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Contemporary Prevalence and Correlates of Incident Heart Failure with Preserved Ejection Fraction

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Abstract

Background—We assessed the prevalence of preserved left ventricular ejection fraction (LVEF) in patients with incident heart failure, and differences in the demographic and clinical characteristics that may differentiate patients presenting with heart failure with preserved versus reduced LVEF.

Methods—We identified all patients with newly diagnosed heart failure between 2005 and 2008 from four sites in the Cardiovascular Research Network based on hospital discharge and

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ambulatory visit diagnoses, and assigned a category of preserved, borderline, or reduced LVEF using data from electronic databases and chart review.

Results—We identified 11,994 patients with incident heart failure; of these, 6,210 (51.8%) had preserved LVEF, 1870 (15.6%) had borderline systolic dysfunction, and 3,914 (32.6%) had reduced LVEF. For those with heart failure with preserved LVEF, mean age was 74.7 years, and 57.1% were women; for those with borderline systolic dysfunction, mean age was 71.6 years and 38.4% were women; and for those with reduced LVEF, mean age was 69.1 years, and 32.6% were women. Compared with white patients, black patients were less likely to have heart failure with preserved systolic function. Those with a history of coronary artery bypass surgery, mitral and/or aortic valvular disease, atrial fibrillation or flutter, or a diagnosis of hypertension were more likely to have heart failure with preserved systolic function, as were those with a diverse range of non-cardiac comorbid conditions including chronic lung disease, chronic liver disease, a history of a hospitalized bleed, a history of a mechanical fall, a diagnosis of depression, and a diagnosis of dementia. Patients with a history of acute myocardial infarction, and a history of ventricular fibrillation or ventricular tachycardia were less likely to have heart failure with preserved LVEF. Patients with higher systolic blood pressures at baseline and lower LDL levels were more likely to have heart failure with preserved LVEF, as were those with lower hemoglobin levels and the lowest glomerular filtration rates.

Conclusions—Heart failure with preserved LVEF is the most common form of the heart failure syndrome among patients newly presenting with this condition, and women and older adults are especially affected. Evidence-based treatment strategies apply to less than a third of patients newly diagnosed with heart failure.

Keywords

Heart Failure; Prevalence; Ejection Fraction; Systolic Function; Elderly; Gender

Introduction

The heterogeneity of the heart failure syndrome is well appreciated, and the importance of heart failure with preserved left ventricular ejection fraction (HF-PEF) as a prominent contributor to the heart failure epidemic has been unequivocally established.^{1,2} Heart failure with “normal ventricular performance” has been described in case reports and small hospital-based case series dating back to the 1970s.³ However, there have been very few large population-based studies of this condition.

In a community-wide study of residents of Olmsted County, Minnesota, among 556 individuals with either incident or prevalent heart failure identified in the early to mid-2000's, more than half had HF-PEF.⁴ Another study of patients hospitalized with decompensated heart failure at Mayo Clinic Hospitals from 1987 through 2001 determined that the prevalence of HF-PEF increased from 38% to 47% to 54% over the three consecutive five-year periods encompassed in the study.⁵

We conducted a large population-based study to provide a contemporary estimate of the prevalence of HF-PEF and heart failure with reduced left ventricular ejection fraction (HF-REF) among newly diagnosed patients with the heart failure syndrome. An additional goal was to describe the demographic and clinical characteristics that may differentiate HF-PEF from heart failure with HF-REF at the time of initial clinical presentation. To address these questions, we identified all patients with newly diagnosed heart failure from four sites participating in the Cardiovascular Research Network (CVRN) between 2005 and 2008.

Methods

The source population included members from four participating health plans within the National Heart, Lung and Blood Institute-sponsored CVRN.⁶ Sites included Kaiser Permanente Northern California, Kaiser Permanente Colorado, Kaiser Permanente Northwest, and Fallon Community Health Plan. Contributing sites provide care to an ethnically and socioeconomically diverse population across varying clinical practice settings and geographically diverse areas. Each site also had a Virtual Data Warehouse (VDW),^{6,7} which served as the primary data source for subject identification and characterization. The VDW is a distributed standardized data resource comprised of electronic datasets at each CVRN site, populated with linked demographic, administrative, ambulatory pharmacy, outpatient laboratory test results, and health care utilization (ambulatory visits and network and non-network hospitalizations with diagnoses and procedures) data for members receiving care at participating sites.

Institutional review boards at participating sites approved the study, and waiver of consent was obtained due to the nature of the study.

Study sample and characterization of left ventricular systolic function

We first identified all persons aged ≥ 21 years with diagnosed heart failure based on either having being hospitalized with a primary discharge diagnosis of heart failure and/or having >3 ambulatory visits coded for heart failure with at least one visit being with a cardiologist between January 1, 2005 through December 31, 2008. We used the following International Classification of Diseases, 9th Edition (ICD-9) codes: 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, and 428.9. Prior studies have shown a positive predictive value of $>95\%$ for admissions with a primary discharge diagnosis of heart failure based on these codes when compared against chart review and Framingham clinical criteria.^{8,9,10} We defined incident heart failure as having no hospitalization or ambulatory heart failure diagnosis at any time during the five-year period before each patient's first heart failure diagnosis.

We ascertained information on quantitative and/or qualitative assessments of LVEF from the results of echocardiograms, radionuclide scintigraphy, other nuclear imaging modalities, and left ventriculography test results available from site-specific databases complemented by manual chart review. We classified patients into categories of preserved and reduced ejection fraction. We defined HF-PEF as either a reported left ventricular ejection fraction $> 50\%$ and/or based on a physician's qualitative assessment of preserved or normal systolic function.¹¹ We defined HF-REF as either a reported left ventricular ejection fraction $\leq 40\%$ and/or based on a physician's qualitative assessment of moderate, moderate to severe, or severe systolic dysfunction. A third category termed "borderline" systolic dysfunction was defined as an LVEF of 41-49% and/or based on a physician's qualitative assessment of mildly reduced systolic function.

Covariates

We ascertained information on coexisting illnesses based on diagnoses or procedures using relevant ICD-9 codes, laboratory results, or filled outpatient prescriptions from health plan hospitalization discharge, ambulatory visit, laboratory, and pharmacy databases, as well as site-specific diabetes mellitus and cancer registries.^{7,8, 12} We collected baseline data on diagnoses of acute myocardial infarction, unstable angina, coronary artery revascularization, stroke or transient ischemic attack, cerebrovascular disease, other thromboembolism, atrial fibrillation or flutter, ventricular fibrillation or tachycardia, mitral or aortic valvular heart

disease, peripheral arterial disease, rheumatic heart disease, receipt of a pacemaker, receipt of cardiac resynchronization therapy, receipt of an implantable cardioverter defibrillator, dyslipidemia, hypertension, diabetes mellitus, hospitalized bleed, diagnosed dementia, diagnosed depression, chronic lung disease, chronic liver disease, mechanical fall, and systemic cancer based on ICD-9 codes and CPT procedure codes.

We ascertained available ambulatory results for systolic and diastolic blood pressure, serum LDL (low-density lipoprotein) and HDL (high-density lipoprotein) cholesterol measurements, estimated glomerular filtration rate, and hemoglobin level on or before the index date from each site's VDW.^{6,7}

Statistical analysis

We compared baseline characteristics across groups of left ventricular systolic function using ANOVA or relevant non-parametric tests for continuous variables and chi-squared tests for categorical variables. Given the large sample size, we focused only on differences in baseline characteristics that may be clinically meaningful.

We constructed a logistic regression model to identify demographic and clinical correlates of incident HF-PEF vs. HF-REF. The model adjusted for age, sex, race, and any other variables that differed between groups with a $P < 0.2$. We also explored whether additional adjustment for clustering at the site level was necessary. All analyses were conducted using SAS statistical software, version 9.1 (Cary, N.C.).

Results

We identified 11,994 patients with incident heart failure over the period of study; the mean age of these patients was 72.4 years (SD 13.1) and 46.2% were female. Nearly half (48.3%) of all patients were 75 years of age or older (Table 1). A total of 6,210 (51.8%) patients had HF-PEF and 3,914 (32.6%) persons had HF-REF, with 1,870 (15.6%) having borderline systolic dysfunction.

Among those with HF-PEF, their mean age was 74.7 years and 55.4% were aged 75 years or older; 57.1% of these patients were women. For those with HF-REF, their mean age was 69.1 years and 38.5% were 75 years or older; 32.6% of these patients were women. For those with borderline systolic dysfunction, their mean age was 71.6 years and 45.2% were 75 years of age or older; 38.4% of these patients were women (Table 1).

Medication use in the 120 days prior to the diagnosis date is summarized in Table 2. Of note, nearly half of all patients were receiving ACE (angiotensin-converting-enzyme) inhibitors or angiotensin II receptor blockers during this time period; more than half were receiving beta-blockers and nearly a third were receiving loop diuretics.

Those with incident HF-PEF differed significantly from those with HF-REF across a range of demographic and clinical characteristics (Table 3). In multivariable analyses, older patients were more likely to be diagnosed with HF-PEF. For example, the odds of having HF-PEF for those aged 65-74 were 14% higher than for those aged 55-64; the odds for those aged 75-84 were 34% higher, and the odds for persons aged 85 or older were 51% higher. Women were over two-fold more likely than men to have HF-PEF (adjusted odds ratio: 2.24; 95% confidence interval 2.06-2.44). Compared with white patients, black patients were less likely to have heart failure with preserved systolic function (adjusted odds ratio: 0.69; 95% confidence interval 0.67-0.71).

Individuals with a history of coronary artery bypass surgery, mitral and/or aortic valvular disease, atrial fibrillation or flutter, or a diagnosis of hypertension were more likely to have HF-PEF, as were those with a diverse range of non-cardiac comorbid conditions including chronic lung disease, chronic liver disease, a history of a hospitalized bleed, a history of a mechanical fall, a diagnosis of depression, and a diagnosis of dementia. Patients with a history of acute myocardial infarction, and a history of ventricular fibrillation or ventricular tachycardia were less likely to have HF-PEF (Table 3).

Patients with higher systolic blood pressures at baseline were more likely to have HF-PEF (Table 3). Compared with a baseline systolic blood pressure of 110-120 mm Hg, the odds for those patients with systolic blood pressures of 130-139 mm Hg were 13% higher; the odds for patients with systolic blood pressures of 140-159 and 160-170 mm Hg were 28% and 60% higher, respectively. For those patients with systolic blood pressures of >180 mm Hg, the adjusted odds ratio was 2.04 (95% confidence interval 1.59 to 2.60). Lower LDL levels, lower hemoglobin levels, and very low estimated glomerular filtration rates (<15 ml/min/1.73 m²) were more likely in those presenting with HF-PEF.

Discussion

In this very large, contemporary, multicenter cohort comprised of patients with newly diagnosed heart failure, more than 50% had HF-PEF. These findings are sobering in that of the 2011 American College of Cardiology Foundation/American Heart Association/American Medical Association-Physician Consortium for Performance Improvement (ACCF/AHA/AMA-PCPI) performance measures for adults with heart failure,¹³ all of the measures associated with therapeutic interventions focus solely on patients with HF-REF. Such patients comprise less than one-third of those with incident heart failure, according to the findings of our study.

The nomenclature regarding the classification of heart failure has been a subject of some controversy.⁵ The most recently revised ACC/AHA- guidelines for the diagnosis and management of heart failure use the term “heart failure with normal left ventricular ejection fraction.”¹⁴ In the present study, we took a somewhat less stringent approach to characterizing patients, as we employed both quantitative and qualitative assessments of left ventricular systolic function which represents how patients are frequently evaluated and classified in clinical practice, especially given the known challenges in the accuracy of the calculation of left ventricular ejection fraction.

As has been reported in previous studies, older age, female sex, hypertension, presence of atrial fibrillation, and lower hemoglobin levels were more likely to be present in patients with HF-PEF.^{5,15} Our study findings also serve to emphasize the complexity of the patient population with heart failure; a variety of non-cardiac conditions such as chronic lung disease, chronic liver disease, depression, and dementia were more likely to be present in patients diagnosed with HF-PEF. The implications of non-cardiac comorbidities, and how they relate to clinical decision-making and clinical outcomes in the patient population with heart failure, have been increasingly appreciated.^{16,17,18,19}

Our study has some limitations. Insured populations in our participating health plans may not be fully representative of the general population. Nevertheless, this limitation is counterbalanced by the breadth of geographic and demographic diversity represented across four geographically diverse health plans, as well as the community-based nature of health care delivery, suggesting that findings from our study are likely to be highly generalizable to heart failure patients in “real-world” practice settings. In our study, heart failure diagnoses were not adjudicated through medical record abstraction and expert review. However, prior

studies have shown a high positive predictive value for the approach we used to identify heart failure patients.

Our findings confirm that a majority of patients who present with heart failure have HF-PEF, and it is likely that the numbers of patients affected by this form of the heart failure syndrome will increase with the aging of the U.S. population over the coming decades. Yet, there remains a dearth of evidence to guide the management of these very complex patients, who suffer adverse outcomes including hospitalization and mortality at very high rates.

Few studies have been undertaken that have specifically focused on patients with HF-PEF, and clinical trials regarding heart failure have tended to exclude the types of patients most commonly presenting with this condition, including the elderly, women, and those with high burdens of comorbidity.^{1,20,21} The imperative to address this situation has never been more apparent and urgent.

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Table 1
Baseline characteristics among 11,994 patients newly diagnosed heart failure identified between 2005-2008

Variable	Overall N = 11,994	Preserved EF N = 6,210	Borderline EF N = 1,870	Reduced EF N = 3,914	p-value
Mean (SD) age, yr	72.4 (13.1)	74.7 (12.1)	71.6 (12.9)	69.1 (14.0)	<0.001
Age categories					<0.001
Age <45	404 (3.4)	123 (2.0)	60 (3.2)	221 (5.6)	
Age 45-54	894 (7.5)	312 (5.0)	141 (7.5)	441 (11.3)	
Age 55-64	1974 (16.5)	827 (13.3)	365 (19.5)	782 (20.0)	
Age 65-74	2929 (24.4)	1508 (24.3)	457 (24.4)	964 (24.6)	
Age 75-84	3815 (31.8)	2218 (35.7)	564 (30.2)	1033 (26.4)	
Age 85	1978 (16.5)	1222 (19.7)	283 (15.1)	473 (12.1)	
Female gender, n (%)	5539 (46.2)	3543 (57.1)	719 (38.4)	1277 (32.6)	<0.001
Race categories					<0.001
White	8922 (74.4)	4759 (76.6)	1421 (76.0)	2742 (70.1)	
Black/African American	972 (8.1)	428 (6.9)	157 (8.4)	387 (9.9)	
Asian American	711 (5.9)	374 (6.0)	104 (5.6)	233 (6.0)	
Native Hawaiian or other Pacific Islander	99 (0.8)	52 (0.8)	13 (0.7)	34 (0.9)	
American Indian or Alaska Native	33 (0.3)	15 (0.2)	4 (0.2)	14 (0.4)	
Missing/Unknown	1257 (10.5)	582 (9.4)	171 (9.1)	504 (12.9)	
Medical History, n (%)					
Acute myocardial Infarction	858 (7.2)	381 (6.1)	198 (10.6)	279 (7.1)	<0.001
Unstable angina	473 (3.9)	273 (4.4)	93 (5.0)	107 (2.7)	<0.001
Coronary artery bypass surgery	475 (4.0)	256 (4.1)	116 (6.2)	103 (2.6)	<0.001
Percutaneous coronary intervention	875 (7.3)	393 (6.3)	198 (10.6)	284 (7.3)	<0.001
Ischemic stroke or transient ischemic attack	753 (6.3)	438 (7.1)	128 (6.8)	187 (4.8)	<0.001
Cerebrovascular disease	1803 (15.0)	1027 (16.5)	304 (16.3)	472 (12.1)	<0.001
Other thromboembolic event	68 (0.6)	42 (0.7)	13 (0.7)	13 (0.3)	0.06
Atrial fibrillation or flutter	3699 (30.8)	2195 (35.3)	586 (31.3)	918 (23.5)	<0.001
Ventricular tachycardia or fibrillation	207 (1.7)	69 (1.1)	40 (2.1)	98 (2.5)	<0.001

Variable	Overall N = 11,994	Preserved EF N = 6,210	Borderline EF N = 1,870	Reduced EF N = 3,914	p-value
Mitral and/or aortic valvular disease	2038 (17.0)	1315 (21.2)	315 (16.8)	408 (10.4)	<0.001
Peripheral arterial disease	718 (6.0)	398 (6.4)	129 (6.9)	191 (4.9)	0.001
Rheumatic heart disease	224 (1.9)	128 (2.1)	32 (1.7)	64 (1.6)	0.26
Implantable cardioverter defibrillator	116 (1.0)	22 (0.4)	23 (1.2)	71 (1.8)	<0.001
Pacemaker	512 (4.3)	282 (4.5)	80 (4.3)	150 (3.8)	0.23
Dyslipidemia	7175 (59.8)	3833 (61.7)	1191 (63.7)	2151 (55.0)	<0.001
Hypertension	8994 (75.0)	5114 (82.4)	1402 (75.0)	2478 (63.3)	<0.001
Diabetes mellitus	2301 (19.2)	1217 (19.6)	383 (20.5)	701 (17.9)	0.03
Hospitalized bleeds	498 (4.2)	306 (4.9)	78 (4.2)	114 (2.9)	<0.001
Diagnosed dementia	803 (6.7)	480 (7.7)	128 (6.8)	195 (5.0)	<0.001
Diagnosed depression	1959 (16.3)	1141 (18.4)	294 (15.7)	524 (13.4)	<0.001
Chronic lung disease	4148 (34.6)	2369 (38.1)	629 (33.6)	1150 (29.4)	<0.001
Chronic liver disease	428 (3.6)	242 (3.9)	57 (3.0)	129 (3.3)	0.12
Mechanical fall	264 (2.2)	178 (2.9)	31 (1.7)	55 (1.4)	<0.001
Systemic cancer	862 (7.2)	493 (7.9)	120 (6.4)	249 (6.4)	0.004
Baseline eGFR category, ml/min/1.73 m ² , n (%)					<0.001
eGFR 130	23 (0.2)	9 (0.1)	6 (0.3)	8 (0.2)	
eGFR 90-130	1503 (12.5)	690 (11.1)	235 (12.6)	578 (14.8)	
eGFR 60-89	4746 (39.6)	2382 (38.4)	758 (40.5)	1606 (41.0)	
eGFR 45-59	2583 (21.5)	1406 (22.6)	386 (20.6)	791 (20.2)	
eGFR 30-44	1614 (13.5)	983 (15.8)	239 (12.8)	392 (10.0)	
eGFR 15-29	572 (4.8)	376 (6.1)	75 (4.0)	121 (3.1)	
eGFR <15	99 (0.8)	70 (1.1)	15 (0.8)	14 (0.4)	
Dialysis	209 (1.7)	117 (1.9)	40 (2.1)	52 (1.3)	
Missing	645 (5.4)	177 (2.9)	116 (6.2)	352 (9.0)	
Baseline hemoglobin category, g/L, n (%)					<0.001
16.0	804 (6.7)	303 (4.9)	131 (7.0)	370 (9.5)	
15.0-15.9	1225 (10.2)	495 (8.0)	202 (10.8)	528 (13.5)	
14.0-14.9	2101 (17.5)	976 (15.7)	341 (18.2)	784 (20.0)	

Variable	Overall N = 11,994	Preserved EF N = 6,210	Borderline EF N = 1,870	Reduced EF N = 3,914	p-value
13.0-13.9	2338 (19.5)	1295 (20.9)	349 (18.7)	694 (17.7)	
12.0-12.9	1925 (16.0)	1147 (18.5)	304 (16.3)	474 (12.1)	
11.0-11.9	1285 (10.7)	829 (13.3)	185 (9.9)	271 (6.9)	
10.0-10.9	788 (6.6)	508 (8.2)	116 (6.2)	164 (4.2)	
9.0-9.9	343 (2.9)	219 (3.5)	51 (2.7)	73 (1.9)	
<9.0	166 (1.4)	101 (1.6)	29 (1.6)	36 (0.9)	
Missing	1019 (8.5)	337 (5.4)	162 (8.7)	520 (13.3)	
Systolic blood pressure category, mmHg, n (%)					<0.001
180	383 (3.2)	234 (3.8)	56 (3.0)	93 (2.4)	
160-179	894 (7.5)	533 (8.6)	132 (7.1)	229 (5.9)	
140-159	2486 (20.7)	1351 (21.8)	412 (22.0)	723 (18.5)	
130-139	2416 (20.1)	1283 (20.7)	368 (19.7)	765 (19.5)	
121-129	1791 (14.9)	899 (14.5)	280 (15.0)	612 (15.6)	
110-120	2603 (21.7)	1253 (20.2)	417 (22.3)	933 (23.8)	
100-109	609 (5.1)	290 (4.7)	79 (4.2)	240 (6.1)	
< 100	283 (2.4)	120 (1.9)	41 (2.2)	122 (3.1)	
Missing	529 (4.4)	247 (4.0)	85 (4.5)	197 (5.0)	
Diastolic blood pressure category, mmHg, n (%)					<0.001
110	153 (1.3)	59 (1.0)	22 (1.2)	72 (1.8)	
100-109	341 (2.8)	129 (2.1)	49 (2.6)	163 (4.2)	
90-99	853 (7.1)	366 (5.9)	146 (7.8)	341 (8.7)	
85-89	726 (6.1)	311 (5.0)	118 (6.3)	297 (7.6)	
81-84	951 (7.9)	482 (7.8)	153 (8.2)	316 (8.1)	
80	8440 (70.4)	4616 (74.3)	1297 (69.4)	2527 (64.6)	
Missing	530 (4.4)	247 (4.0)	85 (4.5)	198 (5.1)	
HDL cholesterol category, g/dL, n (%)					<0.001
60	2110 (17.6)	1229 (19.8)	291 (15.6)	590 (15.1)	
50-50.9	2174 (18.1)	1180 (19.0)	306 (16.4)	688 (17.6)	
40-49.9	3147 (26.2)	1663 (26.8)	517 (27.6)	967 (24.7)	

Variable	Overall N = 11,994	Preserved EF N = 6,210	Borderline EF N = 1,870	Reduced EF N = 3,914	p-value
35-39.9	1516 (12.6)	784 (12.6)	244 (13.0)	488 (12.5)	
<35	1532 (12.8)	730 (11.8)	286 (15.3)	516 (13.2)	
Missing	1515 (12.6)	624 (10.0)	226 (12.1)	665 (17.0)	
LDL cholesterol category, g/dL, n (%)					<0.001
200	118 (1.0)	45 (0.7)	20 (1.1)	53 (1.4)	
160-199.9	483 (4.0)	234 (3.8)	84 (4.5)	165 (4.2)	
130-159.9	1341 (11.2)	668 (10.8)	216 (11.6)	457 (11.7)	
100-129.9	2746 (22.9)	1453 (23.4)	417 (22.3)	876 (22.4)	
70-99.9	3837 (32.0)	2114 (34.0)	576 (30.8)	1147 (29.3)	
<70	1837 (15.3)	1016 (16.4)	320 (17.1)	501 (12.8)	
Missing	1632 (13.6)	680 (11.0)	237 (12.7)	715 (18.3)	

Table 2

Baseline medication use among 11,994 patients with newly diagnosed heart failure identified between 2005-2008.

Medication Category	Overall N = 11,994	Preserved EF N = 6,210	Borderline EF N = 1,870	Reduced EF N = 3,914	p-value
ACE inhibitors/Angiotensin II receptor blockers (ARB)	5688 (47.4)	3080 (49.6)	927 (49.6)	1681 (42.9)	<0.001
Aldosterone receptor antagonist	221 (1.8)	93 (1.5)	29 (1.6)	99 (2.5)	0.001
Beta-blocker	6416 (53.5)	3877 (62.4)	1000 (53.5)	1539 (39.3)	<0.001
Calcium channel blocker	3140 (26.2)	2099 (33.8)	442 (23.6)	599 (15.3)	<0.001
Digoxin	865 (7.2)	498 (8.0)	117 (6.3)	250 (6.4)	0.002
Diuretic (loop)	3571 (29.8)	2085 (33.6)	513 (27.4)	973 (24.9)	<0.001
Diuretic (thiazide)	2807 (23.4)	1728 (27.8)	401 (21.4)	678 (17.3)	<0.001
Nitrate	1403 (11.7)	723 (11.6)	272 (14.5)	408 (10.4)	<0.001
Statin	5463 (45.5)	2980 (48.0)	911 (48.7)	1572 (40.2)	<0.001
Other lipid-lowering drug	636 (5.3)	366 (5.9)	106 (5.7)	164 (4.2)	0.001
Antiplatelet agent	973 (8.1)	484 (7.8)	202 (10.8)	287 (7.3)	<0.001
Anticoagulant	2033 (17.0)	1198 (19.3)	322 (17.2)	513 (13.1)	<0.001

Table 3

Adjusted odds ratios for preserved left ventricular ejection fraction among adults with newly diagnosed heart failure (2005-2008).

Variable	Adjusted Odds Ratio for Preserved Systolic Function (95% Confidence Interval)
Age group, yr	
Age <45	0.77 (0.70-0.85)
Age 45-54	0.79 (0.72-0.86)
Age 55-64	Reference
Age 65-74	1.14 (1.08-1.20)
Age 75-84	1.34 (1.31-1.37)
Age 85	1.51 (1.41-1.61)
Female gender, n (%)	2.24 (2.06-2.44)
Race categories	
White	Reference
Black/African American	0.69 (0.67-0.71)
Asian American	1.02 (0.94-1.12)
Native Hawaiian or other Pacific Islander	1.09 (0.89-1.33)
American Indian or Alaska Native	0.53 (0.46-0.62)
Missing/Unknown	0.79 (0.70-0.89)
Medical History, n (%)	
Acute myocardial Infarction	0.78 (0.65-0.95)
Coronary artery bypass surgery	1.79 (1.39-2.33)
Percutaneous coronary intervention	0.95 (0.80-1.13)
Ischemic stroke or transient ischemic attack	1.05 (0.95-1.17)
Other thromboembolic event	1.05 (0.83-1.34)
Atrial fibrillation or atrial flutter	1.66 (1.57-1.76)
Ventricular tachycardia or fibrillation	0.53 (0.49-0.58)
Mitral and/or aortic valvular disease	1.99 (1.64-2.40)
Peripheral arterial disease	0.98 (0.87-1.09)
Rheumatic heart disease	0.86 (0.74-1.01)
Implantable cardioverter defibrillator	0.29 (0.24-0.35)
Pacemaker	0.89 (0.78-1.01)
Dyslipidemia	1.09 (0.98-1.22)
Hypertension	1.75 (1.62-1.88)
Diabetes mellitus	1.06 (0.99-1.14)
Hospitalized bleeds	1.31 (1.11-1.54)
Diagnosed dementia	1.10 (1.01-1.20)
Diagnosed depression	1.20 (1.16-1.24)
Chronic lung disease	1.38 (1.22-1.55)

Variable	Adjusted Odds Ratio for Preserved Systolic Function (95% Confidence Interval)
Chronic liver disease	1.27 (1.07-1.49)
Mechanical fall	1.38 (1.07-1.78)
Systemic cancer	1.02 (0.87-1.21)
Estimated GFR (ml/min/1.73 m ²)	
eGFR ≥ 130	1.36 (0.86-2.16)
eGFR 90-130	1.02 (0.96-1.10)
eGFR 60-89	Reference
eGFR 45-59	0.95 (0.90-1.00)
eGFR 30-44	1.07 (0.98-1.18)
eGFR 15-29	1.31 (0.99-1.73)
eGFR <15	2.12 (1.77-2.54)
Dialysis	1.47 (1.26-1.71)
Missing	0.84 (0.61-1.17)
Hemoglobin (g/L)	
≥ 16.0	0.72 (0.62-0.82)
15.0-15.9	0.70 (0.65-0.74)
14.0-14.9	0.76 (0.75-0.78)
13.0-13.9	Reference
12.0-12.9	1.15 (1.01-1.31)
11.0-11.9	1.42 (1.35-1.50)
10.0-10.9	1.36 (1.10-1.67)
9.0-9.9	1.37 (1.17-1.60)
<9.0	1.34 (1.03-1.75)
Missing	0.65 (0.53-0.80)
Systolic blood pressure (mmHg)	
≥ 180	2.04 (1.59-2.60)
160-179	1.60 (1.41-1.80)
140-159	1.28 (1.13-1.45)
130-139	1.13 (1.06-1.21)
121-129	1.00 (0.95-1.04)
110-120	Reference
100-109	0.80 (0.66-0.97)
< 100	0.68 (0.62-0.75)
Missing	1.67 (1.30-2.14)
HDL cholesterol (g/dL)	
≥ 60	0.87 (0.79-0.97)
50-59.9	0.83 (0.79-0.88)
40-49.9	Reference

Variable	Adjusted Odds Ratio for Preserved Systolic Function (95% Confidence Interval)
35-39.9	1.01 (0.91-1.13)
<35	0.90 (0.81-1.01)
Missing	0.96 (0.75-1.23)
LDL cholesterol (g/dL)	
200	0.56 (0.42-0.73)
160-199.9	0.98 (0.83-1.16)
130-159.9	Reference
100-129.9	1.08 (0.96-1.21)
70-99.9	1.14 (1.04-1.25)
<70	1.22 (1.09-1.36)
Missing	0.84 (0.71-0.98)