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Temporal Trends in the Incidence of and Mortality Associated With Heart Failure With Preserved and Reduced Ejection Fraction

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ABSTRACT

OBJECTIVES This study aimed to determine temporal trends in the incidence of and mortality associated with heart failure (HF) and its subtypes (heart failure with reduced ejection fraction [HFrEF] and heart rate with preserved ejection fraction [HFpEF]) in the community.

BACKGROUND Major shifts in cardiovascular disease risk factor prevalence and advances in therapies may have influenced HF incidence and mortality.

METHODS In the FHS (Framingham Heart Study) and CHS (Cardiovascular Health Study), for participants who were ≥60 years of age and free of HF (n = 15,217; 60% women; 2,524 incident HF cases; 115,703 person-years of follow-up), we estimated adjusted incidence rate ratios of HF, HFrEF, and HFpEF from 1990 to 1999 and 2000 to 2009. We compared the cumulative incidence of and mortality associated with HFrEF versus HFpEF within and between decades.

RESULTS Across the 2 decades, HF incidence rate ratio was similar ($p = 0.13$). The incidence rate ratio of HFrEF declined ($p = 0.0029$), whereas HFpEF increased ($p < 0.001$). Although HFrEF incidence declined more in men than in women, men had a higher incidence of HFrEF than women in each decade ($p < 0.001$). The incidence of HFpEF significantly increased over time in both men and women ($p < 0.001$ and $p = 0.02$, respectively). During follow-up after HF, 1,701 individuals died (67.4%; HFrEF, n = 557 [33%]; HFpEF, n = 474 [29%]). There were no significant differences in mortality rates (overall, cardiovascular disease, and noncardiovascular disease) across decades within HF subtypes or between HFrEF and HFpEF within decade.

CONCLUSIONS In several U.S. community-based samples from 1990 to 2009, we observed divergent trends of decreasing HFrEF and increasing HFpEF incidence, with stable overall HF incidence and high risk for mortality. Our findings highlight the need to elucidate factors contributing to these observations.
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Despite modern advances in the prevention and treatment of cardiovascular disease (CVD) risk factors, the estimated prevalence of heart failure (HF) in the United States exceeded 5 million in 2010 (1). However, changing trends in the burden of major HF risk factors over the last 2 decades may have affected the incidence and the mortality rates of HF and its subtypes (heart failure with reduced ejection fraction [HFrEF] and heart failure with preserved ejection fraction [HFpEF]). Examination of the temporal trends in the incidence of HF, HFpEF versus HFrEF, and mortality after onset of each condition may guide our understanding of the changing epidemiology of HF. Over the past decade, reports have suggested a decline in HF incidence without change in mortality (2,3). However, data on trends in a broad community sample in the United States are lacking.

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We hypothesized that during 1990 to 2009, the incidence of overall HF and HFpEF in the community declined with improvements in treatment of cardiovascular risk factors. We also hypothesized that the incidence of HFrEF increased and associated mortality decreased, given favorable trends in survival post-myocardial infarction (MI) and landmark trials for treatment of HFrEF. We tested these hypotheses in the FHS (Framingham Heart Study) and CHS (Cardiovascular Health Study) cohorts, which have meticulous ascertainment of HF incidence and mortality, using standardized criteria for HF, HFpEF, and HFrEF.

METHODS

STUDY PARTICIPANTS. We included participants in the FHS original and offspring cohorts and the CHS, as these studies are representative of community-based samples in the United States with surveillance for and phenotyping of HF and detailed follow-up. Cohort study designs, recruitment, and surveillance have been detailed previously (4–7). Cardiovascular physical examinations occur for the FHS original cohort every 2 years (since 1948) and for the offspring cohort approximately every 4 years (since 1971). The CHS includes adults who were 65 years of age or older with an original cohort of 5,201 participants in 1989 to 1990 recruited from 4 U.S. communities: Forsyth County, North Carolina; Sacramento County, California; Washington County, Maryland; and Pittsburgh, Pennsylvania. Additional participants (n = 687), predominantly African-Americans, were enrolled in 1992 to 1993. Both FHS and CHS evaluations included medical history, anthropometry and blood pressure, phlebotomy, electrocardiography, and echocardiography. We conducted analyses of HF incidence in older adults between 1990 and 2009 and mortality up to 5 years following HF diagnosis (n = 2,524). Our samples of FHS and CHS participants were adults at least 60 years of age at the start of each decade 1990 to 1999 and 2000 to 2009. We excluded participants with prevalent HF or lacking follow-up data (n = 831 [5%], n = 554 [8%] from FHS; and n = 277 [3%] from CHS).

ABBREVIATIONS AND ACRONYMS

CVD = cardiovascular disease

HF = heart failure

HFpEF = heart failure with preserved ejection fraction

HFrEF = heart failure with reduced ejection fraction

CLINICAL CHARACTERISTICS AND FOLLOW-UP. All FHS and CHS cohort participants are under continuous surveillance for CVD events and mortality. In addition to in-person examinations, FHS participants complete regular health history updates and questionnaire-based surveys by phone. A panel of 3 physicians reviews all pertinent medical records to adjudicate CVD outcomes. CHS participants receive similar clinic visits, telephone contacts, and medical record review to adjudicate outcomes (8). Clinical covariates at or at the closest examination to the incident HF event were recorded in each cohort. In both cohorts, blood pressure was recorded as the average of 2 measurements obtained in a seated position on resting participants separated by 5 min. The occurrence of MI was assessed by integrating the clinical presentation, cardiac biomarkers, and electrocardiogram. Diabetes mellitus was defined as fasting blood glucose ≥126 mg/dl, random blood glucose >200 mg/dl, or the use of hypoglycemic agents. Current smoking was considered 1 cigarette or more daily over the past year before the cohort examination. Obesity was defined as body mass index of 30 kg/m^2 or more.

In the FHS, HF was diagnosed by a physician adjudication panel that reviewed all pertinent

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inpatient and outpatient medical records, applying FHS criteria that have been consistent over several decades (9). The CHS Events Committee similarly adjudicated HF events by reviewing documented signs, symptoms, diagnostic test results, and/or medical treatment (8,10,11). For the events in this analysis, either probable or definite HF was considered. The sensitivity and specificity of criteria for HF used in FHS and CHS have been previously reported and found to be comparable with other HF criteria (12), and the FHS and CHS definitions have similar associations with mortality (13).

We considered the date of onset of HF as any of the following: the first episode of HF symptoms, physician visit documenting HF, or HF hospitalization in both FHS and CHS. For additional analyses, we defined HFrEF and HFpEF as HF with LVEF <50% and ≥50%, respectively. This cutoff, used by other studies, has been considered by the American Heart Association and European Society of Cardiology as reasonable to differentiate the 2 groups (2,14–17). LVEF was obtained from medical record review of imaging studies, including transthoracic echocardiograms, radionuclide ventriculograms, and invasive angiocardiograms performed within a year of HF diagnosis for FHS and 30 days for CHS. Participants without an assessment of LVEF performed in proximity to the HF episode were included in the analyses of all-HF but excluded in analyses of HF subtype. We evaluated the incidence of HF (and the 2 subtypes HFrEF vs. HFpEF) during the period of interest and considered 5-year follow-up for the outcome of death due to all causes among HF cases. To provide further granularity regarding cause of death, in secondary analysis we compared the prevalence of CVD versus non-CVD death by HF subtype and decade. To understand the specific entities that may have contributed to CVD death, we also examined the prevalence of interim MI and sudden cardiac death between onset of HF and death.

STATISTICAL ANALYSIS. As CHS participants were enrolled during 2 time periods, at-risk time started for each person at the later of the time period or entry into study. For example, a participant enrolled in 1989 would not contribute until January 1, 1990; a participant enrolled in 1992 would not contribute from January 1, 1990, until the date of enrollment. We standardized HF incidence to the U.S. population age 60 to 95 years in 2010. Considering differences in HF incidence by age and sex, we examined standardized age- and sex-adjusted incidence rates of HF overall, and of the subtypes HFpEF and HFrEF, from 1990 to 1999 and 2000 to 2009 (18). Additionally, to account for possible cohort effects, we used age-, sex-, and cohort-adjusted Poisson regression models, which estimated the incidence rate ratio of HF and HF subtypes over time (ratio of incidence rate of HF in second to first decade) (18). In a secondary analysis to evaluate pertinent trends in HF incidence by sex over the 2 decades, we evaluated patterns in incidence of these outcomes in men and women.

We followed participants with incident HF for death within 5 years of diagnosis (up to 2014). After confirming the proportionality of hazards assumption, we examined the age- and sex-adjusted risk for mortality within HFpEF and HFrEF subtypes across the 2 decades using Cox regression models. Additionally, we compared age- and sex-adjusted mortality for HFpEF versus HFrEF and tested whether relative risks for death by HF subtype changed between these decades. To evaluate for possible differences in characteristics of FHS and CHS participants that may have affected the results, we assessed for effect modification by cohort in mortality analyses. Furthermore, because HF is a heterogeneous disorder with multiple extracardiovascular comorbidities, in tertiary analysis, we determined the risks of HF and HF subtype for CVD as compared with non-CVD mortality over 1990 to 1999 and 2000 to 2009. We considered a 2-tailed $p \leq 0.05$ as statistically significant. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, North Carolina).

RESULTS

CHARACTERISTICS OF THE SAMPLE. Characteristics of individuals with HF in each decade are presented in Table 1. We studied older adults with slightly greater prevalence of women in both decades. Participants in the second decade had a similar to slightly higher prevalence of hypertension but greater treatment, with lower mean blood pressure. The use of antihypertensive medications was similar among HF subgroups, with similar mean blood pressure levels within each decade. Despite a slightly higher prevalence of obesity, body mass index was similar between decades and the prevalence of diabetes was slightly lower in the second decade. The prevalence of smoking and MI were lower in the second decade. In both decades, the majority of participants with HFrEF had LVEF <35% (nearly 70% in FHS; 47% in CHS). Over the 2 decades, the use of cardiovascular medications after HF varied by class of medication, with large increases in the use of aspirin, beta-blockers, and lipid-lowering agents; stable and similar use of angiotensin-converting enzyme inhibitors and diureticagents; and a decline in use of digoxin (Online Table 1).

TABLE 1 Characteristics of FHS and CHS Participants With HF

	1990–1999			2000–2009		
	HFrEF (n = 491)	HFpEF (n = 309)	Unclassified HF (n = 567)	HFrEF (n = 353)	HFpEF (n = 431)	Unclassified HF (n = 373)
Age, yrs	75 ± 6	76 ± 7	76 ± 7	80 ± 6	81 ± 5	81 ± 6
Male	57	38	48	52	38	35
Race						
White	91	91	87	90	92	82
Black	8	9	12	10	8	17
Hispanic	0	3	0	1	1	0.3
American Indian/Alaskan native	0	0	0	0	0	1
Asian/Pacific Islander	0	0	0.4	0	0	0.3
Other	1	0	0.4	0	0	0
BMI, kg/m^2	27.4 ± 5.0	27.5 ± 5.0	27.4 ± 5.3	27.4 ± 4.4	28.5 ± 5.3	27.5 ± 5.3
SBP, mm Hg	146 ± 24	146 ± 25	142 ± 22	138 ± 21	139 ± 22	139 ± 22
DBP, mm Hg	73 ± 13	71 ± 11	71 ± 13	69 ± 12	68 ± 11	70 ± 10
Prevalent MI	40	29	29	40	21	25
Hypertension	75	75	70	74	75	79
Hypertension treatment	61	61	60	66	68	73
Diabetes	24	24	25	29	20	21
Smoking	13	7	14	7	5	10
Obesity	20	24	24	24	26	24

Values are mean ± SD or %.

BMI = body mass index; CHS = Cardiovascular Health Study; DBP = diastolic blood pressure; FHS = Framingham Heart Study; HF = heart failure; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction; MI = myocardial infarction; SBP = systolic blood pressure; Unclassified HF = heart failure cases in whom left ventricular ejection fraction was unavailable.

INCIDENCE OF HF, HFrEF, AND HFpEF DURING 1990 TO 2009. Overall, 2,524 incident HF events occurred (1,367 in the first decade), of which 844 (33%; 491 in the first decade) were HFrEF, 704 (29%; 309 in the first decade) were HFpEF, and 940 (37%, 567 in the first decade) were unclassified HF. The age- and sex-adjusted standardized incidence rates for 1990 to 1999 and 2000 to 2009 were 19.7 and 18.9 per 1,000 persons, per 1-year follow-up, respectively (Table 2). Thus, the overall incidence of HF remained similar over the past 2 decades. In Poisson models adjusting for age, sex, and cohort, where the first decade is the referent, the incidence rate ratio of overall HF was 0.94 (95% confidence interval [CI]: 0.86 to 1.02; p = 0.13), indicating no significant change in HF incidence between decades, consistent with the rates of standardized HF incidence. In similar Poisson models of HF subtypes, the incidence rate ratio of HFrEF was 0.80 (95% CI: 0.69 to 0.93; p = 0.0029) and that of HFpEF was 1.53 (95% CI: 1.30 to 1.79; p < 0.0001). These results are also consistent with those of standardized HF incidence rates, suggesting the decline in HFrEF incidence observed from the first to second decade is significant when additionally accounting for cohort, and confirming the significant increase in HFpEF incidence over this time.

TRENDS IN HF AND HF SUBTYPE INCIDENCE BY SEX. HF incidence from 1990 to 2009 is presented by sex in Figure 1 and Online Table 2. The incidences of all HF and HFrEF were greater in men than women in both decades (all p < 0.001). The incidence of HFpEF was similar between men and women in both decades (p = 0.16 and p = 0.08, respectively). The incidence of overall HF decreased by nearly 17% between decades in men (25.5 to 21.2 per 1,000 persons; p = 0.01), but remained relatively constant in women (16.4 and

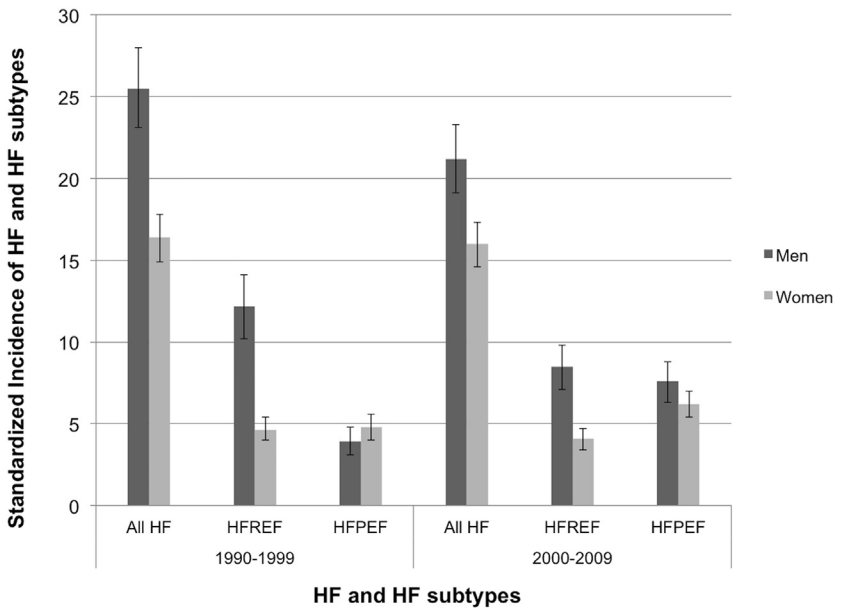
TABLE 2 Incidence of HF in FHS and CHS Participants From 1990–2009

	1990–1999*	2000–2009*	p Value
Number at risk	8,762	6,455	
Person-yrs follow-up	70,548	45,155	
Age at start of window, yrs	73 ± 8	74 ± 9	
Women	5,128 (59)	3,954 (61)	
All HF†			
HF events, n	1,367	1,157	
Std HF incidence per 1,000‡	19.7 (18.4–21.0)	18.9 (17.7–20.1)	0.37
HFrEF			
HFrEF events, n	491	353	
Std HF incidence per 1,000‡	6.6 (5.9–7.3)	6.2 (5.4–6.9)	0.40
HFpEF			
HFpEF events, n	309	431	
Std HF incidence per 1,000‡	4.7 (4.2–5.2)	6.8 (6.1–7.5)	<0.001

Values are n, mean ± SD, n (%), or n (95% confidence interval). *Participants were ≥60 yrs of age at the start of each decade. †Some HF events had undetermined LVEF. ‡Std HF incidence reported as n (95% confidence interval), standardized to age- and sex-specific 2010 (ages 60 to 95 yrs) U.S. population rates, per 1-yr follow-up.

LVEF = left ventricular ejection fraction; other abbreviations as in Table 1.

FIGURE 1 Incidence of HF and HF Subtypes by Decade in Men and Women



Incidence reported standardized to age- and sex-specific 2010 (ages 60 to 95 years) U.S. population rates, per 1-year follow-up (95% confidence interval bars shown). HF = heart failure; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction.

16.0 per 1,000 persons; p = 0.71). Between the 2 decades, the decline in the incidence of HFrEF was largely driven by men, who had HFrEF incidence declined by 30% (12.2 to 8.5 per 1,000 persons; p < 0.001), as women showed a nonsignificant decrease (4.6 to 4.1 per 1,000 persons; p = 0.23). The incidence of HFpEF increased in both sexes over 1990 to 2009, nearly doubling in men (3.9 to 7.6 per 1,000 persons; p < 0.001) but still a substantial (29%) increase in women (4.8 to 6.2 per 1,000 persons; p = 0.02).

RISK OF MORTALITY IN HFrEF AND HFpEF DURING 1990 TO 2009. Participants were followed for mortality up to 5 years (2.75 ± 2.03 years), with 2,306 and 2,093 person-years of follow-up for HFrEF and HFpEF, respectively. Of 2,524 individuals with HF, 1,701 participants died within 5 years of its onset. Among HFrEF and HFpEF groups during follow-up, 557 of 844 (66.0%) and 474 of 740 (64.1%) died, respectively. Comparing the second to first decade, mortality was unchanged for all HF (hazard ratio [HR]: 0.94; 95% CI: 0.85 to 1.03; p = 0.26), and both HFrEF and HFpEF groups (p = 0.70 and p = 0.84, respectively) (Table 3). Mortality was also similar between HFrEF and HFpEF within each decade for 1990 to 1999 and 2000 to 2009 (p = 0.14 and p = 0.54, respectively). There was no significant effect modification by cohort in the relations of HF subtypes with mortality both within and across decades.

There were 894 (53%) CVD deaths and 807 (47%) non-CVD deaths in individuals with HF. Between onset of HF and death, the prevalence of interim MI was 15% and unchanged between 1990 and 2009. The prevalence of sudden cardiac death was low in both periods 1990 to 1999 and 2000 to 2009 (3% and 0.8%, respectively). More individuals with HFrEF died of CVD than non-CVD causes (63% vs. 37%, respectively), whereas we observed the reverse for HFpEF (45% vs. 55%, respectively) (p < 0.0001). The risk for CVD mortality between decades was similar for HFrEF or HFpEF (p = 0.10 and p = 0.50,

TABLE 3 Risk of Mortality From HF in FHS and CHS Combined From 1990 to 2009 Excluding Individuals With Undetermined LVEF

	1990–1999 HR (95% CI)	p Value	2000–2009 HR (95% CI)	p Value	p Value for Cohort Interaction
Hazards for mortality between decades					
HFrEF (n = 844)	Referent	—	0.97 (0.81–1.15)	0.70	0.52
HFpEF (n = 740)	Referent	—	0.98 (0.81–1.19)	0.84	0.11
Hazards for mortality comparing HF subtypes					
HFrEF (n = 844)	Referent	—	Referent	—	
HFpEF (n = 740)	0.87 (0.72–1.05)	0.14	0.95 (0.80–1.13)	0.54	0.52/0.20

Analyses adjusted for age and sex.
CI = confidence interval; HR = hazard ratio; other abbreviations as in Tables 1 and 2.

TABLE 4 Summary of Changes in HF Epidemiology From 1990–2009

	2000–2009 vs. 1990–1999
Incidence	
All HF	←→
HFrEF	↓
HFpEF	↑
CVD and non-CVD mortality*	
All HF	←→
HFrEF	←→
HFpEF	←→
Prevalent use of cardiovascular medications in HF	
Aspirin	↑
Beta-blockers	↑
Angiotensin-converting enzyme inhibitors	←→
Lipid-lowering medications	↑
Diuretics	↓
Digoxin	↓

*There was no change between decades in mortality for overall mortality, CVD mortality, or non-CVD mortality.

CVD = cardiovascular disease; other abbreviations as in Table 1.

respectively) (Online Table 3). Compared with HFrEF, individuals with HFpEF had a lower risk of CVD death ($p < 0.01$ for both decades). Non-CVD mortality risk was similar between decades for both HFrEF and HFpEF subtypes ($p = 0.13$ and $p = 0.75$, respectively) (Online Table 4). Individuals with HFpEF had a greater risk of non-CVD mortality than those with HFrEF from 1990 to 1999 ($p = 0.021$). There were no cohort interactions in the associations of HF subtypes with CVD or non-CVD mortality within or between decades. **Table 4** summarizes our study results and direction of change of HF metrics between decades.

DISCUSSION

In our large study of individuals drawn from multiple community-based cohort samples, HF incidence has remained relatively constant over the past 20 years. Our findings suggest a decline in the incidence of HFrEF, particularly in men, and rise in the incidence of HFpEF in both sexes, but more markedly in men. Whereas female predominance has been reported in HFpEF, our results suggest a balance shift. We observed no significant changes in the incidence of HF and HFrEF in women or mortality associated with HFrEF and HFpEF, either between decades or between these subtypes.

INCIDENCE OF OVERALL HF, HFrEF, AND HFpEF FROM 1990 TO 2009 IN THE COMMUNITY. Trends in HF incidence have been mixed in past decades, with a decline suggested in Olmsted County (2,14,19–24). A study of 3 Danish registries during this period are also consistent with a mixed picture, with a decline in HF incidence in older individuals but a rise in HF incidence in younger individuals (25). A recent U.K. report suggests a decline in HF incidence over the past decade (26). Our findings suggest that contemporary HF incidence over the past 2 decades is relatively unchanged. Differences in the absolute incidence of HF in our study may relate to methodologic and population sample differences, with our inclusion of adults age≥60 years (those at risk for HF) and our cohorts being relatively fixed, rather than dynamic study samples. Our study used standardized criteria for inpatient and outpatient HF constant over the time in the cohort studies. Studies defining HF by hospitalization billing codes (21,23,24,27) may be subject to misclassification bias, and may underestimate HF events compared with physician-adjudicated data (11) and HF initially diagnosed in an outpatient setting (20,24,28).

Temporal trends and sex differences in the incidence of HFrEF versus HFpEF, which have differential risk factors, have not been well described in broad population samples in the contemporary era. Our observed temporal decrease in HFrEF incidence in men, contrasted with an increase in HFpEF incidence in both sexes, suggests a shift in the epidemiology of HF. Our findings are consistent with improvements in primary and secondary prevention and treatment of coronary artery disease, with a decline in ST-segment elevation MIs, and increase in and prolonged survival of individuals with non-ST-segment infarctions (29,30). Sex differences in HFrEF incidence after MI may be explained by differences in and responses to treatment (invasive vs. conservative) strategies (31). Our observed rise in HFpEF incidence in men is consistent with national inpatient data showing a rising prevalence of men with HFpEF over time (32).

RISK OF MORTALITY IN HF FROM 1990 TO 2009. Despite major advances in HFrEF therapeutics in the contemporary era, we observed similar mortality rates in HFrEF and HFpEF, consistent with reports of HF mortality before 2000 (3,33). The risk of death from CVD and non-CVD causes was not significantly improved, and the prevalence of MI and of sudden cardiac death was similar. That mortality was not improved over 1990 to 2009 is noteworthy, considering the increased use of evidence-based CVD and HF medications between decades in our cohort. However, our data also suggests that an equal to greater proportion of individuals with HF were not taking these medicines. Further, angiotensin-converting enzyme inhibitors were administered in the minority of participants with HF, and prevalent use of this medication

class was similar between decades. Our findings that blood pressure remained similar and suboptimal in both HFrEF and HFpEF groups during both decades enforces the suggestion that individuals with HF were inadequately treated with guideline-directed medical therapy. In addition to the limited use of optimal medical therapy in the community, the lack of improvement in HF-associated mortality may reflect other factors, including noncardiovascular morbidities not addressed by appropriate therapies, and/or differences in "real world" versus trial HF patient characteristics, follow-up, and/or treatment. Notably, in HFpEF, non-CVD morbidity is significant and therapies prolonging survival remain elusive. In total, our results emphasize the need to improve prevention and treatment strategies for HF, particularly addressing HFrEF in women and HFpEF in both men and women.

STUDY STRENGTHS AND LIMITATIONS. Strengths of our study include the large, broad sample of 5 U.S. communities and meticulous participant surveillance and adjudication outcome standards. HF adjudication in both cohorts have shown similar outcomes (13). We examined all-cause, CVD, and non-CVD mortality associated with HF and HF subtypes and the prevalence of interim MI and sudden death occurring between HF and mortality, but we did not have validated data on laboratory chemistries across the cohorts and time, or adequate statistical power to examine cause-specific mortality. However, because HF is associated with substantial comorbidities, all-cause mortality may be a preferred analytic outcome.

Additional limitations merit consideration. Whereas greater recognition of the entity of HFpEF in the 2000s may have contributed to the observed rise in HFpEF incidence, adjudicated cardiovascular outcomes in FHS use standard criteria (regardless of LVEF) that have remained constant over time. Additionally, CHS investigators reported normal LVEF in the majority of participants with HF in 1994 to 1995, showing that HFpEF was a recognized condition in the first decade (34). Our observed differential increase in HFpEF in men and women is also consistent with a lack of diagnostic bias, which would be expected to affect both sexes equally. We noted that at least one-half of our participants with HFrEF had LVEF <35%, indicating lack of bias towards a healthier group. Although LVEF assessment was obtained within 1 year of HF diagnosis in FHS, limiting the time between LVEF and HF to 30 days, paralleling assessment in the CHS, would have reduced the sample size by 32%. Individuals with unavailable LVEF contributed to analyses for overall HF incidence and mortality, but could not be analyzed in HF subgroups. However, the observed constant incidence of overall HF is consistent with a decline in HFrEF and rise in HFpEF incidence. Moreover, differences in HF incidence and mortality by race and ethnicity have been reported (35–38). Because most African Americans were enrolled 2 to 3 years following study initiation in the CHS, they were not able to contribute data during this early period. Future studies with a greater diversity may be able to better examine for racial/ethnic differences in contemporary incidence of HF and its subtypes. A final consideration in our evaluations of HF and HF subtype incidence and mortality over time may be introduction of error through multiple testing. While Bonferroni correction of p values would have been overly strict, further validation of our findings in other cohorts may reinforce our results.

CONCLUSIONS

From 1990 to 2009 in our large community-based sample, we observed a relatively constant incidence of HF with differential trends by HF subtypes and between sexes. The incidence of HFrEF declined in men and that of HFpEF rose in both men and women. HF and its subtypes remain conditions with high mortality. Our findings underscore the need to investigate and implement HF preventative strategies to reduce its incidence and mortality.

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PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE: In several U.S. community-based samples from 1990 to 2009, the incidence of HF overall remained similar, balanced by lower incidence of HFrEF but a rise in incidence of HFpEF. Despite therapeutic advances, the mortality associated with HF and its subtypes remained similar, although individuals were on average 5 years older in the second decade.

TRANSLATIONAL OUTLOOK: Our findings highlight the need to elucidate contributory factors to the divergent trends in incidence of HF subtypes over time and the continued high mortality associated with HF, including increasing dissemination of HF therapies in the community.

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APPENDIX For supplemental tables, please see the online version of this paper.