Peer reviewed article

Heart failure events and case fatalities in Switzerland based on hospital statistics and cause of death statistics

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Summary

Objectives: In Switzerland there is a shortage of population-based information on heart failure (HF) incidence and case fatalities (CF). The aim of this study was to estimate HF event rates and both in- and out-of-hospital CF rates.

Methods: Data on HF diagnoses coded according to I 50 (ICD 10) were taken from the Federal Hospital Statistics Database and the Cause of Death Database for the year 2005.

Results: Although the total estimated number of HF events was higher for women (n = 4,201) than for men (n = 3,819), men showed higher numbers up to age group 65–74. Looking at age-specific HF cases per 100,000 population, men had higher rates in all age groups. The latter is also true of the age-standardised HF event rate (82.9/100,000 versus 51.4/100,000 population). Overall, CF was 26.3% and higher for women (32.2%) than for men (19.8%). The same is true of out-of-hospital CF but not of in-hospital CF.

Conclusion: The HF event rate was 20% higher than the HF hospital discharge rate. Out-of-hospital death from HF accounted for the largest proportion of total HF deaths. Sex differences in both the number of HF events and HF event rates can be explained by the larger number of women than men aged 55+ in the Swiss population.

Key words: heart failure epidemiology; estimated heart failure event rate; heart failure case fatality

Introduction

The burden of heart failure (HF) and the resources required to manage the disease over the coming decades will be a major challenge [1, 2]. In Switzerland, planning of national and regional health care and services is rendered difficult by the shortage of data on HF incidence and prevalence. According to the Bruckenberger Report of 2006, the percentage of hospitalised HF cases in Switzerland is markedly lower than in Germany and Austria [3]. For Switzerland, thirteen thousand new cases per year have been estimated on the basis of the incidence in other countries [4]. An incidence of 10,000 cases for 2002 was extrapolated from registry data obtained in four Swiss cantons [5].

Currently, data on HF hospital discharges in Switzerland are provided by the Hospital Statistics Database (HOST) of the Federal Statistics Office (FSO) [6]. Data on death due to HF are available from the FSO Cause of Death Statistics (CoD) [7]. Although the HOST database keeps a record of all hospital discharges of HF patients in Switzerland, it does not contain a complete set of data on HF events in Switzerland since some HF patients are treated for or die from HF out of hospital. For its part, the CoD database does not provide information on case fatality (CF) rates, nor does it differentiate between in- and out-of-hospital deaths.

The aim of this study was to estimate HF event rate and determine the overall CF rate and the in- and out-of-hospital CF rates in Switzerland using the HOST and CoD databases of 2005. Additionally, the number of deaths from HF occurring out of hospital was determined.

No financial relationships to declare.

Material and methods

Data sources

Data from HOST and CoD databases of the Swiss FSO from 1 January to 31 December 2005 [6, 7] were used. Data were coded according to the International Classification of Disease, Version 10 (ICD 10). For HOST, data were coded in the hospitals that patients were discharged from. In accordance with WHO rules [8] the validity of codes are verified by independent auditors in the hospitals and the codes were then transferred to the HOST database. The Hospital response rate was 100%. Cause of death was recorded in the CoD according to WHO rules [8]. Mortality-related data are supplied to the civil registry offices, recorded and coded centrally in the FSO's CoD database. Due to Switzerland's current data protection laws, linking of the two databases to determine HF events is not possible.

Preparation of the HOST and CoD datasets for calculation

1. From the HOST database all cases with principal discharge diagnoses of HF (I50) with coding in the 1st position [9] were selected for analysis (called "cases A"). The code I50 integrates data from three separate codes: Code I50.0 (Congestive HF; right HF secondary to left HF; failure due to congestion); code I50.1 (Left HF: acute pulmonary oedema without specification of underlying heart disease or HF); and code I50.9 (HF, unspecified). When a patient was admitted to a small hospital (e.g. district hospital) following an acute HF event and later transferred to a larger hospital (e.g. university hospital or cantonal hospital), a connection code was used to identify the patient as one and the same in the HOST database, thus ensuring that the patient was only counted once.

2. Patients that survived to be discharged from hospital were called in-hospital survivors (cases As). Data on all HF cases having a discharge code of 5 (i.e. patients had died whilst in hospital) were extracted from the HOST database and labelled "cases Ad".

3. Based on the CoD database, all cases with HF as the underlying cause of death (I50) were identified and called "cases D".

Calculations

With respect to the data preparation procedure described above, the following variables were calculated (rate = number of cases per 100,000 population):

1) Age & sex-specific discharge rates ([cases A / age & sex-specific population] × 100,000).
2) Age & sex-specific event rate of HF ([cases As + cases D] / age & sex-specific population × 100,000).
3) Mortality rate ([cases D / population] × 100,000).
4) Overall CF (cases D / [cases As + cases D] × 100).
5) In-hospital CF (cases Ad / [cases As + cases D] × 100).
6) Out-of-hospital CF ([cases D – cases Ad] / [cases As + cases D] × 100).
7) Percentage of out-of-hospital deaths among the total number of deaths ([cases D – cases Ad] / cases D × 100).
8) Average length of hospital stays ([number of days of cases A / number of cases A]).

For data analysis, the age groups as recommended by EUROCISS were used [9]. The Swiss census denominator data were used to calculate the rates for the year 2005 [10]. If HF event rates and/or mortality rates are to be compared to rates reported for other countries, data must be age-standardised. Age-standardization was calculated according to the European standard population [11].

Results

In 2005 a total of 6,708 cases with HF code I 50 (3,208 women; 3,500 men) were identified in the HOST (table 1a), and 2,106 deaths were recorded in the CoD (1,351 for women, 755 for men).

Hospital discharge rate from heart failure

The number of hospital discharges per 100,000 population increased with age in both men and women. From age group 35–44 to age group 85+, the discharge rates for men were higher than for women (fig. 1; table 1a).

Estimated heart failure events

In 2005, the overall number of patients with HF was 8,120 (4,201 women, 3,819 men). Although the total number of HF cases was higher in women, the age-specific HF event rates were

Table 1a

Age-specific and total heart failure discharges (absolute numbers and rate per 100,000 population) (Switzerland 2005).

Age groups (yr)	Women				Men			
	No. of cases	Population	Rate	95% CI	No. of cases	Population	Rate	95% CI
25–34	9	499595	1.8	0.9–3.5	11	493144	2.2	1.2–4.0
35–44	18	617591	2.9	1.8–4.6	43	622176	6.9	5.1–9.3
45–54	43	521616	8.2	6.1–11.1	136	528681	25.7	21.7–30.4
55–64	142	450133	31.5	26.8–37.2	358	442896	80.8	72.9–89.7
65–74	439	330862	132.7	120.8–145.7	759	281452	269.7	251.2–289.6
75–84	1253	255059	491.3	464.8–519.2	1371	163918	836.4	793.3–881.9
85+	1304	106153	1228.4	1163.5–1296.9	822	45122	1821.7	1701.4–1950.6
Total	3208	2781009	115.4	111.4–119.4	3500	2577389	135.8	131.4–140.4
ASR			41.6	40.2–43.1			76.0	73.5–78.5

ASR, Age-standardised rate

Table 1b

Age-specific and total heart failure events (absolute numbers and rate per 100,000 population) (Switzerland 2005).

Age groups (yr)	Women				Men			
	No. of cases	Population	Rate	95% CI	No. of cases	Population	Rate	95% CI
25–34	9	499595	1.8	0.9–3.5	10	493144	2.0	1.1–3.8
35–44	18	617591	2.9	1.8–4.6	43	622176	6.*	5.1–9.3
45–54	41	521616	7.9	5.8–10.7	132	528681	25.0	21.1–29.6
55–64	136	450133	30.2	25.5–35.7	371	442896	83.8	75.7–92.7
65–74	456	330862	137.8	125.7–151.1	757	281452	269.0	250.5–288.8
75–84	1418	255059	555.9	527.8–585.7	1405	163918	857.1	813.5–903.1
85+	2123	106153	1999.9	1916.7–2086.9	1101	45122	2440.1	2300.1–2588.5
Total	4201	2781009	151.1	146.6–155.7	3819	2577389	148.2	143.5–152.9
ASR			51.4	49.9–53.0			82.9	80.3–85.6

ASR, Age-standardised rate

higher in men aged 45 and over (fig. 1; table 1b). The age-standardised HF event rate was 64.9/100,000, and was higher for men than women (table 1b).

Deaths from heart failure

The age-specific absolute number of HF deaths was higher in men in age groups 55–64 and 65–74, and higher in women in age groups 75–84 and older (fig. 2). Among the 85+ year old population, an absolute number of 1,022 deaths for women and 441 deaths for men was found. Marginal sex differences were found when mortality for age groups was presented as a rate per 100,000 population (fig. 2).

The overall mortality rate was 39.3/100,000 population, and higher for women (48.6/100,000 population) than for men (29.3/100,000 popula-

Figure 1

Heart failure: hospital discharge rates and estimated event rates per 100,000 population, women and men (Switzerland 2005).

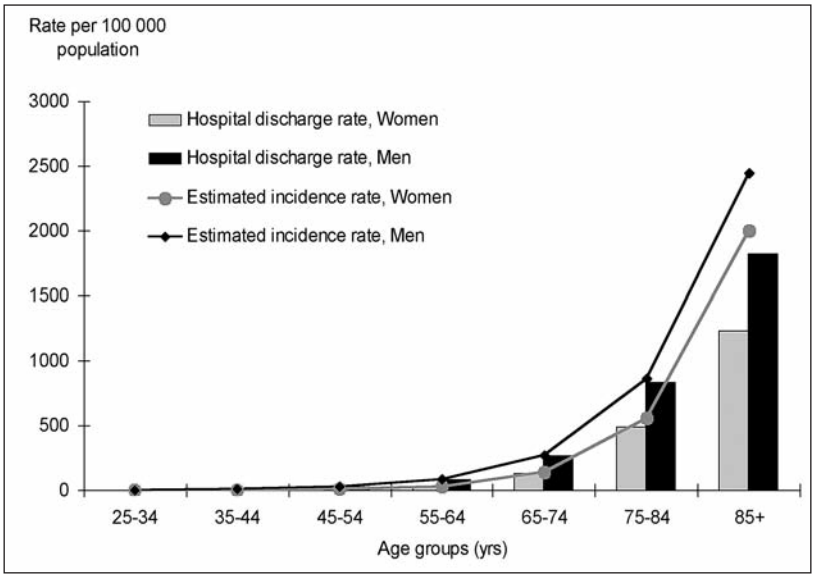
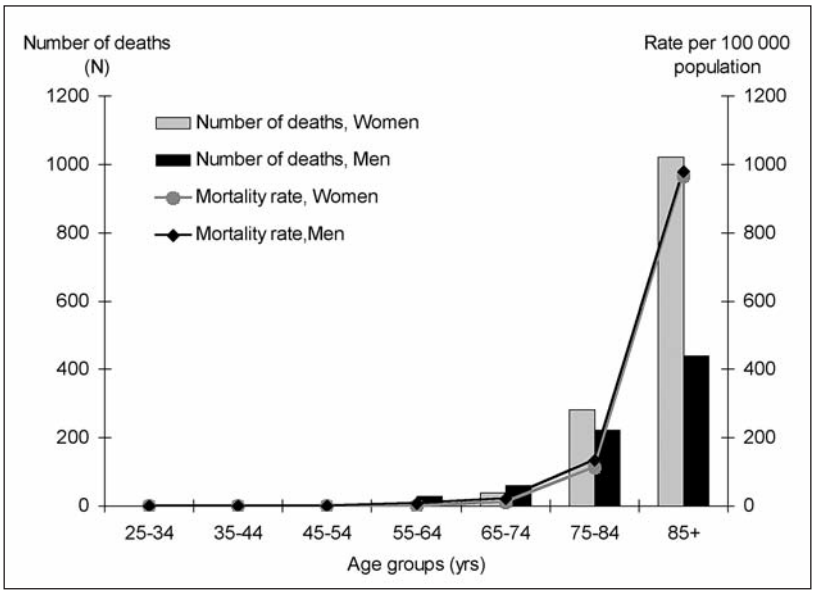


Figure 2

Heart failure: number of deaths and mortality rates per 100,000 population, women and men (Switzerland 2005).



tion). The age-standardised mortality rate was 14.9/100,000 population (14.0/100,000 for women and 16.1/100,000 for men).

Case fatalities

In young men the CF rate was 4.7% in age group 35–44 and 1.6% for age group 45–54. In age groups 65–74 and over the CF rate increased in direct proportion to age: in women from 8.3% (65–74 years) to 48.1% (age 85+) and in men from 8.1% (age 65–74) to 40.11% (age 85+).

The overall case fatality rate was 26.3%. The out-of-hospital CF rate was double the in-hospital CF rate. Overall CF was higher for women (32.2%) than for men (19.8%)

Out-of-hospital CF was more than twice as common in women than men, but in-hospital CF was higher in men (table 2). In total, 62.3% of all identified HF deaths occurred out-of-hospital (73.5% for females, 42.3% for males), with the highest rate of 80.1% for women aged 85 and older.

Age distribution

At the time of hospital discharge due to HF women were on average older than men (80.5 and 75.8 years).

Table 2

Overall case fatality (CF), in-hospital case fatality and out-of-hospital case fatality; women, men and total (Switzerland 2005).

	CF Women		CF Men		CF Total	
	N	% (CI)	N	% (CI)	N	% (CI)
Overall CF	1351	32.2 (30.5–33.9)	755	19.8 (18.4–21.2)	2106	26.3 (25.2–27.4)
In-hospital CF	358	8.5 (7.7–9.5)	436	11.4 (10.4–12.5)	794	9.9 (9.2–10.6)
Out-of-hospital CF	993	23.6 (22.2–25.2)	319	8.4 (7.5–9.3)	1312	16.4 (15.5–17.3)

Discussion

The present study yielded three major findings.

1. HF event rate estimated from the HOST and CoD data was 20% higher than the discharge rate obtained from the HOST data alone.
2. In old age women had a higher absolute number of HF events, but between the 4th and 9th decade and relative to their ratio in the population they exhibited lower event rates than men.
3. Out-of-hospital deaths caused by HF accounted for the largest proportion of total HF deaths.

Methodological aspects

The present study included all hospitalisations for HF in Switzerland as registered in the 2005 HOST database, and all deaths caused by HF as reported in the 2005 CoD database. Population-based registries are considered to be the best and most reliable sources of morbidity data [9]. In Scandinavian countries there are registries based on linking of records from administrative data of hospital discharge registers and death statistics covering the entire population [12]. As an alternative, a record linkage method could probably be applied to combine both HOST and CoD databases by using date of birth, sex and postcode. However, the HOST database lacks the date of birth. Due to Switzerland's restrictive data protection laws, linking data from the HOST and CoD databases for the determination of HF events is currently not possible.

Discharge rate from heart failure

Hospital discharge rates for HF increased with age (fig. 1). Compared to data derived from the WHO database in 2005, the age-standardised discharge rate in Switzerland was approx. 30% and 20% of the rate for United Kingdom and Germany respectively [13]. In their study cases, Khand et al. [14] reported good agreement between the presence of HF and a discharge code of HF in all of the six positions, with coding in the first position being slightly superior. Only 28% of their patients had HF codes in the first position (principal diagnosis), but the proportion increased to 70% when extended to the second position (secondary diagnosis). In countries using DRGs there is an incentive to code for HF as this is usually associated with higher reimbursement than other cardiac diagnoses, in which case the age-standardised Swiss hospital discharge rate would be even lower. As a result, discharge rates cannot be used unrestrictedly as a substitute for HF event rate. Hospitalisation rates for HF are more likely to reflect the treatment practices in a given country, including hospitalisation, home and ambulatory monitoring practices [15–17].

Despite these restrictions, the analysis of data on hospital discharges and in-hospital deaths permits monitoring of trends in HF morbidity and in-hospital CF without giving the reasons for the trends.

Event rates in heart failure

HOST and CoD databases do not differentiate between first-ever and recurrent events. Hence the number of a first-ever HF event could not be derived from this analysis. However, the EUROCISS group has observed that no registry is currently available in Europe on HF [12]. Discrepancies among published studies on HF incidence and/or HF event rates attributable to differences in definitions, selection procedures, age range, validation procedures and/or populations used for age-standardisation, make it difficult to compare them [12]. Nevertheless, the trends in differences by age and sex for HF risk, as observed in this study, seem to be in line with contemporary tendencies. With advancing age the event rate for HF increased, and men were at greater risk for HF than women (fig. 1; table 1b). According to the Framingham study, the incidence of HF was reported to be 0.3% per annum in men and 0.2% per annum in women aged 50–59, rising by a factor of 10 to 2.7% per annum in men and 2.2% per annum in women aged 80–89 [18]. In Switzerland the age-standardised sex quotient of 1.60 indicates a 60% higher HF event rate in men than in women. Similar sex quotients for HF were reported by the Framingham study and the British Heart Foundation (1.68 and 1.75 respectively) [18, 19]. In Switzerland women are older than men when they are discharged from hospital for HF or die from it. This finding is in line with results from a prospective Swiss observational study [20] and a review of 20 studies on sex differences in HF, where women tended to be older when HF was diagnosed [21].

Case fatalities and mortality rates

The preponderance of the larger number of HF deaths in elderly women (fig. 2) may be explained by 1) the onset of various cardiovascular diseases contributing to the development of HF in later life occurs at a later age in women than men [22], and 2) there is a larger female Swiss population, particularly among the older age groups. The latter also explains why sex differences disappear when age-specific HF deaths are presented per 100,000 population (fig. 2). The HF age-standardised mortality rate in Switzerland was half that in Spain in 2004 [23]. It was 34% higher in women and 16% higher in men when compared to the sex-specific, age-standardised mortality rate in Australia [22], but an average of 11% lower than in the USA [25].

A matter of concern in all studies examining specific causes of death is a potential misclassification of deaths and the accuracy of the cause-of-death section in the death certificates [26]. Murdoch et al. [27] reported that HF was coded as the underlying cause in only 1.5% of deaths, but as a contributory cause in a further 14.3% of deaths for a defined period of time. Our findings are based on HF as the underlying cause of death (principal diagnosis), suggesting that the mortality rate may be an underestimation of the actual HF mortality rate.

In Switzerland the age-standardised in-hospital CF rate was relatively low (table 2). In the UK in-hospital CF rates varied widely between different categories of hospitals, with lower percentages in large teaching hospitals and increasing percentages from medium to large general hospitals to small to medium-size general hospitals [28]. As in the UK [28], most deaths in Switzerland attributed to HF occurred out-of-hospital.

The larger number of out-of-hospital CF rates, and a lower in-hospital CF in women compared to men (table 2) may indicate that older female patients with HF are more likely to be living alone at home [21], or in a nursing home, and are less often admitted to a hospital when HF problems occur. Additionally, the larger number of HF deaths occurring out-of- hospital may reflect the fact that many patients survived HF in-hospital, were discharged, and died later, at home or in a nursing home. According to Remes et al. [29] and Wheeldon et al. [30] diagnoses based only on clinical criteria – a common out-of-hospital practice – are often inaccurate, particularly in elderly, female and obese patients. As a result, underestimation of out-of-hospital CF rates in Switzerland is likely.

Limitations

This study is based on routine statistics implying that differentiation between a first-ever and a recurrent HF event was not possible. The HF event rates determined from routine statistics do not allow comparison with incidence rates which refer to first-ever HF events, e.g. obtained from population based registry data.

The methods applied in this study do not take into account patients with HF diagnosis who were treated out of hospital and survived their HF, suggesting an underestimation of the HF event rate. Additionally, sudden death due to HF before hospital admission is sometimes mistakenly not attributed to HF [27]. In Switzerland in 2005, HF as the underlying cause of death was validated by autopsy in only 5% of patients. Thus, the number of HF deaths may be an underestimation of the actual HF deaths in Switzerland. On the other hand, death certificates may overestimate the number of deaths from HF, as HF may be given as the cause of death when there are numerous comorbidities and the actual reason for death is uncertain. This limitation may operate in the advanced age group in particular.

Conclusions

The estimated HF event rate in Switzerland was one fifth higher than the HF discharge rate. The data indicate that the HF discharge rate underestimates the HF event rate. Sex differences in both the absolute number of HF events and HF event rates can be explained by the larger number of women than men aged 55 and older in the Swiss population. The noticeably higher out-of-hospital CF rate than in-hospital CF rate may reflect the fact that many patients die before reaching hospital, or survive in-hospital HF care and die later at home or in a nursing home. Due to methodological limitations, an unknown number of HF cases and deaths caused by HF remained unrecorded. To be able to estimate the overall HF event rate more accurately, personal identification numbers would have to be used to link the data in the HOST database with those in the CoD database.

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