Heart failure in young adults: 20-year trends in hospitalization, aetiology, and case fatality in Sweden

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Aims

To describe trends in incidence and case fatality among younger (18–54 years) and older (55–84 years) Swedish patients with heart failure (HF).

Methods and results

Through linking the Swedish national hospital discharge and the cause-specific death registries, we identified patients aged 18–84 years that were discharged 1987–2006 with a diagnosis of HF. Age-specific mean incidence rates per 100,000 person-years were calculated in four 5-year periods. Kaplan–Meier survival curves were plotted up to 3 years. From 1987 to 2006, there were 443,995 HF hospitalizations among adults 18–84 years. Of these, 4660 (1.0%) and 13,507 (3.0%) occurred in people aged 18–44 and 45–54 years (31.6% women), respectively. From the first to the last 5-year period, HF incidence increased by 50 and 43%, among people aged 18–34 and 35–44 years, respectively. Among people ≥45 years, incidence peaked in the mid-1990s and then decreased. Heart failure in the presence of cardiomyopathy increased more than two-fold among all age groups. Case fatality decreased for all age groups until 2001, after which no further significant decrease <55 years was observed.

Conclusion

Increasing HF hospitalization in young adults in Sweden opposes the general trend seen in older patients, a finding which may reflect true epidemiological changes. Cardiomyopathy accounted for a substantial part of this increase. High case fatality and lack of further case fatality reduction after 2001 are causes for concern.

Keywords

Heart failure • Incidence • Prognosis • Comorbidity • Young adults

Introduction

Heart failure (HF) among the young is rare, but may exert a greater impact on active and income-generating individuals.1 Most HF-studies are based on older adults, and accordingly, little is known about the aetiology, incidence, and trends in HF among younger patients.2,3

While ischaemic heart disease (IHD) and hypertension are predominant causes of HF among older patients, the aetiological make-up of HF in young adults is more heterogeneous. Common causes of HF among the young include adult congenital heart disease (ACHD), different types of cardiomyopathies, myocarditis, or alcohol- or drug-related myocardial lesions.4,5

Despite improved outcomes in the management of coronary heart disease and HF,6 HF still carries a 50% 5-year mortality, parallel to that of many cancers.7,8 Studies indicate that HF incidence and mortality in Sweden, Scotland, and Australia have been decreasing since the early 1990s.6,9–12 Whether this change occurs in younger age groups has to our knowledge not been examined.

We used data from the Swedish national hospital discharge and cause-specific death registries to investigate age-specific trends in
HF incidence, comorbidity and 1-year case fatality trends in 
~440 000 hospital discharges over a period of 20 years.

Methods

The registries

Sweden has universal healthcare providing low-cost hospital care to all 
Swedish permanent residents, with all hospitals reporting discharge dia-
gno ses to a nationwide hospital discharge registry. The data are person 
based and include primary and secondary discharge diagnoses of any 
given hospitalized patient. Data from the national hospital discharge 
registry and cause-specific death registry were linked through a unique 
national personal identity number.

Procedures

Because a large percentage of younger patients with HF had other 
primary aetiological diagnoses, we included all patients aged 18–84 
years from 1987 to 2006 who had a first-ever HF diagnosis code in any 
position. First admission was defined as any hospital admission with no 
previous admission for HF in the past 7 years. This was done to ensure 
the probability of being admitted for the first time was similar for any 
given birth period. From 1987 to 1996, the International Classification of 
Diseases, Ninth Revision (ICD-9) was in use, and thereafter ICD-10. We 
defined HF by 427.10, 427.00 (ICD-8), 428A, 428B, and 428X (ICD-9) 
and I50 (ICD-10). The following diagnoses for concomitant or pre-
existing comorbidity were included up to the point of the HF yielding hos-
pitalization: cardiomyopathy 425 (ICD-9), H2, H3 (ICD-10); IHD 410– 
414 (ICD-9), I20–I25 (ICD-10); valvulopathies 391, 394–398, 421, 424 
(ICD-9), I05-I09, I33-I39 (ICD-10); and congenital heart disease 745– 
747 (ICD-9) and Q20–Q28, Q87, Q89 (ICD-10). Because of overlapping 
HF aetiologies, we assigned mutually exclusive causes of HF in the follow-
ing hierarchical order: (i) congenital heart disease, (ii) valvulopathy, (iii) 
IHD and/or diabetes and/or hypertension, (iv) cardiomyopathy, and (v) 
other causes.

Validity of the registers

From 1987 to 1996, a primary discharge diagnosis was lacking in <1% of 
all admissions. The diagnosis of HF in the Swedish discharge register has 
been validated showing 96% accuracy for primary diagnoses in internal 
medicine or cardiac wards, and 86 and 91% for secondary diagnoses in 
internal medicine and cardiac wards, respectively.

Statistical methods

Annual HF incidence rates per 100 000 person-years and 95% confidence 
intervals (CIs) were calculated using the method of direct standardiza-
tion, using the median year 1996 as a standard. Descriptive statistics 
were applied to summarize the comorbidity prevalence within the iden-
tified HF population. In addition, we used joinpoint regression for the es-
timation of the annual percentage change and to find the specific years 
when significant changes in the trends occurred (Joinpoint Regression 
Program, version 3.3.1. April 2008; Statistical Research and Applications 
Branch, National Cancer Institute). We fitted the data in a log-linear 
model and set the number of possible joinpoints between 0 and 3. For 
each estimate of mean annual percentage change, 95% CIs were calcu-
lated. Further, 1-year, age- and sex-specific case fatality rates were calcu-
lated up to 1 year after admission in patients aged 18–34, 35–44, 45–54, 
and 55–84 years over the periods 1987–91, 1992–96, 1997–2001, and 
2002–06. To estimate changes in 1-year case fatality, hazard ratios for 
each time period of hospitalization were calculated by means of Cox re-
gression with the period of 1987–91 as reference, and adjusted for age, 
sex, diabetes, IHD, cardiomyopathy, and ACHD and/or valve disease.

Results

Between 1987 and 2006, 443 995 hospitalizations for HF were 
recorded among patients aged 18–84 years. Of these HF, 4660 (1.0%) and 13 507 (3.0%) were in patients aged 18–44 and 45–54 
years, respectively. About one-third of the patients were women (Table 1).

The overall burden of comorbidity in this young HF population was 
substantial. Of patients aged <45 years, 21% had IHD with 15% 
having acute myocardial infarction (MI). Fourteen per cent had dia-
betes, 4% a prior stroke, and 8% any cancer. For patients aged 45– 
54 years, IHD, MI and diabetes, stroke, and cancer was found in 39, 
27, and 20, 5 and 9%, respectively. Concomitant cardiomyopathy 
was registered in 20% of those aged <45 years and in 13% of those 
aged 45–54 years. Cardiomyopathy increased from 15 to 25% and 
from 9 to 15% over the four periods in the <45 and 45–54 age 
groups, respectively. Concomitant valve disease and ACHD among 
patients younger than 45 years remained stable throughout the study (Table 1). About 5% had no other diagnosis than HF (data not shown).

Figure 1 and Supplementary material online, Table S1 show the mu-
tually exclusive categories of comorbidities by age over the entire 
study period. The proportion of IHD-related HF hospitalization 
increased substantially with age, whereas cardiomyopathies de-
creased. The proportion of patients diagnosed with ACHD was 12.0% 
among the youngest age group and 0.3% among the oldest. The pro-
portion with valve disease and ACHD did not change materially over 
time in any age group. The prevalence of the combined common aeti-
ologies of IHD, diabetes, and hypertension below the age of 55 years 
was stable throughout the study period in patients <55, but not in 
older patients (increase 54 to 66%), chiefly as a result of a decrease 
in other causes. Cardiomyopathy increased across all age groups.

A closer look at the large and heterogeneous group of patients la-
belled ‘other’ revealed no qualitative differences between the first 
and the last periods, the most common diagnoses being malignancy, 
perimyocarditis, and infectious diseases.

Table 2 illustrates the divergent trends in HF hospitalization 
between younger and older patients. Whereas hospitalization in 
the 55–84 year age group peaked in 1992–96 at 854 per 100 000 de-
creasing to 603 per 100 000 in 2002–06, HF hospitalization among 
persons <45 years increased throughout the entire observation 
period. Trends among persons aged 45–54 years were similar to 
those aged 55–84 years with a less marked decrease after 1996. A 
joinpoint analysis confirmed the continuous increase throughout 
the period for the 18–34 year age group, and from 1999 to 2006 
for the age group 35–44 years. Further in adults ≥45 years a rising 
then falling pattern was seen 1994 signifying the marked breaking 
point for a decline in HF rates (Supplementary material online, 
Figure and Table S2).

Table 3 shows trends in the incidence of HF with concomitant car-
diomyopathy, IHD, and all other causes. From 1987–1991 to 2002– 
2006, the mean incidence of HF with cardiomyopathy more than 
doubled in all age groups (HRs 2.0–3.0). In patients ≥55 years, this 
was not at the expense of other diagnoses as the incidence of HF
from other causes not related to IHD or cardiomyopathy also increased.

**Case fatality**

One-year case fatality at the beginning of the study period was high in all age groups, with about one in four dead at ages 18–54 and 39% ≥ 55 years (Table 4). From 1987–1991 to 2002–06 a marked adjusted 1-year relative case fatality reduction of 60–62% at 18–44 years was observed, and correspondingly 56 and 38% at 45–54 and 55–84 years, respectively. Figure 2 demonstrates the survival benefit was sustained up to 3 years, but that no further significant improvement in case fatality occurred in the 55 year age group after 2001.

**Discussion**

During the study period, we observed an increase in hospitalization for HF among people <45 years of age which was divergent from the continuing decrease after 1992–96 seen among persons ≥54 years of age. The incidence of concomitant cardiomyopathy more than doubled during this period in all age groups. Case fatality in

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</tr>
</thead>
<tbody>
<tr>
<td>Number, n (%)</td>
<td>972 (100%)</td>
<td>1187 (100%)</td>
<td>1133 (100%)</td>
<td>1368 (100%)</td>
<td>4660 (100%)</td>
</tr>
<tr>
<td>Mean age, years (SD)</td>
<td>37.0 (6.9)</td>
<td>37.4 (6.4)</td>
<td>37.1 (6.4)</td>
<td>37.0 (6.6)</td>
<td>37.1 (6.6)</td>
</tr>
<tr>
<td>Women, n (%)</td>
<td>356 (36.6)</td>
<td>428 (36.1)</td>
<td>421 (37.2)</td>
<td>461 (33.7)</td>
<td>1666 (35.8)</td>
</tr>
<tr>
<td>Diabetes, n (%)</td>
<td>165 (17.0)</td>
<td>178 (15.0)</td>
<td>139 (12.3)</td>
<td>154 (11.3)</td>
<td>636 (13.6)</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>109 (11.2)</td>
<td>147 (12.4)</td>
<td>153 (13.5)</td>
<td>232 (17.0)</td>
<td>641 (13.8)</td>
</tr>
<tr>
<td>Prior AMI, n (%)</td>
<td>144 (14.8)</td>
<td>226 (19.0)</td>
<td>150 (13.2)</td>
<td>157 (11.5)</td>
<td>677 (14.5)</td>
</tr>
<tr>
<td>Any IHD, n (%)</td>
<td>203 (20.9)</td>
<td>305 (25.7)</td>
<td>224 (19.8)</td>
<td>232 (17.0)</td>
<td>964 (20.7)</td>
</tr>
<tr>
<td>Valvular disease, n (%)</td>
<td>126 (13.0)</td>
<td>149 (12.6)</td>
<td>134 (11.8)</td>
<td>157 (11.5)</td>
<td>566 (12.1)</td>
</tr>
<tr>
<td>Congenital heart disease, n (%)</td>
<td>57 (5.9)</td>
<td>56 (4.7)</td>
<td>73 (6.4)</td>
<td>90 (6.6)</td>
<td>276 (5.9)</td>
</tr>
<tr>
<td>Cardiomyopathy, n (%)</td>
<td>141 (14.5)</td>
<td>198 (16.7)</td>
<td>243 (21.4)</td>
<td>335 (24.5)</td>
<td>917 (19.7)</td>
</tr>
<tr>
<td>Prior stroke, n (%)</td>
<td>40 (4.1)</td>
<td>50 (4.2)</td>
<td>36 (3.2)</td>
<td>42 (3.1)</td>
<td>168 (3.6)</td>
</tr>
<tr>
<td>Atrial fibrillation, n (%)</td>
<td>80 (8.2)</td>
<td>117 (9.9)</td>
<td>133 (11.7)</td>
<td>205 (15.0)</td>
<td>535 (11.5)</td>
</tr>
<tr>
<td>Malignancy, n (%)</td>
<td>102 (10.5)</td>
<td>94 (7.9)</td>
<td>71 (6.3)</td>
<td>81 (5.9)</td>
<td>348 (7.5)</td>
</tr>
</tbody>
</table>

45–54

| Number, n (%) | 2456 (100%) | 3830 (100%) | 3806 (100%) | 3415 (100%) | 13 507 (100%) |
| Mean age, years (SD) | 50.4 (2.8) | 50.4 (2.7) | 50.8 (2.7) | 50.5 (2.8) | 50.5 (2.7) |
| Women, n (%) | 758 (30.9) | 1220 (31.9) | 1100 (28.9) | 989 (29.0) | 4067 (30.1) |
| Diabetes, n (%) | 480 (19.5) | 750 (19.6) | 748 (19.7) | 689 (20.2) | 2667 (19.7) |
| Hypertension, n (%) | 371 (15.1) | 760 (19.8) | 830 (21.8) | 887 (26.0) | 2848 (21.1) |
| Prior AMI, n (%) | 690 (28.1) | 1093 (28.5) | 998 (26.2) | 819 (24.0) | 3600 (26.7) |
| Any IHD, n (%) | 932 (37.9) | 1601 (41.8) | 1515 (39.8) | 1243 (36.4) | 5291 (39.2) |
| Valvular disease, n (%) | 227 (9.2) | 351 (9.2) | 311 (8.2) | 323 (9.5) | 1212 (9.0) |
| Congenital heart disease, n (%) | 35 (1.4) | 46 (1.2) | 46 (1.2) | 40 (1.2) | 167 (1.2) |
| Cardiomyopathy, n (%) | 219 (8.9) | 445 (11.6) | 513 (13.5) | 523 (15.3) | 1700 (12.6) |
| Prior stroke, n (%) | 138 (5.6) | 209 (5.5) | 202 (5.3) | 172 (5.0) | 721 (5.3) |
| Atrial fibrillation, n (%) | 345 (14.0) | 588 (15.4) | 656 (17.2) | 690 (20.2) | 2279 (16.9) |
| Malignancy, n (%) | 247 (10.1) | 381 (9.9) | 372 (9.8) | 270 (7.9) | 1270 (9.4) |
Table 2  Incidence of first hospital admissions for heart failure per 100 000 person-years in Sweden 1987–2006 by age, sex, and period

<table>
<thead>
<tr>
<th>Age group</th>
<th>18–34</th>
<th>Per 100 000</th>
<th>Hazards ratio (95% CI)</th>
<th>35–44</th>
<th>Per 100 000</th>
<th>Hazards ratio (95% CI)</th>
<th>45–54</th>
<th>Per 100 000</th>
<th>Hazards ratio (95% CI)</th>
<th>55–84</th>
<th>Per 100 000</th>
<th>Hazards ratio (95% CI)</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987–91</td>
<td>266</td>
<td>2.5</td>
<td>1.00</td>
<td>706</td>
<td>10.2</td>
<td>1.00</td>
<td>2456</td>
<td>46.2</td>
<td>1.00</td>
<td>105741</td>
<td>719</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>1992–96</td>
<td>312</td>
<td>2.8</td>
<td>1.15 (1.00–1.33)</td>
<td>875</td>
<td>13.6</td>
<td>1.33 (1.22–1.45)</td>
<td>3830</td>
<td>59.6</td>
<td>1.29 (1.22–1.36)</td>
<td>125138</td>
<td>854</td>
<td>1.19 (1.15–1.23)</td>
<td></td>
</tr>
<tr>
<td>1997–2001</td>
<td>319</td>
<td>2.9</td>
<td>1.19 (1.03–1.37)</td>
<td>814</td>
<td>12.7</td>
<td>1.25 (1.14–1.36)</td>
<td>3806</td>
<td>55.6</td>
<td>1.20 (1.14–1.27)</td>
<td>102067</td>
<td>688</td>
<td>0.96 (0.92–0.99)</td>
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<tr>
<td>2002–06</td>
<td>387</td>
<td>3.7</td>
<td>1.50 (1.31–1.71)</td>
<td>981</td>
<td>14.6</td>
<td>1.43 (1.31–1.55)</td>
<td>3415</td>
<td>53.6</td>
<td>1.16 (1.10–1.22)</td>
<td>92882</td>
<td>603</td>
<td>0.84 (0.81–0.87)</td>
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Men
1987–91 150 2.7 1.00 466 13.0 1.00 1698 63.1 1.00 57399 947 1.00
1992–96 183 3.2 1.18 (0.94–1.47) 576 17.3 1.33 (1.19–1.49) 2610 79.9 1.27 (1.20–1.34) 66766 1098 1.16 (1.12–1.20)
1997–2001 178 3.2 1.16 (0.93–1.46) 534 16.1 1.24 (1.10–1.39) 2706 77.8 1.23 (1.17;1.30) 55847 896 0.95 (0.91–0.98)
2002–06 233 4.4 1.61 (1.30–1.99) 674 19.2 1.48 (1.33–1.65) 2426 74.4 1.18 (1.11–1.25) 51244 777 0.82 (0.79–0.85)

Women
1987–91 116 2.2 1.00 240 7.4 1.00 758 29 1.00 48342 522 1.00
1992–96 129 2.4 1.09 (0.88–1.36) 299 9.8 1.33 (1.11–1.59) 1220 38.9 1.34 (1.22–1.48) 58372 631 1.22 (1.17–1.27)
1997–01 141 2.6 1.19 (0.96–1.46) 280 9.2 1.25 (1.04–1.50) 1100 32.6 1.12 (1.02–1.24) 46220 499 0.96 (0.92–1.00)
2002–06 154 3.1 1.38 (1.13–1.70) 307 9.5 1.30 (1.08–1.55) 989 31.4 1.08 (0.98–1.20) 41638 436 0.84 (0.80–0.87)
Table 3  Incidence of heart failure and concomitant cardiomyopathy, ischaemic heart disease and all other causes per 100 000 person-years by age, sex, and period (1987–2006)

<table>
<thead>
<tr>
<th>Age</th>
<th>Period</th>
<th>18–34</th>
<th>35–44</th>
<th>45–54</th>
<th>55–84</th>
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<tr>
<td></td>
<td>n</td>
<td>Inc*</td>
<td>HR</td>
<td>95% CI</td>
<td>n</td>
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<tr>
<td>Cardiomyopathy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987–91</td>
<td>37</td>
<td>0.3</td>
<td>1.00</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td>1992–96</td>
<td>58</td>
<td>0.5</td>
<td>1.51</td>
<td>(1.00–2.28)</td>
<td>140</td>
</tr>
<tr>
<td>1997–01</td>
<td>69</td>
<td>0.6</td>
<td>1.82</td>
<td>(1.21–2.71)</td>
<td>174</td>
</tr>
<tr>
<td>2002–06</td>
<td>108</td>
<td>1.0</td>
<td>2.98</td>
<td>(2.05–4.33)</td>
<td>227</td>
</tr>
<tr>
<td>Ischaemic heart disease, IHD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987–91</td>
<td>16</td>
<td>0.2</td>
<td>1.00</td>
<td></td>
<td>177</td>
</tr>
<tr>
<td>1992–96</td>
<td>34</td>
<td>0.3</td>
<td>1.98</td>
<td>(1.20–3.27)</td>
<td>262</td>
</tr>
<tr>
<td>1997–01</td>
<td>21</td>
<td>0.2</td>
<td>1.20</td>
<td>(0.72–2.00)</td>
<td>187</td>
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<tr>
<td>2002–06</td>
<td>25</td>
<td>0.2</td>
<td>1.45</td>
<td>(0.89–2.36)</td>
<td>188</td>
</tr>
<tr>
<td>All other diagnoses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987–91</td>
<td>213</td>
<td>2.0</td>
<td>1.00</td>
<td></td>
<td>425</td>
</tr>
<tr>
<td>1992–96</td>
<td>220</td>
<td>2.0</td>
<td>1.02</td>
<td>(0.86–1.19)</td>
<td>473</td>
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<tr>
<td>1997–01</td>
<td>229</td>
<td>2.2</td>
<td>1.08</td>
<td>(0.92–1.27)</td>
<td>453</td>
</tr>
<tr>
<td>2002–06</td>
<td>254</td>
<td>2.5</td>
<td>1.25</td>
<td>(1.07–1.45)</td>
<td>566</td>
</tr>
</tbody>
</table>

HR, hazard ratio for HF hospitalization. Inc*, incidence per 100 000 person-years.
young patients was reduced by more than half, but with no further decrease after 2001.

Previous data from Sweden, Netherlands, and Scotland show that HF admissions have levelled off and eventually declined. This may now also be the case in the USA. Because HF is predominantly a disorder of the elderly, there is a lack of data on trends in younger people.

Decreasing mortality and increasing readmission rates influence hospitalization rates, but in our data 97.8% of admissions were unique individuals. For the same reason mortality reduction cannot explain the increasing hospitalization rates. Conversely, fiscal measures in Sweden during the past three decades have reduced hospital bed supply by two-thirds since 1980 leading to higher hospitalization thresholds. The national discharge registry only reached full coverage from 1987, it was not possible to exclude all readmissions within the 7 years prior to 1987. However, the expected effect on our data set would be an overestimation, not an underestimation of the incidence in the first 7 years.

Epidemiological studies of HF in patients <40 years of age are scarce. The Framingham cohort comprised patients aged 28–62 years, but none of the analyses from that cohort identified enough cases to appropriately address trends in HF in this age group. In a sub-study of the CARDIA cohort, a 20-year follow-up prospective analysis of 5115 patients 18–30 years revealed new onset HF in a mere 27 subjects.

Hypertension, diabetes, and IHD are major targets for reduction of HF. In the CARDIA study, hypertension was a major aetiological risk factor in the development of early HF. In our HF population, diabetes and IHD were common and increased with age, but not over time. The rising prevalence of hypertension in HF patients may influence the incidence of HF, but as the validity of this diagnosis is poor, this conjecture remains speculative. The introduction of reimbursement by diagnosis-related groups systems in 1992 may explain some of the increase in HF seen in our data between the first two periods, but does not explain the continued and accelerating increase in hospitalization for patients <45 years seen in the two latter periods.

**Cardiomyopathy in heart failure**

The incidence of cardiomyopathy more than doubled in all age groups, and the largest share of the increase in HF incidence among patients <45 years of age could be directly ascribed to increasing concomitant cardiomyopathy. Before 1995, cardiomyopathy was defined as ‘heart muscle disease of unknown cause’, but was later redefined to encompass ‘all disease affecting the heart muscle’. This changed coding practices affecting perceived admission and incidence rates, but cannot account for the continuous increase in cardiomyopathy throughout the 20-year period.

Only a few cross-sectional studies have described the epidemiology of cardiomyopathy. In a US population-based study, the sex- and age-adjusted incidence of idiopathic dilated cardiomyopathy in patients <55 years was 17.9/100 000 person-years (n = 32). Swedish population-based studies, using different definitions and age bands have shown varying but lower incidence rates more similar to our study ranging from 1.0/100 000 at 18–44 to 8.7/100 000 at 45–54 years.

The underlying cause of the observed increase of HF in the young is not known. Given the seriousness of HF diagnosis in young patients,
these patients are highly likely to have been admitted for investigation regardless the time period. Accordingly, our findings may suggest a change in phenotype, with an increasing proportion of HF due to cardiomyopathy, most notably in the youngest patients in whom IHD is rare.

Obesity, which has more than tripled in Sweden among the young 1985–2002,22 changes in drug abuse patterns and excessive alcohol consumption are all potentially contributing factors, but their impact could not be assessed in our population.

Decreasing case fatality among young adults

One-year case fatality was substantially reduced in all age groups. Mortality data among persons <55 years of age with HF are exiguous. Rochester population-based data show stable 1-year mortality ranging from 23 to 28% (mean age 74 years).23 In contrast, another survey from the same population (1979–2000) reported a 52% survival improvement among men in their 60 s, but only 28% among men in their 80 s, a finding congruent to the more pronounced case fatality reduction observed among younger subjects in our population.24 Our data did not show any further improvement in fatality after 2001. Neurohormonal blockade has improved survival in patients with systolic HF.25–27 The largest relative reduction in case fatality occurred from 1987–1991 to 1997–2001, i.e. prior to the publication of the landmark trials validating beta-blocking agents in HF treatment, suggesting that beta-blocker treatment had not been fully implemented,26,27 or did not impact fatality in this population. Beta-blockers and ACE-inhibitors were, however, at the time widely employed in the treatment of hypertension and IHD and may have curtailed the emergence or at least a further increase in HF during this time period.

Limitations

The study has several advantages, such as an unselected and large population and near-complete follow-up. However, there are also some limitations. First, using discharge diagnosis codes poses a risk of underestimation.28 Secondly, hospital admission rates and not true incidence were employed. It is reasonable to believe that young patients with new onset HF undergo comprehensive assessment, including echocardiography in a cardiac ward where the validity of the HF diagnosis is higher than stated by Ingelsson et al.14 in their study of elderly men. Additionally the lack of further mortality reduction over the last period would not indicate a spurious inflation in incidence because of inclusion of milder cases. Coding practices may certainly have influenced the data, but if so most likely at all ages.

A further limitation is the lack of important biological variables, increasingly used over the period, such as the measurement of natriuretic peptides, or ejection fraction. The absence of such objective measurements obviously detracts from the comparability of HF rates over time.

HF is, however, largely a clinical diagnosis, and though we contend that the lack of biological variables is unlikely to explain the diverging
changes in HF incidence over time in the different age groups, we acknowledge that their addition would have added value to the study.

Diagnosing practices for cardiomyopathy changed in the mid-1990s. Accordingly, the group classified as other, could have harboured undiagnosed cases of cardiomyopathy from earlier periods. Recent unpublished data from an on-going validation study by our group showed that a diagnosis of DCM could be confirmed in 92% (202 out of 219 cases, using data from medical records from five calendar years over the period 1989–2009) with a further 4% classified as suspected DCM, and, importantly, no change in diagnostic accuracy over time. A systematic and variable underreporting of hypertension, a major cause of HF, was probably present, but this is unlikely to have influenced hospitalization rates differentially in different age groups. The stagnating mortality reduction observed does not support a falsely inflated incidence rate in the young. Thus, potential shifts in diagnoses and classifications are unlikely to explain the opposing trends in HF incidence in younger and older patients.

Conclusion

Increasing HF admission in young adults opposes the general trend noted in older patients. Although the cause for this is not known, it may reflect true epidemiological changes and may serve as an ominous sign of stagnating morbidity reduction among young adults. Declining case fatality reduction with lack of further improvement after 2001 is a cause for concern.

Supplementary material

Supplementary material is available at European Heart Journal online.

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References


