

Congestive Heart Failure Due to Diastolic or Systolic Dysfunction

Frequency and Patient Characteristics in an Ambulatory Setting

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Objective: To determine the age- and sex-specific frequencies and characteristics of patients with diastolic and systolic dysfunction heart failure.

Design: Retrospective medical record survey encompassing 1 year.

Setting: Community-based family practice office.

Patients: One hundred thirty-six patients who met the modified Framingham criteria for the diagnosis of congestive heart failure (CHF) and had a known left ventricular ejection fraction. Diastolic dysfunction was defined as an ejection fraction of 45% or greater and systolic dysfunction heart failure as an ejection fraction of less than 45%.

Main Outcome Measures: Age- and sex-specific frequency; patient comorbid conditions; medications taken; and number of emergency department visits, hospitalizations, and deaths.

Results: The frequency of CHF increased with age for

men and women (1.3% for patients 45-54 years old to 8.8% for patients >75 years old). The distribution according to left ventricular ejection fraction and age varied according to sex. Women had later onset of CHF that was predominantly diastolic dysfunction heart failure. Men had proportionately more systolic dysfunction heart failure at all ages. Forty percent of all patients with CHF had diastolic heart failure, and these patients had fewer functional limitations (76% with New York Heart Association classes I and II), fewer hospitalizations for CHF, and a trend toward fewer deaths during the study year compared with patients with systolic dysfunction.

Conclusions: Congestive heart failure is a heterogeneous condition in this family practice setting, and diastolic dysfunction heart failure occurs frequently. Further study of the natural history and treatment of diastolic dysfunction heart failure should be performed in the primary care setting.

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CONGESTIVE heart failure (CHF) is a common chronic condition with 5-year mortality rates as high as 50% and health care expenditures of close to \$10 billion annually in the United States.¹⁻³ The costs and outcomes of CHF are concerning in the context of an aging US population in which the prevalence of CHF is projected to rise.³ Increasing attention is being given to better understand the pathophysiology, natural history, and treatment of CHF to prevent the condition, control symptoms, and improve patient outcomes.^{1,3-8}

Congestive heart failure is a clinical syndrome of fatigue and dyspnea with 2 primary pathophysiological types. The most common underlying cardiac mechanisms responsible for CHF are left ventricular diastolic dysfunction or systolic

dysfunction either alone or in combination.⁹ Left ventricular function can be determined by echocardiography, cardiac catheterization, or radionuclide ventriculography. Patients who have CHF signs and symptoms with normal systolic function in the absence of other explanatory conditions are often classified as having diastolic dysfunction heart failure. Several patient care decisions depend on determination of left ventricular function because prognosis and medical treatment differ for diastolic and systolic dysfunction heart failure.¹⁰⁻¹²

The prevalence of diastolic and systolic dysfunction heart failure in the primary care setting is unknown. Vasan et al¹³ reviewed 31 studies of patients with diastolic heart failure. Ninety percent of the studies were conducted in tertiary care settings with limited generalizability to primary care practice. Of 3 studies per-

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MATERIALS AND METHODS

DESIGN

A retrospective medical chart review was completed for all patients with CHF who received care in our ambulatory practice from July 1, 1994, to June 30, 1995.

SETTING

This study was conducted in the ambulatory practice and the inpatient service of the University of Cincinnati Department of Family Medicine Residency Program in the Franciscan Hospital—Mt Airy campus, a 150-bed community hospital in suburban Cincinnati, Ohio. The residency program had 8 family physician faculty and 24 resident physicians during the study. The practice provided care for a total of 7856 patients drawn from Western Hamilton County during the study, of whom 56% were older than 35 years. The racial breakdown of the practice population was 88% white, 11% African American, and 1% other ethnic origins including Asian, American Indian, and Hispanic.

PATIENT IDENTIFICATION AND RETROSPECTIVE CHART AUDITS

Patients with a diagnosis of CHF were identified by retrospective and prospective methods: through computerized billing data from inpatient and outpatient visits between July 1, 1994, and December 31, 1995, and by their physicians between October 1, 1994, and June 30, 1995, at the point of service, using a template office note for patients with CHF. The template office notes were duplicate forms that included checkoff boxes for diagnostic criteria, the cause of heart failure, comorbid conditions, New York Heart Association (NYHA) class, and medications used, as defined below. These forms were filled out by physicians during the visit. Missing data were collected by a research assistant.

A total of 157 patients were identified and underwent office and hospital chart audits for care received between July 1, 1994, and June 30, 1995. The following patient data were recorded:

1. Patient age and sex and month and year of CHF diagnosis.
2. Diagnostic criteria and NYHA classification: Patients were evaluated to determine when and if they met the modified Framingham criteria (**Table 1**) for the diagnosis of CHF.¹⁷ New York Heart Association classification for CHF was determined by the patient's physician, and the most recent determination was used.
3. Comorbid conditions: history of active treatment of chronic obstructive pulmonary disease, diabetes mellitus, stroke or claudication, depression, and hypertension; documented myocardial infarction by serial enzyme or electrocardiographic criteria; moderate to severe valvular heart disease by echocardiogram; left ventricular hypertrophy

and atrial fibrillation by electrocardiographic criteria; renal insufficiency defined as a serum creatinine level greater than 133 $\mu\text{mol/L}$ (>1.5 mg/dL); current smoking status; and alcohol use greater than 1 drink per day.

4. Documentation of left ventricular ejection fraction (EF): Echocardiography, radionuclide ventriculography, or cardiac catheterization reports were obtained from the patient's office or hospital medical record. In printed reports from these studies, left ventricular systolic EF was recorded as a percentage or was characterized as normal, mild, moderate, or severe reduction in systolic function. For purposes of this study, we described a patient with a left ventricular EF greater than 45% as having diastolic dysfunction heart failure, 26% to 45% as having moderate systolic dysfunction heart failure, and 25% or less as having severe systolic dysfunction heart failure. If a patient had more than 1 measure of left ventricular function, the most recent result was used in the analysis.

5. Cardiac and selected medications: diuretic agents, angiotensin-converting enzyme (ACE) inhibitors, digoxin, calcium channel blockers, aspirin, nitrates, β -adrenergic blocking agents, warfarin sodium, dobutamine, hydralazine, and amiodarone. The most current cardiac and selected medication lists were used in the analysis.

6. Selected outcomes: The number of ED visits and hospitalizations, either CHF or non-CHF related. Any deaths that occurred between July 1, 1994, and June 30, 1995, were also recorded.

DETERMINATION OF THE AGE- AND SEX-ADJUSTED FREQUENCY

For each specific group shown in the **Figure**, the number of patients with CHF was divided by the total number of patients in the practice in that age and sex group to determine the frequency of CHF.

EXCLUDED PATIENTS

Five patients previously diagnosed as having CHF did not meet the Framingham criteria for CHF and were excluded from the study (misdiagnosed). Sixteen patients who met the diagnostic criteria for CHF did not have a known left ventricular EF. These patients were significantly older than the rest of the cohort (mean age, 83.3 years), had heart failure for twice as long (mean duration, 4.3 years), and were predominantly women (63%). They were taking fewer cardiac medications (mean, 2.2), and 60% were NYHA class I or II. These patients were excluded in the comparisons according to left ventricular EF.

STATISTICAL ANALYSIS

For statistical comparisons, a *t* test or a Mantel-Haenszel χ^2 test was performed as appropriate for bivariate analysis. All statistical analyses were completed using commercially available statistical software on a personal computer.¹⁸

formed in a community hospital, the prevalence of diastolic dysfunction heart failure ranged from 14% to 41%.¹⁴⁻¹⁶ The wide range of prevalence rates was likely caused by different echocardiographic criteria used to characterize left ventricular function. The authors called

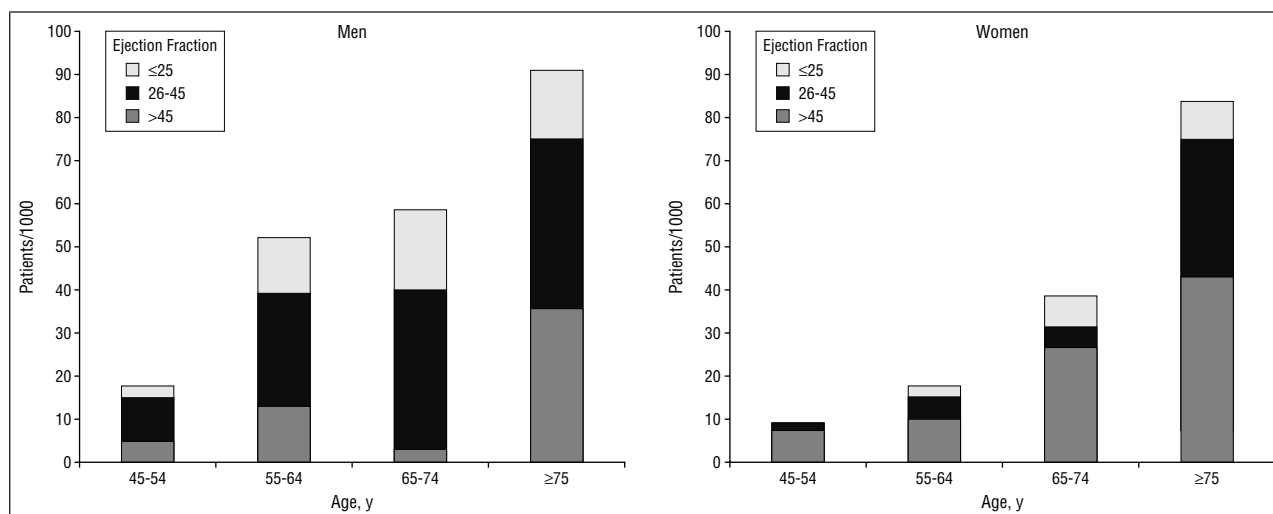
for well-designed, prospective, community-based investigations to better characterize the prevalence and natural history of diastolic dysfunction heart failure.

We identified a cohort of patients with CHF to study the natural history of heart failure in a large community-

Table 1. Modified Framingham Criteria for the Diagnosis of Congestive Heart Failure*

Major Criteria	Minor Criteria
Paroxysmal nocturnal dyspnea or orthopnea	Ankle edema
Neck vein distention	Night cough
Crackles (>10 cm from the base of the lung)	Dyspnea on exertion
Cardiomegaly on chest radiograph	Hepatomegaly
Acute pulmonary edema	Pleural effusion
S ₃ gallop	Tachycardia ≥120 beats/min
Weight loss ≥4.5 kg caused by CHF treatment	Weight loss ≥4.5 kg caused by CHF treatment where factors other than treatment of CHF could have contributed to the weight loss
Venous pressure ≥16 cm H ₂ O	
Echocardiographic left ventricular dimension ≥60-mm end-diastolic diameter ≥45-mm end-systolic diameter	

*Modified from Kleber et al.¹⁷ The presence of 2 major or 1 major and 2 minor criteria are needed to diagnose congestive heart failure (CHF).



Age- and sex-specific frequency of diastolic and systolic dysfunction heart failure using the practice population as the denominator.

based family practice office. The primary objectives of this study were to determine the age- and sex-specific frequency of CHF among our patients and the proportion of patients with CHF who have diastolic dysfunction heart failure. Secondary objectives were to characterize the cohort in terms of comorbid conditions; medications used; and the number of emergency department (ED) visits, hospitalizations, and deaths in 1 year.

RESULTS

CHARACTERISTICS OF THE CHF COHORT (N = 152)

Patients with CHF had a mean age of 72 years (range, 29-99 years). Seventy-four percent of patients were older than 65 years, and 59% were older than 75 years. Patients had a diagnosis of CHF for a mean duration of 2 years 9 months (range, 1 month to 16 years). All functional classes of heart failure were represented (mean NYHA class, 2.2; I, 32%; II, 29%; III, 30%; and IV, 9%), and most patients had multiple comorbid conditions (mean, 4.6 per patient). During the study year, 29% of patients were newly diagnosed, 51% were hospitalized for CHF exacerbation, and 11% died.

CHARACTERISTICS OF PATIENTS WITH CHF ACCORDING TO LEFT VENTRICULAR EF

Of 136 patients who had their EFs determined, 40% had an EF greater than 45% (diastolic dysfunction heart failure), 40% had an EF between 26% and 45% (moderate systolic dysfunction heart failure), and 20% had an EF of 25% or less (severe systolic dysfunction heart failure). These groups differed in several patient characteristics (**Table 2**). Patients with diastolic dysfunction heart failure were predominantly women and had significantly better functional status; 76% were classified as NYHA I or II (mean NYHA class, 1.9). In contrast, patients with systolic dysfunction heart failure were predominantly men, and nearly half had NYHA class III or IV heart failure (mean NYHA class, 2.3). Hypertension was the primary comorbid condition in patients with diastolic dysfunction heart failure, and nearly half experienced a myocardial infarction that did not have major effects on left ventricular function. For patients with systolic dysfunction heart failure, hypertension was also common, but these patients had a trend toward more myocardial infarctions and increased frequency of renal insufficiency compared with patients with diastolic dysfunction. The number of comorbid conditions was not

Table 2. Demographics, NYHA Classification, and Selected Conditions in Patients With CHF With Normal and Reduced Systolic Ejection Fractions*

	Ejection Fraction, %			P
	≥45 (n = 54)	44-26 (n = 55)	≤25 (n = 27)	
Women	39 (72)	21 (38)	11 (41)	<.001
Age, mean, y	72.3	70.6	72.3	...
Duration of CHF, mean ± SD, mo	29.9 ± 4.8	35.5 ± 5.2	25.1 ± 5.0	...
NYHA class				
I	21 (39)	15 (27)	8 (30)	<.01
II	20 (37)	15 (27)	4 (15)	
III	10 (18)	22 (40)	10 (37)	
IV	3 (6)	3 (6)	5 (19)	
Comorbid conditions				
Hypertension	45 (83)	44 (80)	17 (63)	.11
Documented MI	25 (46)	39 (71)	17 (63)	.14
COPD	24 (44)	22 (40)	17 (63)	...
Atrial fibrillation	16 (30)	19 (35)	7 (26)	...
Depression	16 (30)	18 (33)	12 (44)	...
LVH by EKG	18 (33)	22 (40)	12 (44)	...
History of CVA	16 (30)	11 (20)	5 (19)	...
Diabetes	19 (35)	16 (29)	7 (26)	...
Creatinine level >133 μmol/L (>1.5 mg/dL)	12 (22)	18 (33)	11 (41)	.08
Current smoker	16 (30)	14 (25)	9 (33)	...
>1 alcohol drink/d	7 (13)	6 (11)	4 (15)	...
Conditions, mean No.	4.4	4.6	5.0	...

*Data are given as number (percentage) of patients, unless otherwise indicated. NYHA indicates New York Heart Association; CHF, congestive heart failure; MI, myocardial infarction; COPD, chronic obstructive pulmonary disease; LVH, left ventricular hypertrophy; EKG, electrocardiogram; and CVA, cerebrovascular accident.

significantly different between patients with diastolic and systolic dysfunction heart failure.

SEX- AND AGE-SPECIFIC FREQUENCY OF CHF

The age- and sex-specific frequency of CHF among patients in our practice was calculated using the total number of patients in each age and sex group as the denominator. The frequency of CHF increased with age in both sexes, with the highest number occurring in individuals older than 75 years (Figure). The mean age at onset of CHF was significantly different for men and women (67.3 vs 73.2 years; $P < .01$). Women had a lower frequency of CHF than men, particularly those younger than 75 years. For the entire cohort, the age-specific frequency of CHF was 1.3% in patients 45 to 54 years of age, 3.2% for those 55 to 64 years, 4.7% for those 65 to 74 years, and 8.8% for those 75 years or older.

Considering the frequency according to left ventricular EF for men and women, individuals with an EF of 25% or less accounted for fewer cases of CHF across all age groups (Figure). Men older than 75 years had a higher frequency of diastolic dysfunction heart failure than did men in younger age groups. For men younger than 75 years, heart failure was more likely caused by left ventricular systolic dysfunction. In contrast to this, women with CHF tended to have diastolic dysfunction heart fail-

Table 3. Medications Used to Treat CHF in Patients With Normal or Reduced Systolic Ejection Fractions*

	Ejection Fraction, %			P
	≥45 (n = 54)	44-26 (n = 55)	≤25 (n = 27)	
Diuretics	39 (72)	46 (84)	26 (96)	<.01
ACE inhibitors	29 (54)	40 (73)	22 (81)	<.01
Digoxin	19 (35)	32 (58)	19 (70)	<.001
Calcium channel blockers	26 (48)	24 (44)	7 (26)	<.05
Nitrates	20 (37)	29 (53)	13 (48)	...
β-Adrenergic blocking agents	12 (22)	15 (27)	0	...
Warfarin sodium	6 (11)	11 (20)	8 (30)	<.04
Dobutamine	4 (7)	10 (18)	8 (30)	<.01
Hydralazine	2 (4)	1 (2)	0	...
Cardiac medications, mean No.	2.81	3.62	3.52	...

*Data are given as number (percentage) of patients, except for number of cardiac medications. CHF indicates congestive heart failure; ACE, angiotensin-converting enzyme.

Table 4. Emergency Department (ED) Visits, Hospitalizations, and Deaths in Patients With Normal or Reduced Systolic Ejection Fractions*

	Ejection Fraction, %			P
	≥45 (n = 54)	44-26 (n = 55)	≤25 (n = 27)	
ED visits for non-CHF	24 (44)	19 (35)	9 (33)	...
Hospitalizations for non-CHF	22 (41)	15 (27)	9 (33)	...
ED visits for CHF	21 (39)	28 (51)	17 (63)	<.04
Hospitalizations for CHF	20 (37)	31 (56)	19 (70)	<.01
Deaths in the past year	2 (4)	7 (13)	5 (19)	.13

*Data are given as number (percentage) of patients. CHF indicates congestive heart failure.

ure in all age groups, and female patients with systolic dysfunction were not commonly encountered until after age 75 years.

MEDICATIONS USED TO TREAT CHF

Patients' left ventricular EFs were strongly correlated with use of specific medications (Table 3). Patients with systolic dysfunction heart failure were more frequently treated with diuretics, ACE inhibitors, digoxin, dobutamine, and warfarin sodium compared with patients with diastolic dysfunction heart failure. Patients with diastolic dysfunction heart failure were more commonly treated with calcium channel blockers. Of the patients with diastolic dysfunction taking digoxin, two thirds had a diagnosis of atrial fibrillation.

CHF PATIENT OUTCOMES ACCORDING TO LEFT VENTRICULAR EF

The percentage of patients with non-CHF-related ED visits and hospitalizations was comparable in patients with diastolic and systolic dysfunction heart failure (Table 4). The number of patients with diastolic dysfunction heart failure who had ED visits and hospitalizations for CHF

was significantly less compared with patients with systolic dysfunction heart failure.

A total of 17 patients from the entire cohort died during the 1-year study. Patients with diastolic dysfunction heart failure had a trend toward fewer deaths during the year compared with patients with systolic dysfunction heart failure (Table 4).

COMMENT

This is the first study of the frequency of CHF according to age, sex, and left ventricular EF in a family practice setting. Characterizing patients in this way in the context of their other comorbid conditions reveals considerable heterogeneity among patients with CHF. Patients with diastolic dysfunction represented 40% of those who met the modified Framingham criteria and had their EF determined. The frequency estimates, although remarkably similar to those of other studies,^{2,14-16,19-26} should be received with caution because of methodological difficulties with CHF prevalence studies.^{13,27} The frequency of CHF is difficult to ascertain because of the challenge of diagnosing CHF caused by diastolic dysfunction.¹³ Currently, there are no universally accepted gold standard criteria to diagnose the clinical syndrome that defines CHF.

The issue of misdiagnosis of CHF is not trivial in the primary care setting. The proportion of patients inappropriately diagnosed as having CHF has been reported to be as high as 30% to 50%.^{16,28} To reduce the possibility of misdiagnosis, we used template office notes that included the modified Framingham diagnostic criteria while identifying obvious noncardiac causes of CHF-like symptoms. These diagnostic criteria have been used consistently in the Framingham heart studies^{3,5,26} and in a large clinical trial,¹⁷ and although one criterion cannot be obtained in the primary care setting (central venous pressure, >16 mm H₂O), the remainder can be readily applied. Our low rate of misdiagnosis is at odds with previously reported studies.^{16,28} Remes et al²⁸ used the Boston diagnostic criteria, a point system that partially corresponds with the modified Framingham criteria.²⁹ The study population of Remes et al²⁸ consisted of patients who had symptoms suggestive of CHF who were then referred to a cardiology clinic for further evaluation. Referral bias may have accounted for a high level of diagnostic uncertainty in this population and an overestimated frequency of misdiagnosis in the primary care setting. Wheeldon et al,¹⁶ in another community-based study, reported a false-positive diagnosis rate in 47% of patients with a diagnosis of CHF, but the definition of CHF was limited to patients with left ventricular systolic dysfunction.

The results of our study suggest that the misdiagnosis of CHF may be lower than previously reported if the modified Framingham criteria are used, noncardiac causes of dyspnea are identified, and patients with diastolic dysfunction heart failure are included. The relative utility of the modified Framingham criteria for diagnosing patients with diastolic dysfunction heart failure compared with those with systolic dysfunction has not been studied. We used the criteria primarily to increase the

specificity of the diagnosis for patients with CHF in the study, that is, to exclude from the study patients with normal systolic function and a false-positive CHF diagnosis. We reviewed all patient records, including copies of ED visits when available, to detect the occurrence of signs or symptoms listed in the Framingham criteria to maximize the sensitivity of our efforts to include all patients from our practice who met criteria for a true CHF diagnosis.

Patients who meet the modified Framingham criteria for CHF and have normal systolic function presumably have ventricular diastolic dysfunction. Patients with mitral regurgitation or stenosis, pericardial disease, or severe intravascular volume overload can also present with normal systolic function accompanied by signs and symptoms of heart failure.³⁰ Ventricular hypertrophy, increased ventricular wall stiffness, and impaired ventricular relaxation are common underlying pathophysiological mechanisms that lead to increased resistance to ventricular filling and true diastolic dysfunction.³¹ Many patients with systolic dysfunction, particularly those with ischemic heart disease, also have stiff ventricles and a component of diastolic dysfunction.³¹ The criterion standard for determining diastolic dysfunction is direct measurement of increased end-diastolic pressure reflecting an increased resistance to filling of 1 or both cardiac ventricles. This cannot be determined accurately without an invasive procedure. Several Doppler flow measures of ventricular filling during diastole have been described and represent the best available noninvasive techniques for assessing diastolic dysfunction.³² Doppler measures may have limited practical usefulness to clinicians, however, because they are often abnormal in healthy elderly patients without CHF symptoms and may be deceptively normal in patients with progressively worsening restrictive ventricular filling patterns.³³⁻³⁵ Most studies that have examined the prevalence of diastolic dysfunction heart failure have assumed that patients without other explanations for their symptoms and normal systolic function by echocardiography have diastolic dysfunction as the underlying mechanism for their CHF.

In 3 community hospital-based series¹⁴⁻¹⁶ studying the prevalence of diastolic dysfunction heart failure, all used echocardiography to characterize systolic function. The prevalence of diastolic dysfunction heart failure ranged from 14% to 41% in these studies. The wide differences in observed prevalence could be attributed to the different echocardiographic criteria used to diagnose diastolic dysfunction. The study that reported a prevalence of 14% used the relatively strict left ventricular EF cutoff value of 55%. Excluding this study generates a prevalence range of 29% to 41%, which is consistent with our findings. Considered together with the data presented in this study, results of these studies indicate that diastolic dysfunction heart failure may be common in the primary care setting.

The difference in onset and type of heart failure by sex confirms results of previous studies of patients with CHF.³⁶⁻³⁹ A greater proportion of women in all age groups had diastolic dysfunction heart failure. The onset of CHF in women seemed to occur later in life compared with men, presumably reflecting the later onset of coronary

artery disease in women. The effect of sex hormone levels on the development of CHF independent of coronary artery disease has not been studied. Half the women in the diastolic dysfunction group also had a history of myocardial infarction. Presumably, these women had more limited infarctions compared with their male counterparts, but the extent of the infarction was not determined in our study. Adams et al³⁹ reported that women with heart failure caused by ischemic heart disease have outcomes similar to men, whereas women with heart failure caused by nonischemic causes have significantly better survival after controlling for left ventricular EF. Results of a few physiological and pathological studies^{40,41} suggest that women are less vulnerable to the effects of cardiac damage than men. The increased prevalence of diastolic dysfunction heart failure observed in the oldest age groups for men and women may be explained by increases in blood pressure, arterial stiffness, and declines in left ventricular diastolic function that frequently occur in the normal aging process.³⁰ The heterogeneity of CHF we observed in men and women and across different age groups supports recommendations for obtaining an echocardiogram to determine systolic function in patients with heart failure.

IDENTIFICATION OF the type of CHF is important in determining treatment and prognosis. Pharmacological therapy of patients with diastolic dysfunction heart failure is currently theoretical and empiric because of the lack of clinical trial data. In this study, patients with diastolic dysfunction were most commonly treated with diuretics. Diuretics are initially helpful for diastolic dysfunction heart failure if fluid overload and pulmonary congestion are present, but overdiuresis should be avoided because small decreases in volume can lead to large changes in pressure inside stiff ventricles.³⁰ Our patients were also more likely to be treated with calcium channel blockers compared with patients with systolic dysfunction. Use of calcium channel blockers, particularly those that tend to limit heart rate such as diltiazem or verapamil, may be beneficial for these patients.⁴² Use of calcium channel blockers, ACE inhibitors, and β -adrenergic blocking agents may improve diastolic function by improving myocardial relaxation, reversing ischemia, and limiting ventricular hypertrophy.^{30,42} With the therapeutic goals of prolonging diastole to improve ventricular filling and modifying the neurohormonal responses associated with CHF, β -adrenergic blocking agents may prove to be an ideal treatment for patients with diastolic dysfunction. β -Adrenergic blocking agents recently have been shown to be beneficial in the treatment of patients with CHF with mild to moderate systolic dysfunction.⁴³ Digoxin therapy is generally not indicated for patients with diastolic dysfunction but may be prescribed for rhythm disturbances such as atrial fibrillation that occur in these patients.⁴⁴ Most patients with diastolic heart failure taking digoxin in our study also had atrial fibrillation.

Hospitalization for CHF during the year was common in our CHF cohort. Patients with diastolic dysfunction accounted for 28% of hospitalized patients. This rep-

resents a significant number of hospitalizations in a year. The individualized treatment needed to reduce or prevent hospitalizations in this group of patients has received little attention. Although the numbers were small, the lower number of deaths in the diastolic dysfunction heart failure group is consistent with the better prognosis previously reported for these patients.^{37,45} It is not clear why these patients have a better prognosis. Prospective studies controlling for severity of symptoms (NYHA class), sex, age, comorbid conditions, medications used, and duration of CHF with a larger study size are needed to define issues of prognosis and disease progression.

This study has several potential limitations. First, the frequency of CHF may have been underestimated because of the dependence on documentation of the modified Framingham criteria in office and hospital medical records. Central venous pressure measurement is an inpatient procedure that few patients in our cohort had done. Some physicians rarely listed S₃ gallop in their chart notes, whereas other physicians routinely did. Use of template chart notes during the study year aided in the documentation of diagnostic criteria, but this method still might have been incomplete. Second, the modified Framingham criteria may not identify patients with symptoms from very mild diastolic or systolic dysfunction. Although ventricular dysfunction is present, such patients may not meet the Framingham criteria and would not have been included in our cohort. Marantz et al²⁹ reported that 20% of patients with EFs less than 40% did not meet any clinical criteria for heart failure. Left ventricular function was unknown for 5 patients who were excluded from the study because they did not meet diagnostic criteria. Third, the frequency of echocardiography and the treatment of patients with CHF cannot be generalized to other family practice settings. The study was conducted in a teaching practice with investigators who are interested in optimal treatment of CHF. This may explain why the use of echocardiography and ACE inhibitors was considerably higher than previously reported in primary care settings.^{46,47} Because the number of patients with CHF included in the study was relatively small and they were identified from a single practice site, the generalizability of our findings to other ambulatory practices is limited. The age-specific frequencies of CHF illustrated in the Figure were calculated as a proportion of only those patients seeking care from physicians in our practice. The true prevalence of CHF in the surrounding community is unknown.

Although the frequency of CHF may differ in other ambulatory settings, this initial description of patients with heart failure in an ambulatory practice raises important issues for further research. The results of this study suggest that what family physicians recognize intuitively is true—patients with chronic conditions cared for in family practice offices are different from those subselected from tertiary care centers to participate in large clinical trials. We found significant heterogeneity among patients with CHF seen in our community-based family practice center with a high frequency of diastolic dysfunction heart failure and mild functional impairment. For patients older than 75 years, CHF was diagnosed with similar frequency in men and women. Older women with

CHF, particularly those with diastolic dysfunction, often have been excluded from large CHF clinical trials. Patients with both types of CHF were frequently hospitalized and, therefore, contributed to the high level of resources used for the care of patients with this diagnosis. Unfortunately, little is known about how to best limit disability and prevent hospitalizations for patients with diastolic dysfunction heart failure. The natural history of diastolic dysfunction heart failure and recommendations for optimal medical treatment have received little attention. To strengthen the evidence base for providing care to patients with CHF seen by family physicians, further studies should be performed in primary care settings.

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