health diagnosis, and collaborative care between cardiovascular experts and mental health professionals should be established to advance the care of those with heart disease.

Nonstandard Abbreviations and Acronyms

SADHEART	Sertraline Antidepressant Heart Attack Randomized Trial
SADHART-CHF	Sertraline Against Depression and Heart Disease in Chronic Heart Failure

incidence and mortality and a 35% increased risk of HF.[15] More research on anxiety, CAD, and HF may be useful in that anxiety and depression may share common causes.[16–18]

In addition to morbidity and mortality, CVD with concomitant anxiety incurs significant health care costs through hospitalizations and emergency department (ED) visits.[19] Much like depression, anxiety is a predictor of ambulatory health care use and rehospitalization.[20,21] A recent study of patients with HF noted that anxiety, depression, or their combination significantly contributed to all-cause mortality but did not predict rehospitalization.[3] In contrast, Suzuki and colleagues[4] found that comorbid anxiety and depression were predictive of both rehospitalization and mortality in patients with HF.

Evidence for the impact of mental health treatment for anxiety or depression on outcomes in HF and CAD remains conflicting. Although patients with CVD frequently experience anxiety and depression, a Cochrane systematic review found little evidence that psychologic treatments are associated with improvement in clinical outcomes in patients with CAD or HF.[22] This was similarly true for more recent trials including[23] SADHEART (Sertraline Antidepressant Heart Attack Randomized Trial), which found that sertraline is safe for use with patients with CVD. However, this study was not designed to investigate CVD outcomes.[24]

In addition to their economic impact, heart disease, depression, and anxiety substantially impair quality of life.[8] They are mechanistically linked such that each contributes to the progression of the other further contributing to diminished quality of life.[7] Indeed, coexistence of depression results in perception of symptom severity that exceed measures of actual functional impairment.[25]

The aim of this study was to use a public database to examine the impact of psychotherapy or psychopharmacologic treatments on adverse outcomes in patients admitted to the hospital with CAD or HF and who were diagnosed with anxiety or depression. The findings provide novel insight into the impact of mental health interventions on outcomes in patients with HF and CAD.

METHODS

Data Availability

The data that support the findings of this study are available from the corresponding author upon request.

Design and Study Cohort

The study was approved by the Ohio State University's institutional review board. The review board granted a waiver of consent given that obtaining consent would prohibit performance of this retrospective large database analysis. As described below, patients were identified who were hospitalized for specific heart disease diagnoses and who had diagnoses for anxiety or depression. Claims for mental health treatment for these patients were also noted. Those for whom there were no claims for mental health treatment constituted the nontreatment comparison group.

Specifically, a retrospective cohort design examined the association between mental health treatment, health service utilization, and mortality in patients with CAD or HF and comorbid anxiety or depression. We included all adults aged 21 to 64 years over a 3-year period who had a first hospital admission for 2 claims for ischemic heart disease or HF diagnoses (*International classification of Diseases, Ninth Edition, Clinical*

Modification [*ICD-9 CM*] codes 410.X to 414.X, 428.X), and who had ≥2 claims for any anxiety disorder (ie, *ICD-9-CM* 300.00, 300.1, 300.02, 300.21, 300.22, 300.23, 300.3X, 308.3X, 309.0X, 309.24, 309.28, 309.81) or depression (ie, *International Classification of Diseases, Ninth Revision* [*ICD-9*] codes 296.2X, 296.3X, 304.4X, 311). All patients were continuously enrolled in Ohio's Medicaid program during the 6-month period prior to the index (first) admission. The index admission was defined as a hospital admission with: (1) a diagnosis of CAD or HF at the index admission, and (2) no history of CAD events or HF in the 6-month period prior to index admission. Patients diagnosed with schizophrenia or psychosis (*ICD-9* code 295.X), bipolar disorder (*ICD-9* codes 296.00–296.1, 296.4–296.8), dementia (*ICD-9* codes 290–290.9), autism spectrum disorder (*ICD-9* codes 299.00, 299.8, 299.9), and intellectual disability (*ICD-9* codes 317–319) were excluded.

Data Sources

Data came from 2 sources: Ohio Medicaid claims files and death certificate files over a 3-year period ranging from July 1, 2009 to June 30, 2012. Patients were continuously enrolled in Ohio's Medicaid program during the 6 months prior to index (first) hospital admission and were followed up through the end of 2014 (for up to 4 years), or until death or end of Medicaid enrollment. Medicaid claims data included information on outpatient, inpatient, and pharmacy service claims; demographic and clinical characteristics including up to nine *ICD-9-CM* diagnoses; and program eligibility. Death certificate records included social security number, last name, first name, date of birth, race or ethnicity, county of residence, and *ICD-10* codes (used for cause of death classification starting in 1999) for all causes of death. Medicaid service files and death certificate data were linked by year with a deterministic, multistep algorithm based on decedent identifier, including social security number, first and last names (truncated to the first 6 letters), and date of birth.

Outcome Measures

Four time to event variables were analyzed: (1) hospital readmission; (2) ED visits for CAD and HF (*ICD-9* codes 402.X–405.X, 410.X–417.X, 420.X–429.X); (3) all-cause mortality; and (4) heart disease mortality.

Primary Explanatory Variables

The primary explanatory variables were any psychotherapy (*ICD-9-CM* 290–319), any treatment with antidepressant medication (based on pharmacy records), or their combination following the index admission. Psychotherapy was defined by the procedure codes for diagnostic interviewing (90 801, 90 791, 96 150, 96 151) and individual, group, or family psychotherapy (90 804, 90 806, 90 808, 90 810, 90 812, 90 814, 90 853, 90 857, 90 847, 90 849, 90 839, 90 840, 96 152, 96 153, 96 154, and local healthcare common procedure coding).

Covariates

Demographic characteristics included patient's age at admission, race and ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and other), sex, and Medicaid eligibility status (disabled versus poverty). Clinical characteristics were based on claims during the 6 months prior to the index hospitalization and included the presence of at least 1 claim for anxiety or depressive disorder (*ICD-9-CM* codes 291–292).

Pharmacy claims during the study period were used to classify psychotropic medications (eg, antidepressants, mood stabilizers, antipsychotics, and anxiolytics) and cardiac medications. For analyses, cardiac medications were categorized as β-blockers, calcium channel blockers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, statins, diuretics, digoxin, α-agonists, α-blockers, lipid medications other than statins, antiarrhythmics, and long-acting nitrates.

Statistical Analysis

Patient demographics and clinical characteristics are presented using frequencies and percentages for categorical variables and mean and SD for age. In addition, these same characteristics are described by receipt of any mental health treatment during the follow-up period for each of the outcomes: all-cause mortality, coronary heart disease mortality, first ED visit, and rehospitalization. Cox proportional hazards regression was used to assess the hazard for each outcome for those who received either psychotherapy, medication, their combination, or no mental health treatment during the period between the index admission and outcome.

Covariates used in the models were selected from a larger number of possible comorbidities in an iterative process in which correlations between comorbidities and outcomes were first examined. Those with correlations associated with a probability of ≤0.10 were included in models and then hazards were calculated. Variables with the smallest effect on outcomes were then eliminated and the model was again run. The process of eliminating nonsignificant variables and then again calculating the model was repeated several times to arrive at a final model for all-cause mortality. For consistency across outcomes, this model was used for other outcomes.

The final models include variables that in this process were significantly associated with outcomes or considered important to include on conceptual grounds (eg, race).

Three models were developed for each outcome: model 1 included only patient demographics and disability status as well as the interaction of age with disability; model 2 included the variables in model 1 and included comorbid disorders; and model 3 added all medications to model 2. The proportional hazards assumption was assessed through inspection of graphs of Cox-predicted curves compared with Kaplan–Meier curves (Stata postestimation command stcoxkm). Assessments of between-group significance were Bonferroni corrected within each outcome. All analyses were conducted using Stata version 15.1 (StataCorp LLC).

RESULTS

Patient characteristics are summarized in Table 1 for the entire sample and for patients who received antidepressant medications and psychotherapy (23. 2%), psychotherapy alone (14.8%), antidepressants alone (29. 2%), and no mental health treatment (33.0%). The mean age of the patients included in the sample was 50.1±9.7 years and did not differ greatly among the subgroups. Sixty-eight percent of the sample were women and this percentage was essentially the same in all subgroups. The majority of patients in the sample identified as of White race (80.9%) with others identifying as other racial and ethnic origins. Again, these percentages did not differ greatly among subgroups.

The prevalence of anxiety, depression, and comorbid conditions is shown in Table 1. A total of 92.2% of patients were diagnosed as having anxiety and 55.5% as having depression. The most prevalent comorbidities were identification as being disabled (48.7%), substance use (53.4%), pulmonary disease (57.6%), and diabetes without complications (37.6%).

Types of antidepressant and psychotropic medications prescribed for the patient sample are shown in Table 1 and are based on categories listed in the Medicaid database. These include antidepressants in general (52.3%), tricyclic antidepressants (15.4%), antipsychotic medications (40.1%), benzodiazepine (68.7%), mood stabilizers (36.1%), buspirone (9.6%), and hydroxyzine (17.8%). The most frequently prescribed cardiovascular medications were β-blockers (47.0%), calcium channel blockers (26.4%), and angiotensin-converting enzyme inhibitors (35.6%).

Inspection of the Kaplan–Meier curves compared with the predicted models suggested that the proportional hazards assumption was not violated. Table 2 presents models for each outcome and Cox regression survival curves are presented in the Figure. For each of the outcomes except CAD-related mortality, those who received some form of mental health treatment were significantly less likely to experience the outcome than those who received no mental health treatment.

All-Cause Mortality

As shown in Table 2, pharmacotherapy, psychotherapy, and their combination were related to reductions in the hazard ratios (HRs) for all-cause mortality, cardiovascular mortality, ED visits, and hospital readmissions compared with the nontreatment reference group. Psychotherapy in combination with medical therapy led to significant reductions in HRs for all-cause mortality in all 3 covariate-adjusted models, ranging from 0.33 to 0.35 (all P values <0.001). Reductions in the HRs for all-cause mortality were less marked but consistent with reduced risk for patients who received psychotherapy alone ranging from 0.52 to 0.61 (all P values <0.01). Pharmacotherapy alone led to reductions in the all-cause mortality hazards ranging from 0.70 to 0.72 but were only significant for models 1 (adjustment for demographics) and 2 (adjustment for demographics and comorbidities) (P<0.01 and P<0.03, respectively).

Coronary Heart Disease Mortality

Reductions were observed in the HRs for CAD mortality in all groups and in covariate-adjusted models but were not significant.

ED Visits

All treatments in all 3 models were associated with significant (P<0.001) reductions in the HRs for ED visits. As for all-cause mortality, combined treatment with psychotherapy and medication was associated with the greatest reduction in HRs compared with the nontreatment referent group with HRs ranging from 0.26 to 0.33. Psychotherapy alone was associated with reduced hazards for emergency visits ranging from 0.47 to 0.52, and medical therapy alone was associated with HRs ranging from 0.51 to 0.059.

Hospital Readmission

HRs for hospital readmission were significantly reduced for all treatments and in all models (P<0.001). Similar to all-cause mortality and ED visits, combined therapy was associated with the lowest HRs that ranged from 0.25 to 0.32. HRs for admission were reduced for psychotherapy alone and ranged from 0.51 to 0.54. Medical therapy alone was associated with HRs ranging from 0.45 to 0.53.

DISCUSSION

Although there is extensive evidence that mental health has a significant impact on CVD, there is little if any evidence that treatment of depression or anxiety has an

Table 1. Patient Characteristics

Characteristics	Treatment				
	Antidepressant+psychotherapy	Antidepressant only	Psychotherapy only	No mental health treatment	Entire sample
Demographic characteristics					
No. (%)	363 (23.2)	454 (29.2)	231 (14.8)	515 (33.0)	1563 (100)
Mean age (SD), y	47.6 (10.3)	49.9 (9.6)	50.8 (9.4)	51.8 (9.2)	50.1 (9.7)
Sex, n (%)					
Women	256 (70.5)	321 (70.7)	167 (72.3)	321 (62.3)	1065 (68.1)
Men	107 (29.5)	133 (29.3)	64 (27.7)	194 (37.7)	498 (31.9)
Race and ethnicity, n (%)					
Non-Hispanic Black, Hispanic, and other	64 (17.6)	71 (15.6)	47 (20.3)	116 (22.5)	298 (19.1)
White	299 (82.4)	383 (84.4)	184 (79.7)	399 (77.5)	1265 (80.9)
Disabled	246 (67.8)	340 (74.9)	26 (11.3)	149 (28.9)	761 (48.7)
Comorbid diagnoses, n (%)					
Anxiety	325 (89.5)	421 (92.7)	211 (91.3)	484 (94.0)	1141 (92.2)
Depression	254 (70.0)	242 (53.3)	139 (60.2)	233 (45.2)	868 (55.5)
Substance use	197 (54.3)	256 (56.4)	124 (53.7)	258 (50.1)	835 (53.4)
Obesity	88 (24.2)	94 (20.7)	69 (29.9)	116 (22.5)	367 (23.5)
Cerebrovascular disease	49 (13.5)	79 (17.4)	43 (18.6)	83 (16.1)	254 (16.3)
Peripheral vascular disease	30 (8.3)	52 (11.5)	31 (13.4)	54 (10.5)	167 (10.7)
Pulmonary disease	200 (55.1)	261 (57.5)	138 (59.7)	301 (58.4)	900 (57.6)
Connective tissue disease	14 (3.9)	25 (5.5)	17 (7.4)	36 (7.0)	92 (5.9)
Ulcer	14 (3.9)	15 (3.3)	6 (2.6)	19 (3.7)	54 (3.5)
Mild liver disease	12 (3.3)	18 (4.0)	9 (3.9)	21 (4.1)	60 (3.8)
Moderate/severe liver disease	7 (1.9)	8 (1.8)	6 (2.6)	13 (2.5)	34 (2.2)
Diabetes without complications	136 (37.5)	160 (35.2)	92 (39.8)	199 (38.6)	587 (37.6)
Hemiplegia	10 (2.8)	20 (4.4)	9 (3.9)	20 (3.9)	59 (3.8)
Renal disease	41 (11.3)	63 (13.9)	48 (20.8)	89 (17.3)	241 (15.4)
Cancer	24 (6.6)	43 (9.5)	13 (5.6)	56 (10.9)	136 (8.7)
Metastatic carcinoma	8 (2.2)	18 (4.0)	5 (2.2)	16 (3.1)	47 (3.0)
Medications, n (%)					
β-Blocker	266 (73.3)	299 (65.9)	35 (15.2)	135 (26.2)	735 (47.0)
Calcium channel blocker	149 (41.0)	173 (38.1)	11 (4.8)	79 (15.3)	412 (26.4)
Angiotensin-converting enzyme inhibitor	200 (55.1)	231 (50.9)	28 (12.1)	98 (19.0)	557 (35.6)
Statin	212 (58.4)	266 (58.6)	30 (13.0)	105 (20.4)	613 (39.0)
Digoxin	13 (3.6)	21 (4.6)	3 (1.3)	10 (1.9)	47 (3.0)
Nitrates	124 (34.2)	129 (28.4)	12 (5.2)	50 (9.7)	315 (20.2)
Other vasodilator	30 (8.3)	52 (11.5)	4 (1.7)	23 (4.5)	109 (7.0)
Antiarrhythmic	117 (32.2)	128 (28.2)	10 (4.3)	55 (10.7)	310 (19.8)
α-Agonist	64 (17.6)	68 (15.0)	6 (2.6)	27 (5.2)	165 (10.6)
α-Blocker	18 (5.0)	17 (3.7)	0 (0.0)	6 (1.2)	41 (2.6)
Antidepressant, n (%)	363 (100.0)	454 (100.0)	0 (0.0)	0 (0.0)	817 (52.3)
Tricyclic	96 (26.4)	108 (23.8)	8 (3.5)	29 (5.6)	241 (15.4)

(*Continued*)

Table 1. Continued

Characteristics	Treatment				
	Antidepressant+psychotherapy	Antidepressant only	Psychotherapy only	No mental health treatment	Entire sample
Antipsychotic	305 (84.0)	298 (65.6)	6 (2.6)	17 (3.3)	626 (40.1)
Benzodiazepine	290 (79.9)	364 (80.2)	136 (58.9)	283 (55.0)	1073 (68.7)
Mood stabilizer	226 (62.3)	243 (53.5)	21 (9.1)	75 (14.6)	565 (36.1)
Buspirone	74 (20.4)	60 (13.2)	3 (1.3)	13 (2.5)	150 (9.6)
Hydroxyzine	135 (37.2)	109 (24.0)	5 (2.2)	29 (5.6)	278 (17.8)

Table 2. HRs for Cox Regression Models (N=1563)

	Model 1*	Model 2†	Model 3‡
	HR (95% CI), *P* value	HR (95% CI), *P* value	HR (95% CI), *P* value
All-cause mortality			
No treatment	1.00		
Psychotherapy only	0.61 (0.43–0.87), 0.01	0.58 (0.41–0.81), 0.002	0.52 (0.37–0.75), <0.001
Antidepressant only	0.70 (0.52–0.92), 0.01	0.72 (0.54–0.96), 0.03	0.70 (0.47–1.04), 0.09
Psychotherapy and antidepressant	0.33 (0.23–0.46), <0.001	0.35 (0.25–0.50), <0.001	0.34 (0.21–0.55), <0.001
Antidepressant only vs psychotherapy only (*P*>0.99); antidepressant+psychotherapy vs antidepressant only (*P*<0.001); psychotherapy+antidepressant vs psychotherapy only (*P*=0.08); no treatment vs antidepressant only (*P*=0.03); no treatment vs psychotherapy only (*P*=0.002); no treatment vs antidepressant+psychotherapy (*P*<0.001).§			
Coronary heart disease mortality			
No treatment	1.00		
Psychotherapy only	0.48 (0.20–1.16), 0.10	0.47 (0.21–1.04), 0.06	0.42 (0.17–1.04), 0.06
Antidepressant only	0.92 (0.48–1.74), 0.48	0.94 (0.49–1.81), 0.84	0.69 (0.28–1.72), 0.43
Psychotherapy and antidepressant	0.47 (0.21–1.02), 0.06	0.47 (0.19–1.12), 0.09	0.32 (0.17–1.04), 0.06
Antidepressant only vs psychotherapy only (*P*>0.99); antidepressant+psychotherapy+vs antidepressant only (*P*=0.14); psychotherapy+antidepressant vs psychotherapy only (*P*>0.99); no treatment vs antidepressant only (*P*>0.99); no treatment vs psychotherapy only (*P*=0.18); no treatment vs antidepressant+psychotherapy (*P*=0.11).			
ED visits			
No treatment	1.00		
Psychotherapy only	0.52 (0.42–0.65), <0.001	0.51 (0.41–0.64), <0.001	0.47 (0.37–0.59), <0.001
Antidepressant only	0.58 (0.50–0.67), <0.001	0.59 (0.50–0.68), <0.001	0.51 (0.42–0.62), <0.001
Psychotherapy and antidepressant	0.32 (0.26–0.39), <0.001	0.33 (0.26–0.40), <0.001	0.26 (0.20–0.34), <0.001
Antidepressant only vs psychotherapy only (*P*>0.99); psychotherapy+antidepressant vs antidepressant only (*P*<0.001); psychotherapy+antidepressant vs psychotherapy only (*P*=0.001); no treatment vs antidepressant only (*P*<0.001); no treatment vs psychotherapy only (*P*<0.001); no treatment vs antidepressant+psychotherapy (*P*<0.001)			
Hospital readmission			
No treatment	1.00		
Psychotherapy only	0.54 (0.43–0.67), <0.001	0.52 (0.42–0.65), <0.001	0.51 (0.41–0.64), <0.001
Antidepressant only	0.53 (0.45–0.62), <0.001	0.53 (0.45–0.63), <0.001	0.42 (0.34–0.52), <0.001
Psychotherapy and antidepressant	0.30 (0.24–0.38), <0.001	0.32 (0.26–0.40), <0.001	0.25 (0.19–0.34), <0.001
Antidepressant only vs psychotherapy only (*P*=0.56); psychotherapy+antidepressant vs antidepressant only (*P*<0.001); psychotherapy+antidepressant vs psychotherapy only (*P*<0.001); no treatment vs antidepressant only (*P*<0.001), no treatment vs psychotherapy only (*P*<0.001); no treatment vs antidepressant+psychotherapy (*P*<0.001).			

*Model 1: adjusted for age, sex, race, disability, and the interaction age with disability.

†Model 2: model 1 plus comorbid disorders: pulmonary disease, mild liver disease, moderate liver disease, diabetes without complications, diabetes with complications, hemiplegia, renal disease, any cancer, and any metastatic carcinoma.

‡Model 3: model 2 plus medication use and prior diagnosis of depression or substance use disorder. Medications include angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, β-blockers, diuretics, statins, nitrates, antiarrhythmics, α-agonists, any other cardiac medication, antipsychotics, benzodiazepines, mood stabilizers, buspirone, and hydroxyzine. This model also included prior mental health treatment.

§All pairwise comparisons used Bonferroni adjustments within outcomes.

ED indicates emergency department; and HR, hazard ratio.

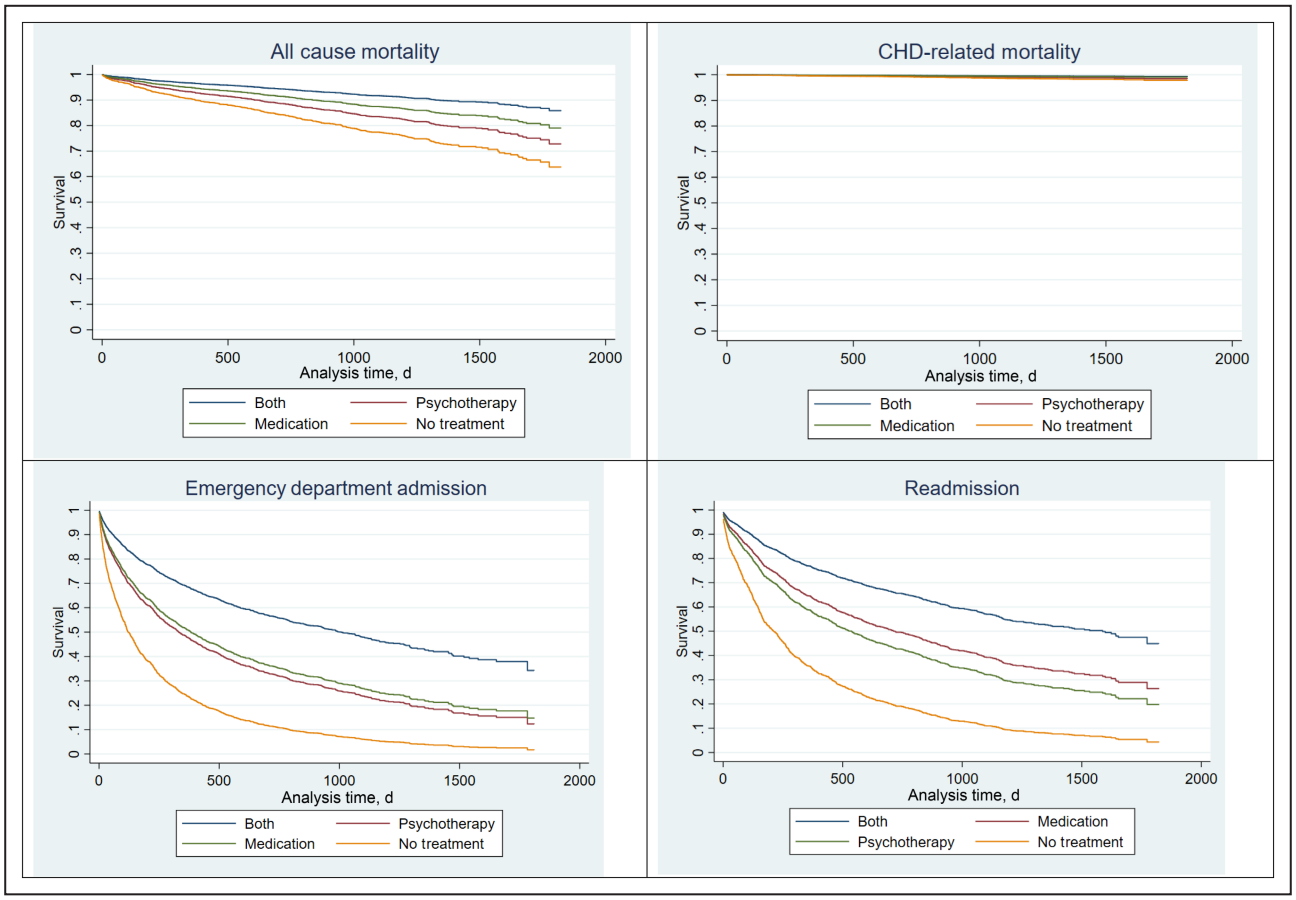

Figure. Hazard models.
Time-to event-curves derived from Cox regression in models for all-cause mortality, coronary heart disease (CHD) mortality, emergency department admissions, and hospital readmission for those treated with both psychotherapy and education, only one mode of treatment, no treatment for mental health disorders.

impact on disease-related outcomes. To the authors' knowledge, this article is the first to show that mental health treatment may be associated with reduced risk for relevant outcomes. This study shows that mental health treatment for anxiety or depression, whether pharmacotherapy or psychotherapy, was associated with a marked and significant reduction in the risk for readmission to the hospital (75% risk reduction if receiving both treatments, 49% for psychotherapy alone, and 58% for medication alone) or evaluation in the ED (74% risk reduction if receiving both treatments, 49% for medication treatment alone, and 53% for psychotherapy alone). These findings indicate that mental health interventions are essential to reducing hospitalizations and ED visits in patients with HF or coronary disease and concomitant depression or anxiety.

Prior studies of medications for treatment of depression in patients with CVD have largely focused on their safety. In some cases, secondary end points related to disease outcome have been assessed such as in SADHART-CHF (Sertraline Against Depression and Heart Disease in Chronic Heart Failure),[5,6] which found a trend toward reduction in hospitalizations for patients with HF who received treatment for depression. Accordingly, the current study addresses a gap in the understanding of the relationship between anxiety and depression, CVD outcomes, and treatment.

The results support the usefulness of mental health treatment in improving outcomes in patients with CVD-related hospital admissions. They are generally consistent across models that include progressively larger numbers of potential confounders, such as comorbid conditions and medications. These data suggest that treatments may be useful in reducing all-cause mortality, ED visits, and hospital readmissions. While the findings relevant to CAD-related deaths are suggestive, they are not significant. This may be related to a relatively small sample size of patients with this diagnosis and a consequent lack of sufficient statistical power to detect an effect.

Hospital readmissions and ED visits for heart disease significantly contribute to the economic burden of health care in addition to diminishing patient quality of life.[26,27] Hospitals incur Medicare monetary penalties

for early readmission for some CVDs, further contributing to costs. Interventions that can reduce the frequency of readmission and ED care hold the promise of significantly reducing health care costs. Considering the cost of hospital and ED visits versus that for mental health professional visits, our results suggest that the cost–benefit ratio for mental health care is likely to be important.

In light of recent evidence that the prevalence of anxiety exceeds that of depression,[28,29] screening patients for anxiety and depression in the clinical management of patients with heart disease is essential. Identification of patients with significant but previously unrecognized anxiety or depression allows clinicians to intervene. The data further suggest that cross-disciplinary health care programs that include both cardiovascular and mental health care experts may be effective in improving outcomes and reducing costs. Effective strategies for identifying anxiety and depression in patients with subsequent effective treatment may be an important strategy by which clinicians can improve the quality of life in individuals with HF.[26]

The mechanisms by which mental health interventions are related to reductions in hospitalizations, ED visits, and all-cause mortality remain speculative. However, these findings are consistent with the current understanding of the heart brain connection. Both heart disease and anxiety are associated with activation of the sympathetic nervous system and the production and release of proinflammatory cytokines.[27,30] Simultaneous activation of these systems promote the progression of both central nervous system–mediated conditions such as anxiety and depression as well as heart disease. Mental health treatment may reduce both anxiety and depression and the incidence of cardiovascular events.

The study is limited in that we have sampled the Ohio Medicaid database and there is no means to ascertain whether the results are generalizable to other areas of the United States or over longer periods of time. Although the specific medications used in the treatment were included in the analysis, it is not possible to determine the type of psychotherapy patients received. A further limitation is that the study sample included individuals aged 21 to 64 years: the age range of those covered by Medicaid. While this permits a broader sample than a Medicare cohort, it is truncated at an upper age limit that excludes older adults. Because of the observational nature of the data, we are not able to infer causality nor were we able to validate mental health diagnoses with standardized assessments. While we were able to control for a wide array of demographic and clinical confounding factors, it was also not possible to capture severity of illness or other factors that may be associated with outcomes (eg, lifestyle factors or adherence).

In conclusion, the findings of this study demonstrate that mental health interventions have a significant protective impact on cardiovascular outcomes for patients with depression and anxiety. There has been question as to whether medical or person-to-person interventions, such as cognitive behavioral therapy, have such an impact even though anxiety and depression are known to be important modifiers of disease risk and outcome. This study indicates that such therapies indeed have a beneficial effect on hospital and ED admissions and, in some cases, mortality. Accordingly, these findings motivate further studies investigating mental health interventions in patients with CVD. Studies investigating the mechanistic basis for the benefits of these interventions will guide the design of new treatment strategies that can alleviate both the personal health and financial burden of CVD and mental illness.

ARTICLE INFORMATION

Received May 22, 2023; accepted January 12, 2024.

Affiliations

Department of Psychiatry and Behavioral Health, The Ohio State University Wexner Medical Center, Columbus, OH (C.N.C., C.F., D.S., P.F.B.); and Department of Psychiatry and Behavioral Medicine (R.L.O.), Nova Southeastern University, Fort Lauderdale, FL .

Sources of Funding

This study was supported by a grant from the American Psychological Association, Washington, DC to Dr Carmin. Dr Binkley is supported by the James W. Overstreet Chair in Cardiology at Ohio State University Wexner Medical Center.

Disclosures

None.

REFERENCES

1. Davidson KW, Gidron Y, Mostofsky E, Trudeau KJ. Hospitalization cost offset of a hostility intervention for coronary heart disease patients. *J Consult Clin Psychol*. 2007;75:657–662. doi: 10.1037/0022-006X.75.4.657
2. Writing Group Members; Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, Das SR, de Ferranti S, Després J-P, Fullerton HJ; American Heart Association Statistics Committee; Stroke Statistics Subcommittee. Heart disease and stroke statistics-2016 update: a report from the American Heart Association. *Circulation*. 2016;133:e38–360. doi: 10.1161/CIR.0000000000000350
3. Alhurani AS, Dekker RL, Abed MA, Abed MA, Khalil A, Al Zaghal MH, Lee KS, Mudd-Martin G, Biddle MJ, Lennie TA, et al. The association of co-morbid symptoms of depression and anxiety with all-cause mortality and cardiac rehospitalization in patients with heart failure. *Psychosomatics*. 2015;56:371–380. doi: 10.1016/j.psym.2014.05.022
4. Suzuki T, Shiga T, Kuwahara K, Kobayashi S, Shinchi S, Nishimura K, Suzuiki A, Minami Y, Ishigooka J, Kasanuki H, et al. Impact of clustered depression and anxiety on mortality and rehospitalization in patients with heart failure. *J Cardiol*. 2014;64:456–462. doi: 10.1016/j.jjcc.2014.02.031
5. Jiang W, Krishnan R, Kuchibhatla M, Cuffe MS, Martsberger C, Arias RM, O'Connoer CM; SADHART-CHF Investigators. Characteristics of depression remission and its relation with cardiovascular outcome among patients with chronic heart failure (from the SADHART-CHF study). *Am J Cardiol*. 2011;107:545–551. doi: 10.1016/j.amjcard.2010.10.013

6. O'Connor CM, Jiang W, Kuchibhatla M, Silva SG, Cuffe MS, Callwood DD, Azkhary B, Stough WG, Arias RM, Rivelli SK, et al. Safety and efficacy of sertraline for depression in patients with heart failure: results of the SADHART-CHF (Sertraline Against Depression and Heart Disease in Chronic Heart Failure) trial. *J Am Coll Cardiol*. 2010;56:692–699. doi: 10.1016/j.jacc.2010.03.068
7. Emani S, Binkley PF. Mind-body medicine in chronic heart failure: a translational science challenge. *Circ Heart Fail*. 2010;3:715–725. doi: 10.1161/CIRCHEARTFAILURE.110.951509
8. Ferketich AK, Binkley PF. Psychological distress and cardiovascular disease: results from the 2002 National Health Interview Survey. *Eur Heart J*. 2005;26:1923–1929. doi: 10.1093/eurheartj/ehi329
9. Frasure-Smith N, Lespérance F. Depression and other psychological risks following myocardial infarction. *Arch Gen Psychiatry*. 2003;60:627–636. doi: 10.1001/archpsyc.60.6.627
10. Frasure-Smith N, Lespérance F. Depression and anxiety as predictors of 2-year cardiac events in patients with stable coronary artery disease. *Arch Gen Psychiatry*. 2008;65:62–71. doi: 10.1001/archgenpsychiatry.2007.4
11. Frasure-Smith N, Lespérance F, Talajic M, Khairy P, Dorian P, O'Meara E, Roy D. Anxiety sensitivity moderates prognostic importance of rhythm-control versus rate-control strategies in patients with atrial fibrillation and congestive heart failure: insights from the Atrial Fibrillation and Congestive Heart Failure Trial. *Circ Heart Fail*. 2012;5:322–330. doi: 10.1161/CIRCHEARTFAILURE.111.964122
12. Janszky I, Ahnve S, Lundberg I, Hemmingsson T. Early-onset depression, anxiety, and risk of subsequent coronary heart disease: 37-year follow-up of 49,321 young Swedish men. *J Am Coll Cardiol*. 2010;56:31–37. doi: 10.1016/j.jacc.2010.03.033
13. Kawachi I, Sparrow D, Vokonas PS, Weiss ST. Symptoms of anxiety and risk of coronary heart disease. The Normative Aging Study. *Circulation*. 1994;90:2225–2229. doi: 10.1161/01.cir.90.5.2225
14. Barger SD, Sydeman SJ. Does generalized anxiety disorder predict coronary heart disease risk factors independently of major depressive disorder? *J Affect Disord*. 2005;88:87–91. doi: 10.1016/j.jad.2005.05.012
15. Emdin CA, Odutayo A, Wong CX, Tran J, Hsiao AJ, Hunn BH. Meta-analysis of anxiety as a risk factor for cardiovascular disease. *Am J Cardiol*. 2016;118:511–519. doi: 10.1016/j.amjcard.2016.05.041
16. Chauvet-Gélinier JC, Trojak B, Vergès-Patois B, Cottin Y, Bonin B. Review on depression and coronary heart disease. *Arch Cardiovasc Dis*. 2013;106:103–110. doi: 10.1016/j.acvd.2012.12.004
17. Cohen BE, Edmondson D, Kronish IM. State of the art review: depression, stress, anxiety, and cardiovascular disease. *Am J Hypertens*. 2015;28:1295–1302. doi: 10.1093/ajh/hpv047
18. Kubzansky LD, Kawachi I, Weiss ST, Sparrow D. Anxiety and coronary heart disease: a synthesis of epidemiological, psychological, and experimental evidence. *Ann Behav Med*. 1998;20:47–58. doi: 10.1007/BF02884448
19. Rodwin BA, Spruill TM, Ladapo JA. Economics of psychosocial factors in patients with cardiovascular disease. *Prog Cardiovasc Dis*. 2013;55:563–573. doi: 10.1016/j.pcad.2013.03.006
20. Strik JJ, Denollet J, Lousberg R, Honig A. Comparing symptoms of depression and anxiety as predictors of cardiac events and increased health care consumption after myocardial infarction. *J Am Coll Cardiol*. 2003;42:1801–1807. doi: 10.1016/j.jacc.2003.07.007
21. Baumeister H, Haschke A, Munzinger M, Hutter N, Tully PJ. Inpatient and outpatient costs in patients with coronary artery disease and mental disorders: a systematic review. *Biopsychosoc Med*. 2015;9:11. doi: 10.1186/s13030-015-0039-z
22. Whalley B, Thompson DR, Taylor RS. Psychological interventions for coronary heart disease: cochrane systematic review and meta-analysis. *Int J Behav Med*. 2014;21:109–121. doi: 10.1007/s12529-012-9282-x
23. Huffman JC, Mastromauro CA, Beach SR, Celano CM, DuBois CM, Healy BC, Suarez L, Rollman BL, Januzzi JL. Collaborative care for depression and anxiety disorders in patients with recent cardiac events: the Management of Sadness and Anxiety in Cardiology (MOSAIC) randomized clinical trial. *JAMA Intern Med*. 2014;174:927–935. doi: 10.1001/jamainternmed.2014.739
24. Glassman AH, O'Connor CM, Califf RM, Swedberg K, Schwartz P, Bigger T, Krishnan RR, van Zyl LT, Swenson RJ, Finkel MS, et al. Sertraline treatment of major depression in patients with acute MI or unstable angina. *JAMA*. 2002;288:701–709. doi: 10.1001/jama.288.6.701
25. Gottlieb SS, Kop WJ, Ellis SJ, Binkley P, Howlett J, O'Connor C, Blumenthal JA, Fletcher G, Swank AM, Cooper L, et al; HF-ACTION Investigators. Relation of depression to severity of illness in heart failure (from Heart Failure And a Controlled Trial Investigating Outcomes of Exercise Training [HF-ACTION]). *Am J Cardiol*. 2009;103:1285–1289. doi: 10.1016/j.amjcard.2009.01.025
26. Trudnak T, Kelley D, Zerzan J, Griffith K, Jiang HJ, Fairbrother GL. Medicaid admissions and readmissions: understanding the prevalence, payment, and most common diagnoses. *Health Aff (Millwood)*. 2014;33:1337–1344. doi: 10.1377/hlthaff.2013.0632
27. Hospital guide to reducing Medicaid readmissions. Agency for Healthcare Research and Quality. Publication no. 14-0050-EF. 2014. Accessed March 8, 2019. https://www.ahrq.gov/sites/default/files/publications/files/medreadmissions.pdf
28. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005;62:593–602. doi: 10.1001/archpsyc.62.6.593
29. Scott KM, de Jonge P, Alonso J, Viana MC, Liu Z, O'Neil S, Aguilar-Gaxiola S, Bruffaerts R, Caldas-de-Almeida JM, Stein DJ, et al. Associations between DSM-IV mental disorders and subsequent heart disease onset: beyond depression. *Int J Cardiol*. 2013;168:5293–5299. doi: 10.1016/j.ijcard.2013.08.012
30. Nemeroff CB, Goldschmidt-Clermont PJ. Heartache and heartbreak—the link between depression and cardiovascular disease. *Nat Rev Cardiol*. 2012;9:526–539. doi: 10.1038/nrcardio.2012.91