ORIGINAL ARTICLE

Burden of heart failure in primary healthcare

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Received 19 April 2022; accepted 2 June 2022

KEYWORDS
Primary healthcare; Heart failure; Epidemiology; Healthcare resource utilization

Abstract
Objectives: To determine the epidemiology of heart failure registered in primary healthcare clinical records in Catalunya, Spain, between 2010 and 2014, focusing on incidence, mortality, and resource utilization.
Design: Retrospective observational cohort study.
Setting: Study was carried out in primary care setting.
Participants and interventions: Patients registered as presenting a new heart failure diagnosis. The inclusion period ran from 1st January 2010 to 31st December 2013, but patients were followed until 31st December 2013 in order to analyze mortality.
Main measures: Information came from electronic medical records.
Results: A total of 64,441 patients were registered with a new diagnosis of heart failure (2.76 new cases per 1000 persons-year). Among them, 85.8% were ≥65 years. The number of cases/1000 persons-year was higher in men in all age groups. Incidence ranged from 0.04 in women <45 years to 27.61 in the oldest group, and from 0.08 in men <45 years to 28.52 in the oldest group. Mortality occurred in 16,305 (25.3%) patients. Primary healthcare resource utilization increased after the occurrence of heart failure, especially the number of visits made by nurses to the patients’ homes.
Conclusion: Heart failure incidence increases with age, is greater in men, and remains stable. Mortality continues to be high in newly diagnosed patients in spite of the current improvements in treatment. Home visits represent the greatest cost for the management of this disease in primary care setting.
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https://doi.org/10.1016/j.aprim.2022.102413
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Impacto de la insuficiencia cardíaca en la atención primaria

Resumen
Objetivo: Determinar la epidemiología de la insuficiencia cardíaca registrada en las historias clínicas de atención primaria en Cataluña, España, entre 2010 y 2014, centrándose en la incidencia, la mortalidad y la utilización de recursos sanitarios.

Diseño: Estudio de cohorte observacional retrospectivo.

Emplazamiento: El estudio se llevó a cabo en atención primaria.

Participantes e intervenciones: Pacientes registrados con nuevo diagnóstico de insuficiencia cardíaca en el periodo de estudio. El periodo de inclusión fue del 1 de enero de 2010 al 31 de diciembre de 2013, pero los pacientes se siguieron hasta el 31 de diciembre de 2014 para poder determinar la mortalidad.

Mediciones principales: La información se obtuvo de la historia clínica electrónica de los participantes.

Resultados: Se registraron un total de 64.441 pacientes con nuevo diagnóstico de insuficiencia cardíaca (2,76 nuevos casos/1000 personas-año). De ellos, el 85,8% tenían ≥65 años. El número de casos/1000 personas-año fue mayor en hombres en todos los grupos de edad. La incidencia varió de 0,04 en mujeres <45 años a 27,61 en el grupo de mayor edad, y de 0,08 en hombres <45 años a 28,52 en el grupo de mayor edad. La mortalidad se produjo en 16.305 (25,3%) pacientes. La utilización de los recursos de atención primaria aumentó tras el diagnóstico de insuficiencia cardíaca, especialmente el número de visitas realizadas por las enfermeras a los pacientes en su domicilio.

Conclusión: La incidencia de insuficiencia cardíaca aumenta con la edad, es mayor en hombres y se mantiene estable en el tiempo. La mortalidad continúa siendo alta en pacientes recién diagnosticados a pesar de las mejoras actuales en el tratamiento. Las visitas domiciliarias representan el mayor coste para el manejo de esta enfermedad en el ámbito de atención primaria.

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Introduction

Heart failure (HF) is a growing public health concern and accounts for 1% of the general adult population. In Spain more than 10% of those aged >70 years are affected by HF, and it has become the third leading cause of death. Moreover, since current therapies prolong the lives of HF patients in the following decades its incidence is expected to increase. This does, however, depend on the diagnostic criteria employed and population studied, and HF epidemiology has changed, and a decline in incidence has even been reported.

A recent Spanish publication, using an administrative database to identify HF codified according to the International Codification Disease 9th revision (CIE-9), reported an incidence of 2.78 per 1000 persons-year.

An ever-increasing number of healthcare resources are employed in attending HF patients. In Europe the economic burden of managing HF accounts for almost 7% of the global healthcare expenditure, the main cost coming from hospitalizations. Although there has been an improvement in prognosis, mortality in the first three years following diagnosis remains close to 25%. This study aims to determine the epidemiology of HF registered in the primary healthcare records in Catalunya, Spain, between 2010 and 2013. It focuses on HF incidence, mortality, and PHC resource utilization.

Methods

Study design

A retrospective observational cohort study based on PHC electronic medical records (EMR). Its objective was to determine the incidence, healthcare resource utilization, and mortality of HF patients attended in PHC.

Study period

The study period ran from 1st January 2010 until 31st December 2013, but patients were followed until 31st December 2014 in order to analyze mortality.

Study population

Information came from the EMR of PHC patients ≥18 years attended at any of the 279 centres managed by the Catalan Institute of Health, Spain.

Variables

To estimate incidence we analyzed the new HF cases that occurred among the 5165778 individuals residing in
Catalunya during the study period who were free from this disease at baseline.

Comorbidities and demographic information were taken at the moment of HF onset. Mortality was calculated as all-cause death for the incident cases.

Age, gender, body mass index (BMI), smoking status, alcohol consumption, and associated comorbidities were also recorded.

Diagnoses were registered following the International Classification of Diseases, Tenth Revision (ICD-10) codes: heart failure [HF(150)], dementia (F00–F03), anaemia (D50–D64), atrial fibrillation [AF(I48)], cancer (C00–C97), chronic kidney disease [CKD(N18)], chronic obstructive pulmonary disease [COPD(J40–J44)], diabetes mellitus(E10–E14)], depression (F32–F33), lipoprotein metabolism disorders and other lipidaemias (E78), hypertension (I10–I15), peripheral artery disease (I73.9), coronary heart disease [CHD(I20–I25)], stroke (I63–I65), and obesity (E66.0–66.2, E66.8–E66.9).

Data sources

Data were obtained from the SIDIAP database (Information System for the Enhancement of Research in Primary Care) which stores records from routine PHC clinical practice. An anonymization algorithm was used to encrypt the information.

Costs and healthcare resource utilization were calculated according to the following: PHC nurse consultations/home visits, laboratory tests, PHC General Practitioner (GP) consultations/home visits, and primary care emergency consultations.

Statistical analyses

Continuous variables were summarized and mean and standard deviations calculated to describe the cohorts. Categorical variables were summarized by frequency and percentage.

The incidence of HF was computed between 2010 and 2013 in the population at risk without prior HF diagnosis on 1st January 2010. Incidence rates were calculated as the number of patients with HF divided by the sum of all individual-time at risk out of 5165778 subjects. In order to determine mortality, patients were followed until 31st December 2014.

All-cause mortality rates for patients in the incident cohort were computed as the number of patients who died divided by the sum of all individual-time at risk since the diagnosis was recorded. Individual-time at risk for the outcome was defined as the number of days from incidence date to the date of death or to end of follow-up, whichever occurred first.

Cox regression models were performed to estimate mortality rate related with comorbidities. Crude and adjusted hazard ratios (HR) with their 95% confidence interval (95%CI) were calculated. The models were constructed using the covariates clinically associated with HF incidence. Furthermore, the HR were computed specifically by age group. Resource utilization was assessed before and after HF diagnosis.

Data management and statistical analysis were performed with R3.5.1 statistical package.

Ethics

The study protocol was approved by the Clinical Research Ethics Committee, Institut Universitari d’Investigació en Atenció Primària Jordi Gol (IDiAP Jordi Gol) (Ref: P15/147). All data were anonymized, and EMR confidentiality was respected in accordance with national and international regulations regarding personal data protection.

Results

Incidence

Median follow-up was 21 (interquartile interval 10–36) months.

A total of 64441 patients had a new HF diagnosis recorded between 2010 and 2014, a figure that represents 2.76 new cases per 1000 persons-year. Among the patients 85.8% were >65 years.

Men presented higher rates of smoking, alcohol consumption, type 2 diabetes mellitus, chronic pulmonary disease, myocardial infarction, and cancer. Women presented higher rates for obesity, anemia, atrial fibrillation, depression, dyslipidemia, and hypertension (Table 1). The incidence of HF remained stable along the study period.

Incidence rates (cases/1000 person/year) in women ranged from 0.04 cases/1000 person/year in those <45 years to 27.61 in the oldest subjects, and from 0.08 in men <45 years to 28.52 in the oldest subjects (Table 2).

Mortality

Among the patients who presented incident HF between 1st January 2010 and 31st December 2014, a total of 16305 (25.3%) died during follow-up. Mortality was higher in men than in women (26.6% versus 24.3%, p < 0.001, respectively) (Fig. 1).

A total of 10068 patients died during the first year of follow-up (15.6%). This percentage represented 61.7% of mortality in the whole period.

Healthcare resource utilization and costs

Before the first registered HF episode, the median number of consultations with the GP and nurse at the PHC was 19 (interquartile interval 9–34) and 12 (interquartile interval 5–27), respectively. After the first episode, the median number of consultations at the PHC with the GP were 16 (interquartile interval 7–30) and 12 (interquartile interval 5–28) with the nurse. Home visits by the GP increased from 2 (interquartile interval 1–4) to 3 (interquartile interval 1–6) whilst those made by the nurse rose from 3 (interquartile interval 1–10) to 5 (interquartile interval 2–14).

Primary care emergencies were used at least once by 7.27% of the patients following HF diagnosis.

The total number of encounters with PHC professionals increased dramatically after HF occurrence, especially regarding the number of home visits made by the nurses (from 181826 to 318662). The total cost for the PHC as
a consequence of HF diagnosis was approximately 223.31 euros/individual/year. When compared to the figure prior to diagnosis this represents a difference of 4 553 411 euros for the 64 441 patients. The global cost was higher in women, who represented the 55.6% of the sample (Table 3).

Discussion

Main findings

Incidence of HF increased dramatically with age and was greater in men, particularly in the younger strata populations. Mortality in incident HF patients grew steadily across the age groups, it was ten-fold higher in the oldest group, and was also higher in men. We observed an increment in PHC resource utilization after the first episode of HF registered in the clinical records.

Several factors have been identified in the literature explaining differences in incidence rates. They include methodologies, diagnosis criteria, and HF approaches employed by local health systems. Moreover, it has been reported that diagnosis could be confirmed in only half of the patients labelled as HF in the PHC records. Aged

Age-adjusted HF incidence may tend to decrease in western countries, possibly due to optimized cardiovascular risk

| Table 1 | Characteristics of incident heart failure cases. |
|---------|-------------------------------------------------|
|         | Total | Women | Men | p-value |
| Age (years) | N=64441 | N=35832 | N=28609 |
| <45 | 804 (1.2) | 257 (0.7) | 547 (1.9) | 0.000 |
| 45-54 | 2190 (3.4) | 609 (1.7) | 1581 (5.5) | |
| 55-64 | 6105 (9.4) | 2209 (6.1) | 3896 (13.6) | |
| 65-74 | 14518 (22.5) | 7164 (20.0) | 7354 (25.7) | |
| 75-84 | 27959 (43.4) | 16664 (46.5) | 11295 (39.5) | |
| ≥85 | 12865 (20.0) | 8929 (24.9) | 3936 (13.8) | |

| Risk factors | Smoking | Alcohol | Hypertension | Dyslipidaemia | Obesity | Diabetes |
|--------------|---------|---------|--------------|---------------|---------|----------|
| Smoking | 6049 (9.3) | 10633 (16.5) | 49384 (76.6) | 29481 (45.7) | 18363 (28.5) | 22093 (34.3) |
| Alcohol | 1232 (3.4) | 2565 (7.1) | 28931 (80.7) | 16892 (47.1) | 11415 (31.9) | 11267 (31.4) |
| Hypertension | 4817 (16.8) | 8068 (28.2) | 20453 (71.5) | 12589 (44.0) | 6948 (24.3) | 10826 (37.8) |
| Dyslipidaemia | 2329 (10.5) | 2999 (10.5) | <0.001 |
| Obesity | 1804 (5.0) | 3905 (13.6) | <0.001 |
| Diabetes | 9603 (33.6) | 9603 (33.6) | <0.001 |

| Cardiovascular comorbidity | Peripheral artery disease | Acute myocardial infarction | Atrial fibrillation |
|---------------------------|---------------------------|-----------------------------|--------------------|
| Smoking | 1322 (3.6) | 1804 (5.0) | 12382 (34.6) |
| Alcohol | 7604 (21.2) | 5070 (17.7) | 9603 (33.6) |
| Hypertension | 5070 (17.7) | 1547 (18.0) |
| Dyslipidaemia | 20453 (71.5) | 7354 (25.7) |
| Obesity | 12589 (44.0) | 8341 (29.2) |
| Diabetes | 6948 (24.3) | 3896 (13.8) |

| Non-cardiovascular comorbidities | Anaemia | Cancer | Chronic kidney disease | Chronic obstructive pulmonary disease | Depression | Mortality during follow-up |
|--------------------------------|---------|--------|------------------------|--------------------------------------|-----------|--------------------------|
| Smoking | 12674 (19.7) | 4929 (14.6) | 12506 (19.4) | 11867 (18.4) | 7540 (11.7) | 16305 (25.3) |
| Alcohol | 7604 (21.2) | 4282 (12.0) | 6962 (19.4) | 3526 (9.8) | 5601 (15.6) | 8709 (24.3) |
| Hypertension | 5070 (17.7) | 5147 (18.0) | 5544 (19.4) | 8341 (29.2) | 1939 (6.7) | 7596 (26.6) |
| Dyslipidaemia | 20453 (71.5) | 7354 (25.7) | 8341 (29.2) | <0.001 |
| Obesity | 12589 (44.0) | 8341 (29.2) | 3896 (13.8) | <0.001 |
| Diabetes | 6948 (24.3) | 3896 (13.8) | 7596 (26.6) | <0.001 |

| Table 2 | Heart failure incidence according to gender and age. |
|---------|---------------------------------------------------|
| Age groups | Women | Men | | |
| | Incidence cases | Cumulate incidence | Cases/1000 persons/year | Incidente cases | Cumulate incidence | Cases/1000 person/year |
| <45 | 257 | 0.02% | 0.04 | 547 | 0.03% | 0.08 |
| 45-54 | 609 | 0.14% | 0.31 | 1581 | 0.37% | 0.80 |
| 55-64 | 2209 | 0.65% | 1.37 | 3896 | 1.22% | 2.62 |
| 65-74 | 7164 | 2.77% | 5.97 | 7354 | 3.26% | 7.24 |
| 75-84 | 16664 | 7.61% | 17.75 | 11295 | 7.50% | 18.29 |
| ≥85 | 8929 | 9.22% | 27.61 | 3936 | 9.06% | 28.52 |
Table 3  Differences in primary healthcare resource utilization and costs before and after diagnosis of heart failure by sex (women: 35 832 (55.6%) and men 28 609 (44.4%).

| Type of consultation                      | Total of encounters (N) | Total cost (€) |
|------------------------------------------|-------------------------|----------------|
|                                          | After HF diagnosis      | Before HF diagnosis | After HF diagnosis | Before HF diagnosis |
|                                          | Total          Women   Men | Total          Women   Men | Total          Women   Men | Total          Women   Men |
| Nurse at PHC<sup>b</sup>                  | 1 222 671       652 104 | 570 567        1 198 277 | 657 062       541 215 | 34 234 788       18 258 912 | 15 975 876       33 551 756       18 397 736 | 15 154 020       |
| Nurse at patient’s home                   | 318 662        208 595 | 110 067        181 826 | 126 576       55 250 | 14 339 790       9 386 775       4 953 015 | 8 182 170       5 695 920       2 486 250       |
| Laboratory test<sup>c</sup>               | 164 861        90 567  | 74 294         180 531 | 99 885        80 646 | 1 500 235       824 160         676 075       | 1 642 832       908 954         733 879       |
| General practitioner at PHC<sup>b</sup>   | 1 320 889       741 253 | 579 636        1 526 364 | 870 065       656 299 | 52 835 560      29 650 120       23 185 440 | 61 054 560      34 802 600       26 251 960       |
| General practitioner visit at patient’s home | 128 248       83 651  | 44 597         86 240       59 298 | 26 942 | 8 336 120       5 437 314       2 898 806 | 5 605 600       3 854 370       1 751 230       |
| Primary care emergency visits             | 30 640        16 039  | 14 601         840 6       494 5 | 3461 | 1 838 400       962 340         876 060       | 504 360       296 700         207 660       |
| Total                                    | 3 185 971       1 792 209 | 1 393 762      3 181 644 | 1 817 831 | 1 363 813 | 113 084 893      64 519 621       48 565 272 | 110 541 278      63 956 280       46 584 999       |

| Yearly person cost (€)                    | After HF diagnosis | Before HF diagnosis |
|------------------------------------------|-------------------|-------------------|
|                                          | Total          Women   Men | Total          Women   Men |
| Nurse at PHC<sup>b</sup>                  | 268.68          254.55      | 286.90          201.60      | 199.33          204.43      |
| Nurse at patient’s home                   | 112.54          130.86      | 88.95           49.16       | 61.71           33.54       |
| Laboratory test<sup>c</sup>               | 11.77           11.49       | 12.14           9.87        | 9.85           9.90        |
| General practitioner at PHC<sup>b</sup>   | 414.67          413.35      | 416.37          366.85      | 377.08          354.14      |
| General practitioner visit at patient’s home | 65.42           75.80       | 52.06           33.68       | 41.76           23.62       |
| Primary care emergency visits             | 14.42           13.42       | 15.73           3.03        | 3.21           2.80        |
| Total                                    | 887.50          899.47      | 872.15          664.19      | 692.95          628.43      |

<sup>a</sup> Heart failure.
<sup>b</sup> Primary healthcare.
<sup>c</sup> Includes the following (haemoglobin, total cholesterol, HDL cholesterol, LDL cholesterol, fasting blood glucose, glycosylated haemoglobin in diabetics, creatinine, glomerular filtration rate.
factor management.\textsuperscript{17} Our findings show that HF incidence remained almost stable along the study period and was much lower in the youngest subjects compared to the oldest. A study from administrative databases in Spain found similar rates to those described in our population.\textsuperscript{6} The incidence observed by the Rotterdam study was 1.4%.\textsuperscript{18} Similar results in a Swedish one analyzing information from an administrative database.\textsuperscript{19}

Regarding mortality, a meta-analysis of 1.5 million HF patients observed an 87\% survival rate the first year and 35\% five years after diagnosis. Five-year survival, however, increased from 29.1\% in the period before 1979 to 59.7\% in the period 2000–2009.\textsuperscript{20}

After a median follow-up of 5 years, a study based on England, found up to 56.1\% mortality among incident HF patients.\textsuperscript{21} A recent publication from Spain found a mortality rate of 14\% and was even higher in hospitalized patients (24\%).\textsuperscript{22}

Healthcare resource utilization may be approached from a number of perspectives, depending on setting, healthcare system, and variables analyzed. A publication from Spain described a lower number of PHC consultations, but higher emergency care use, in HF patients. Findings probably were due to the sample taken from secondary care and because all subjects were symptomatic at the inclusion baseline.\textsuperscript{23}

In agreement with our research, it has been observed that the highest costs regarding HF patients are related to hospitalization episodes, and, in second term, PHC home visits.\textsuperscript{24} Findings that concur with another study from an administrative database in Catalunya (Spain) in which the main expense was attributable to hospitalization.\textsuperscript{25}

The number of GP and the PHC nurse home visits increased after the first HF episode, probably due to the inherent limitations of the patient’s new condition.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Mortality in incident heart failure patients between 2012 and 2014. Panel A: mortality according to age groups. Panel B: mortality according to sex and age.}
\end{figure}
Strengths and limitations

We analyzed the registered diagnosis from an administrative database oriented towards clinical purposes. It is possible, therefore, that the percentage of HF diagnoses was lower than expected.

Other variables could have been included in the resource utilization category such as medication. Nevertheless, as specific HF medication is usually prescribed by cardiologists after the first HF episode we cannot attribute the cost exclusively to the PHC setting.

Data from this study period do not allow discrimination between reduced and preserved ejection fraction, since this variable was not registered systematically at that time and we found some missing values.

Conclusion

Incidence of HF in the adult population increases with age, is greater in men, and remains stable. Mortality continues to be high in newly diagnosed HF patients in spite of the current, improved treatment. The greatest expense resulting from HF management in the PHC setting is due to home visits.

Conflict of interests

None declared.

Acknowledgements

The authors gratefully acknowledge Novartis Pharma AG for partially funding this project, and SIDIAP database for providing data.

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