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Research Article

# Chronic Heart Failure: An Epidemiological Study Of Impaired Oxidative Stress

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## Abstract

Chronic heart failure (CHF) is the leading cause of hospitalization for those over the age of 65 and represents a significant clinical and economic burden. About half of hospital re-admissions are related to co-morbidities, polypharmacy and disabilities associated with CHF. Moreover, CHF also has an enormous cost in terms of poor prognosis with an average one year mortality of 33%–35%. While more than half of patients with CHF are over 75 years, most clinical trials have included younger patients with a mean age of 61 years. Inadequate data makes treatment decisions challenging for the providers. Older CHF patients are more often female, have less cardiovascular diseases and associated risk factors, but higher rates of non-cardiovascular conditions and diastolic dysfunction. The prevalence of CHF with reduced ejection fraction, ischemic heart disease, and its risk factors declines with age, whereas the prevalence of non-cardiac co-morbidities, such as chronic renal failure, dementia, anemia and malignancy increases with age. Diabetes and hypertension are among the strongest risk factors as predictors of CHF particularly among women with coronary heart disease. This review paper will focus on the specific consideration for CHF assessment in the older population. Management strategies will be reviewed, including non-pharmacologic, pharmacologic, quality care indicators, quality improvement in care transition and lastly, end-of-life issues. Palliative care should be an integral part of an interdisciplinary team approach for a comprehensive care plan over the whole disease trajectory. In addition, frailty contributes valuable prognostic insight incremental to existing risk models and assists clinicians in defining optimal care pathways for their patients.

**Keywords:** heart failure, coronary heart disease, hypertension

## Introduction

Chronic heart failure (CHF) incidence and prevalence increases with age. It is a major cardiovascular syndrome expected to increase over the next 25 years as its incidence will more than double and its prevalence will increase 10 fold from age 60 to age 80.[1],[2] While 50% of patients with HF are over 75 years of age, most clinical trials have included younger patients with a mean age of 61 years. Inadequate data makes treatment decisions challenging for health care providers as they need to extrapolate how best to treat this special population.

CHF is the leading cause of hospitalization for those over the age of 65 and represents a significant clinical and economic burden.[3]–[5] In Canada, the cost of a heart failure (HF) hospital admission ranges between $6000 and $15000.[4] Rates of readmission are high in the elderly within 3–6 months after discharge, ranging between 27%–47%. About half of re-admissions are related to co-morbidities, poly-pharmacy and disabilities associated with CHF.[6] Inpatient and outpatient costs associated with CHF management make it one of the most costly health care problems. Leaving aside the monetary cost, HF also has an enormous cost in terms of poor prognosis with an average one year mortality of 33%–35%.[4].

## Epidemiology

The prevalence and incidence of CHF are increasing in the Western countries, particularly in individuals older than 80 years of age.[5] Based on Framingham data, the lifetime risk of developing CHF is one in five, and its incidence increases with age with a steep rise from 1.4%–1.9% among middle-aged patients to 12.8%–14.7% among octogenarians.[7] Older CHF patients were more often female (50% *vs.* 35%; $P < 0.0001$), had less cardiovascular diseases and associated risk factors, but had higher rates of non-cardiovascular co-morbidities.[8] The prevalence of CHF with reduced ejection fraction, ischemic heart disease, and its risk factors declined with age, whereas the prevalence of non-cardiac co-morbidities, including chronic renal failure, anemia, and malignancy, increased with age.[8]

Diabetes has been found to be one of the strongest risk factor as a predictor of CHF particularly among women with coronary heart disease.[9]

Based on the 44-year follow-up of the Framingham Heart Study and the 20-year follow-up of the offspring cohort, 80% of men and 70% of women under the age of 65 who have HF will die within eight years.[10] Following the diagnosis of HF, survival is poorer in men than in women, however, less than 15% of women survive more than 8–12 years. The one-year mortality rate is high, with one in five dying. In patients diagnosed with HF, sudden cardiac death occurs at six to nine times the rate of the general population.[10].

## Etiological factors

The commonest causes of HF are coronary artery disease (CAD), hypertension and diabetes, however, hypertension and diabetes have been found to be stronger risk factors in elderly women and CAD and smoking are stronger risk factors in elderly men.[11] The concomitant diseases such as atrial fibrillation, valvular heart disease, diabetes, chronic kidney disease, anemia, chronic obstructive pulmonary disease (COPD), depression, arthritis, sensory impairment, and cognitive dysfunction substantially add to the complexity of HF care. It has been shown that 2/3 of elderly patients with HF have more than two non-cardiac co-morbidities and over 25% of them have more than six comorbidities.[13],[14] Despite advances in the care of individuals with HF, uncertainty remains about how best to manage CHF in elderly patients with complex co-morbidities.[13].

## Clinical presentation

HF with preserved ejection fraction and contractility is the most common phenotype of HF in the elderly. Age-associated myocardial and vascular wall stiffness with the consequent increase in aortic impedance may lead to increased end-diastolic pressure in a stiff ventricle resulting in pulmonary edema.[8],[15]

Conditions which further impair ventricular filling such as atrial fibrillation (very common in this population), has the potential to trigger a HF decompensation more easily in the aged heart with limited cardiac reserve. With time progression and further cardiovascular insults, the left ventricular dilatation worsens and dysfunction may occur as a final stage.[15] It has been demonstrated that elderly patients presenting to hospital with acute HF are more likely to present with acute pulmonary edema and hypertension and only 2% present with hypotension.[16] Factors that have been found to contribute to acute de-compensation are: active ischemia/infarction, uncontrolled hypertension, atrial fibrillation, renal failure, viral infections, pneumonias, COPD, anemia, and drugs [either non-adherence or use of nonsteroidal anti-inflammatory drugs (NSAIDs).

## Cognitive function

Despite the fact that 80% of patients with heart failure are older than 65 years, recognition of cognitive impairment by physicians in this population has received relatively little attention. In a recent study of older adults hospitalized with HF, cognitive impairment was common (present in 47% of patients) but was only documented in half of the cases (22.7%).[20] The patients with cognitive impairment were significantly more likely to experience mortality or hospital readmission at 6 months compared with patients without cognitive impairment.[21].

## Methods

Fifty nine patients with a diagnosis of chronic heart failure due to coronary heart disease (n=34) or idiopathic dilated cardiomyopathy (n=25) and 20 healthy controls underwent assessment of functional capacity. Maximal oxygen uptake ($MVO_2$) and regression slope relating to minute ventilation to carbon dioxide output ($VE\text{-}VCO_2$) were measured during a maximal treadmill exercise test. Metabolic assessment consisted of measuring serum uric acid and fasting lipids, and insulin sensitivity, obtained by minimal modelling analysis of glucose and insulin responses during an intravenous glucose tolerance test. Clustering of indices of functional disease capacity and metabolic factors was explored using factor analysis and multivariate regression analysis.

## Results

Compared to 20 healthy controls, patients with chronic heart failure had a 52% lower $MVO_2$ ($P<0{\cdot}001$), 56·8% higher serum uric acid concentrations ($P<0{\cdot}001$) as well as a 60·5% lower insulin sensitivity ($P<0{\cdot}001$). Salient univariate correlations in the chronic heart failure group included serum uric acid concentrations with exercise time during the exercise test ($r= -0{\cdot}53$), $MVO_2$ ($r= -0{\cdot}50$) (both $P<0{\cdot}001$), $VE\text{-}VCO_2$ slope ($r=0{\cdot}45$), and NYHA functional class ($r=0{\cdot}36$) (both $P<0{\cdot}01$). In factor analysis of the chronic heart failure group, serum uric acid formed part of a principal cluster of metabolic variables which included $MVO_2$ and $VE\text{-}VCO_2$, slope. In multivariate regression analysis, serum uric acid concentrations emerged as a significant predictor of $MVO_2$, exercise time (both $P<0{\cdot}001$,) $VE\text{-}VCO_2$ slope and NYHA functional class (both $P<0{\cdot}02$), independent of diuretic dose, age, body mass index, serum creatinine, alcohol intake, plasma insulin levels, and insulin sensitivity index.

## Conclusions

HF is a prevalent disease in the elderly population and will continue to increase. This population is unique with multiple co-existing conditions in addition to cognitive, functional changes and in particular, the presence of the frailty. Health care professionals need to be equipped with the knowledge and the tools to assure excellent comprehensive care not only addressing the HF issues but the individual as a whole. Supporting older adults with a multitude of geriatric syndromes will ensure maximum benefit from multiple complex medical regimens and better quality of life.

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