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Original Study

Long-term Impact of Hip Fracture on the Use of Healthcare Resources: a Population-Based Study

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A B S T R A C T

Objectives: To assess the impact of hip fracture (HF) on health care expenditures and resource use.
Design: Observational, retrospective study. An administrative registry was used to obtain sociodemographic, clinical, and expenditure data of patients treated in centers all over Catalonia (North-East Spain).
Setting and participants: Male and female patients aged 65 years or older admitted to a Catalonian hospital due to hip fracture (HF) between January 1 2012, and December 31, 2016.
Measures: The study data set included the expenditure and frequency of using nonemergency transport, rehabilitation, skilled nursing facility, specialist visits, admissions to the emergency department, hospitalization, pharmacy, and primary care. The patient status at each time point included living at home, staying in hospital, staying in a skilled nursing facility, institutionalized in a nursing home, and death.
Results: The record included 38,628 patients (74.4% female) with a mean [standard deviation (SD)] age of 84.9 (7.07) years. The average expenditure per patient during the first year after hospital admission was €11,721.06, the index hospitalization being the leading expenditure (€4740.29). Expenditures related to hospitalization and skilled nursing facility remained higher than preinjury throughout the 3 years following HF. Three years after the index admission, 44.9% of patients had died, 39.7% were living in their homes, 14.2% were in a nursing home, 0.9% were in a skilled nursing facility, and 0.3% were in hospital. The expenditure of hospitalizations, primary care, and visits to the emergency department increased few months before the HF.
Conclusions: In patients hospitalized for HF, the expenditure per patient decreases after hospital discharge but the use of healthcare resources is not restored to preinjury values. The increase of expenditures associated with primary care services, hospitalization, and emergency department services during the few months preceding hospital admission suggests a decline of health status in these patients.

Hip fractures (HFs) are the most frequent and serious osteoporotic fractures and are considered a trend indicator of osteoporosis in public health science.[1] Despite a better understanding of osteoporosis and its management, the demographic shift of the population in many areas worldwide results in an alarming increase in the incidence of HFs.[1,2] Based on the incidence increase seen in the last decades and the demographic projections for the upcoming years, some authors have depicted a scenario that might override 21 million HFs worldwide in 2050.[1]

In addition to a high morbidity and mortality, HF has an important societal impact, and it is associated with a higher use of health care resources. In central Europe, the estimated expenditure per patient for HF management was 5- to 10-fold greater than that of fractures in the upper and lower limb outside the hip.[3] The total expenditure and the use of health care resources associated with HF may differ from one

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patient to another and strongly depends on the characteristics of the health care system. The estimated expenditures for acute HF in Europe range from €2000 in Bulgaria to nearly €25,000 in Denmark.[4] Similarly, HF treatment in Asia and the United States amounts $774–14,198 and $7788–31,310, respectively.[5,6] Regardless of the individual expenditure for HF management, its high incidence makes HF a significant contributor to the total health care expenditure. In 2010, EU countries spent approximately €20 billion in the treatment of HF, which accounted for 54% of the total osteoporosis-related expenditures.[4]

Inpatient care is the category with highest expenditures during the first 12 months following HF and accounts for nearly one-third of all health and social care expenditures in the first year.[7] Although HF patients are frequently readmitted to hospital, index hospitalization expenditures clearly outshine and may represent up to 80% of the total inpatient expenditures in the first year after HF. Other expenditures that significantly contribute to the total financial burden during the first year include rehabilitation, social care in the patient's home or institutional setting, medical equipment, and home modification.[7]

Notwithstanding the high expenditure of HF treatment during the first months, HF patients often need to deal with long-term disabilities, which may continue influencing the health and social care burden long after the first hospital discharge.[8] However, although the expenditures generated during the immediate first period following the fracture are described elsewhere, there is little information regarding the mid- and long-term economic footprint of HF on the financial burden of these patients. In this retrospective analysis of an administrative database capturing clinical and financial data from 7.5 million people, we investigated how HF shifts the economic burden of these patients from the year preceding the HF to several years following the event.

Methods

Population and Data Source

This was an observational, retrospective study based on sociodemographic, clinical, and expenditure data from the Catalan (Catalonia, northeast of Spain) health service (CatSalut) data set. CatSalut provides free health care services through a network of 62 public hospitals and 369 primary care units. Since 2011, the Catalan Health Surveillance System (CHSS) collects detailed information on the use of health care resources by the entire population of Catalonia. The CHSS registry compiles data on hospitalization, primary care, skilled nursing facilities and mental health network, information on pharmacy prescriptions and expenditure, and a registry on billing records, which includes outpatient visits to specialists, visits to the emergency department, nonurgent medical transportation, ambulatory rehabilitation, home oxygen therapy, and dialysis.[9] The registry has an automated data validation system that checks data consistency and identifies potential errors. Furthermore, as this information is used for making supplier payments, external audits are regularly conducted to ensure the quality and reliability of the data.

For this analysis, searches were restricted to patients (male and female) aged 65 years or older who were admitted to any public hospital because of an HF (index admission) between January 1, 2012, and December 31, 2016. For each patient, clinical data and the use of health resources between 1 year before and 3 years after the index admission were collected. Data regarding HF inpatient care at private health centers could not be analyzed because those centers use different patient identification codes. Nevertheless, HF patients are rarely admitted to private hospitals; for reference, out of 1,016,190 all-cause hospitalizations that occurred in Catalonia in 2015, a total of 808,908 (80%) were in public hospitals, whereas the rest occurred in private hospitals. In 2015, a total of 10,310 HF-related hospitalizations were registered in Catalonia: 9628 in public hospitals and only 682 (7%) in private ones. Data retrieved from the CatSalut surveillance system was anonymized to prevent patient identification. The study protocol was approved by the Independent Ethics Committee of the Jordi Gol Primary Care Research Institute (Spain) (ref. P17/128). Based on the sample size and the absence of personal information in the data set used for analysis, the Ethics Committee determined that it was not necessary to obtain written informed consent from each patient.

Variables and Expenditure Estimate

The analysis included the expenditure associated with 8 categories: nonemergency transport, rehabilitation, skilled nursing facility, visits to the specialists, admissions to the emergency department, hospitalization, pharmacy (ie, medicines including both used at hospital and dispensed by community pharmacies), and primary care. The category "other" included all other expenditures recorded in the CHSS: hospital and outpatient mental healthcare, minor outpatient surgery, domiciliary hospitalization, home respiratory therapy, and dialysis. The expenditure associated with each category was estimated based on the use rate (person-years) and the average expenditure of the activity.[10] Because nursing homes are not paid by CatSalut, expenditures associated with admission and management in nursing homes could not be included. The use rate was computed monthly (30-day periods, counting from the index admission) and yearly (365-day periods, counting from the index admission). For each category, the sum of all activities during the given period was divided by the average number of patients at risk in the same period. Regarding the monthly resource use rate, patients at risk were half the number of patients at the beginning and the end of the period. Likewise, the yearly number of patients at risk was estimated from the sum of all days at risk, divided by 365.

In addition to expenditures, information regarding the patient overall status was collected. The following status were considered: living at home, staying in hospital, institutionalized in a nursing home (ie, a licensed residence for long-term care of older patients), staying in a skilled nursing facility (ie, a post-acute care resource including short-term rehabilitation and long-term care of patients with care needs not provided by nursing homes), and death. The progression of the patient status was analyzed in 7-day periods from the date of the index admission. The patient status at the end of the 7-day period was assigned. Patients who were still alive and were not hospitalized or institutionalized in any health care facility were included in the "living at home" category. At time 0, only 2 options were considered: living at home or living in a nursing home.

Statistics

For analysis purposes, only data retrieved from the CHSS, up to December 31, 2016, were considered. The clinical characteristics of the study population were described as frequency and percentage of each category for the overall population and for males and females. Age was described as mean and standard deviation. Expenditures were described as the average expenditure (in euros) per patient and category during a given period and percentage of the total expenditure for the same period. Patient status was described as the percentage of patients who were either followed up for the given period or dead using a Selwood analysis, as described in a previous work.[11] Hypothesis tests were performed only for the differences between males and females regarding clinical and demographic characteristics. Categorical variables were compared using the chi-squared test and age was compared using the Student t test. The threshold for statistical significance was set at a 2-sided α-value of 0.05, and all analyses were performed using the R software (version 3.4.3).

Table 1
Characteristics of the Study Population at the Time of Fracture

	Overall (n = 38,620)	Male (n = 9886)	Female (n = 28,734)	*P*
Demographic characteristics				
Age, mean (SD)	84.9 (7.09)	83.8 (7.45)	85.3 (6.92)	<.001
Clinical characteristics				
Previous fracture, n (%)	3711 (9.61)	604 (6.11)	3107 (10.8)	<.001
Comorbidities, n (%)				
Diabetes	11,859 (30.7)	3306 (33.4)	8553 (29.8)	<.001
COPD	6667 (17.3)	3300 (33.4)	3367 (11.7)	.000
Depression	10,755 (27.8)	1813 (18.3)	8942 (31.1)	<.001
Heart failure	8548 (22.1)	2424 (24.5)	6124 (21.3)	<.001
Ischemic heart disease	6312 (16.4)	2444 (24.8)	3868 (13.5)	<.001
Stroke	7604 (19.7)	2635 (26.6)	4969 (17.3)	<.001
Chronic kidney disease	9654 (25.0)	2906 (29.4)	6748 (23.5)	<.001
Cirrhosis	664 (1.72)	246 (2.49)	418 (1.45)	<.001
Osteoporosis	7939 (20.6)	537 (5.43)	7402 (25.8)	.000
Osteoarthritis	18,695 (48.4)	3647 (36.9)	15,048 (52.4)	<.001
Dementia	8284 (21.4)	1892 (19.1)	6392 (22.2)	<.001
Previous admission to a nursing facility, n (%)	6400 (16.6)	1342 (13.6)	5058 (17.6)	<.001
Outcome				
Mortality, n (%)				
In-hospital mortality	1747 (4.52)	658 (6.65)	1089 (3.79)	<.001
Mortality at 30 d	2974 (7.70)	1126 (11.4)	1848 (6.43)	<.001
Mortality at 1 y	9400 (24.3)	3367 (34.0)	6033 (21.0)	<.001
Posterior admission to a nursing facility, n (%)	5594 (14.5)	1249 (12.6)	4345 (15.1)	<.001

COPD, chronic obstructive pulmonary disease.

Results

Characteristics of Study Population

The retrospective record included 38,628 patients admitted to any CatSalut hospital after an HF between 2012 and 2016: 9886 (25.6%) were male and 28,734 (74.4%) female. The mean (SD) age of the study population was 84.9 (7.07) years, the women being significantly older than the men: the mean ages (SD) were 83.8 (7.43) and 85.3 (6.91) years for men and women, respectively ($P < .001$). Table 1 summarizes the clinical characteristics of the study population as well as the outcomes. Osteoporosis, osteoarthritis, depression, and dementia were significantly more prevalent in females, whereas all other comorbidities analyzed were significantly more prevalent in men. Women were more frequently admitted to a nursing home both before and after the HF. One-year mortality was significantly higher in males, including in-hospital mortality and 30-day mortality.

Healthcare Expenditures

The expenditure per patient 1 year after the index admission was €11,721.06, approximately 3 times more than the year preceding the HF (Table 2). The average expenditure during the second and third year after HF was €3508.68, which almost matched the preinjury value. When considering each category separately, pharmacy and hospitalization were the leading expenditures before the HF, whereas in the first year after the index admission, hospitalization and stay in a skilled nursing facility accounted for 73.8% of the total expenditure (Table 2). The contribution of these 2 categories decreased in the second and third year after HF, but remained persistently higher than preinjury. In contrast, expenditures associated with primary care and pharmacy accounted for a smaller percentage of the total expenditure in the second and third year than in the preinjury year.

The use of health care resources of all categories showed a similar trend, consisting of a sharp increase in the first month of hospital admission, and a decline until reaching values slightly above the preinjury scenario (Figure 1). Six to 7 months after the index admission, the monthly use of health care resources steadied, progressively reaching an average annual value close to the preinjury value during the second and third years after HF. Of note, all categories except specialist visits, pharmacy, and rehabilitation showed a remarkable increase in the few months preceding the HF.

Patient Status

Figure 2 shows the percentage of patients living at home, living in a health care facility (ie, hospital, nursing home, or skilled nursing facility), or death at the end of each 7-day period after the index

Table 2
Yearly Expenditures (Average) per Patient (Euros, %)

	Before Hip Fracture	After Hip Fracture		
	(1 Year)	1st Year	2nd Year	3rd Year
Hospitalization	859.57 (24.6)	4740.29 (40.4)	999.14 (27.4)	896.95 (26.6)
Primary care	544.18 (15.6)	642.15 (5.5)	513.65 (14.1)	487.00 (14.5)
Skilled nursing facility	354.17 (10.1)	3913.15 (33.4)	403.37 (11.0)	374.73 (11.1)
Emergency department	144.93 (4.1)	316.62 (2.7)	151.14 (4.1)	148.94 (4.4)
Specialist visits	257.25 (7.4)	370.48 (3.2)	247.44 (6.8)	223.04 (6.6)
Nonurgent health transport	48.05 (1.4)	189.05 (1.6)	66.98 (1.8)	56.08 (1.7)
Rehabilitation	23.15 (0.7)	224.38 (1.9)	43.75 (1.2)	32.49 (1.0)
Pharmacy	1043.81 (29.9)	1121.67 (9.6)	1041.75 (28.5)	971.79 (28.9)
Other	221.72 (6.3)	203.27 (1.7)	183.82 (5.0)	175.30 (5.2)
Total	3495.83	11,721.06	3651.03	3366.32

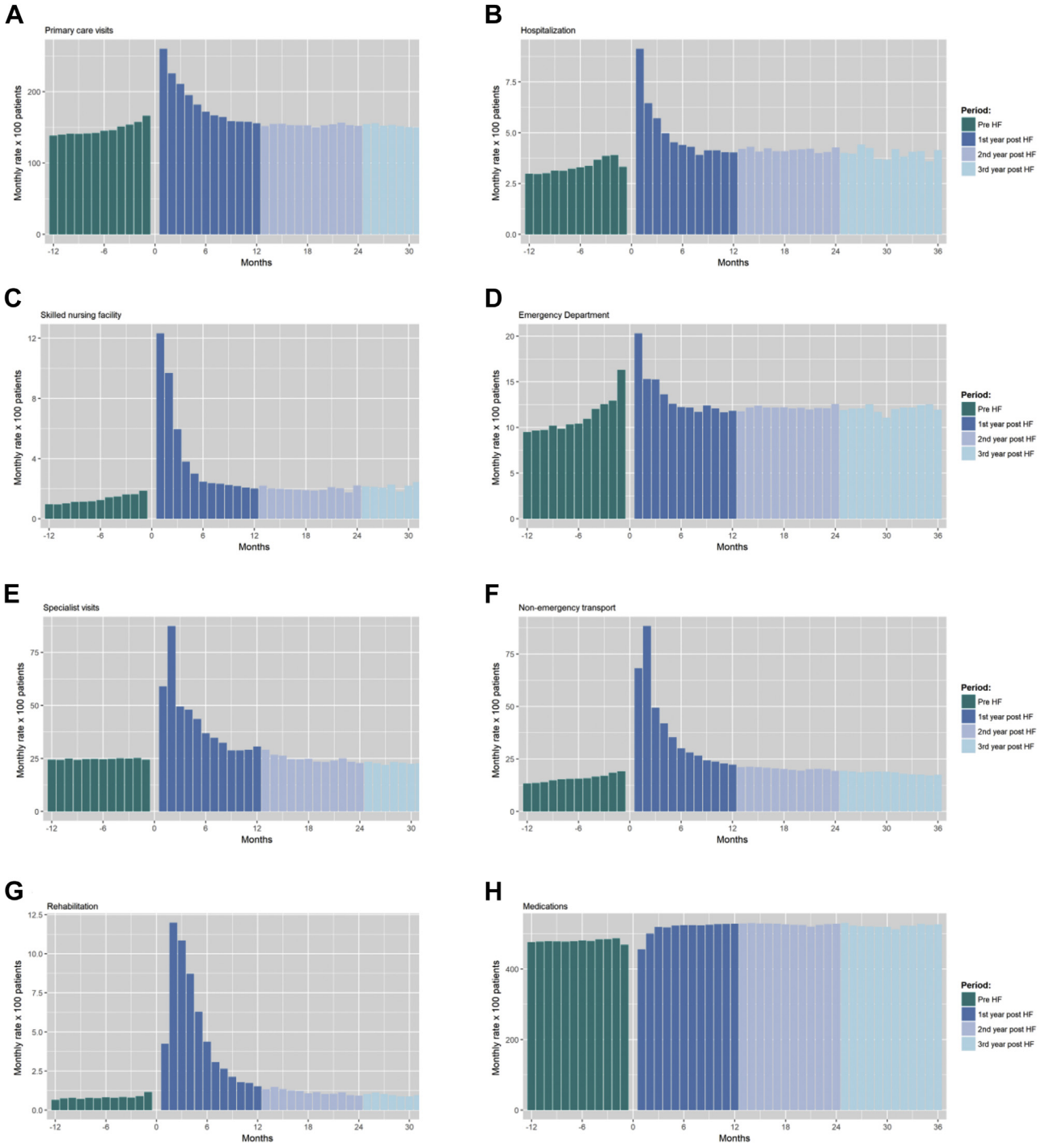

Fig. 1. Use of healthcare resources per patient in each category, corresponding to the year preceding the HF (green) and the years following the index admission (dark to pale blue for the 1st, 2nd, and 3rd years after the index admission, respectively). (A) Primary care visits. (B) Hospitalization. (C) Nurse skilled facility. (D) Visits to emergency department. (E) Specialist visits. (F) Nonurgent health transport. (G) Rehabilitation. (H) Medicines (pharmacy).

admission. At time 0, where only 2 categories were considered (living at home or living in a nursing home), 83.4% of patients were living at home. After the initial drop of this percentage due to the index hospitalization, the percentage of patients living at home progressively increased, reaching a maximum of 56.8% 23 weeks after the index admission. Subsequently, this percentage declined progressively as the percentage of dead patients increased. The percentage of patients staying in a skilled nursing facility dramatically increased immediately after the index hospitalization and decreased rapidly during the first few months. Finally, the percentage of patients staying in a nursing home experienced a slight initial decline but remained almost constant throughout the 3-year period after HF. Three years after the index admission, 44.9% of the patients had died, 39.7% were living at home, 14.2% were living in a nursing home, 0.9% were in a skilled nursing facility, and 0.3% were in hospital.

Discussion

In this retrospective analysis of a total cohort population, we found that patient expenditures within the first year following an HF were 3

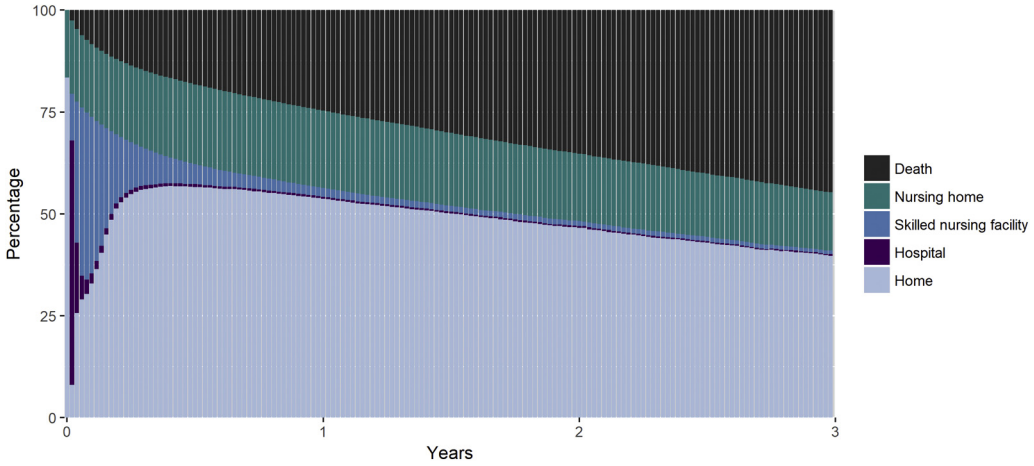

Fig. 2. Progression in patient status after experiencing the HF. Patient status was estimated in 7-day periods (Selwood analysis). At time 0, patients were assigned to either living at home or in a nursing home.

times greater than those of the year preceding the HF. Although pharmacy was the leading expenditure before HF, hospitalization and admission in a skilled nursing facility overrode all expenditures in the year following HF. The total expenditure of each patient stabilized between 6 and 7 months after the index admission, but the contribution of hospitalization and skilled nursing facility to the total expenditure persisted higher than preinjury throughout the 3 years following HF. The monthly expenditures related to hospitalization, primary care, and visits to the emergency department increased notably within the few months preceding the index hospitalization.

Our expenditure picture during the first year after HF is in line with that depicted by other authors who have persistently identified index hospitalization as the leading expenditure, irrespective of the health care model.[7,12,13] It is worth mentioning that in the last few years, our local health care system has implemented an intermediate care model based on skilled nursing facilities. This resource is aimed to avoid unnecessary extensions of hospital stay while warranting a safe return home, based not only on the patient's clinical status but also on his or her social and family environment.[14] Depending on the patient's profile, skilled nursing facilities may be eventually used as an alternative to acute hospitalization.[15] Hence, if we consider the admission in these facilities an extension of hospital stay, the total inpatient expenditures during the first year would account for 73.8%, close to the average 79.6% reported in a pooled analysis of HF expenditures.[7]

Despite the lack of data on patients' clinical status over time, the use of health care resources can be used as an indicator of the average health status and complexity of HF patients. In this regard, the persistently higher contribution of hospitalization and skilled nursing facility to the expenses in the 3 years following the index admission suggests a failure in restoring the preinjury status of HF patients. Conversely, the expenditure associated with outpatient resources such as pharmacy, primary care, and specialist visits represented a smaller percentage of the total cost in the second and third years, compared with the preinjury values. Of note, patient mortality rate 3 years after HF was 45%, which suggests that patients with complications (who were more likely to increase health care expenditures) did not reach the second and third year of follow-up.

Another remarkable finding regarding the use of healthcare resources was the increase of visits to the emergency department and—to a lesser extent—primary care and hospitalization within the few months preceding the HF. This observation supports the syndrome-based approach proposed by other authors to explain HF.[16] Similarly to the cardiovascular paradigm, in which cardiovascular events are considered an outcome of the metabolic syndrome, this new framework proposes HF as a consequence of various conditions apart from osteoporosis, such as sarcopenia, frailty, diabetes, obesity, malnutrition, and dementia. Although an analysis of the specific causes of hospitalizations and visits to the emergency department was beyond the scope of our study, the increased frequency of these events before HF might be reasonably attributed to an increasing clinical complexity preceding the HF.

Our results are strengthened by the total cohort approach (the percentage of patients treated out of the public health care system is residual; hence, our cohort captured nearly all HF cases occurring within the analyzed period). Furthermore, compared with other studies describing health care expenditures associated with HF, our analysis provides a comprehensive view of resource use and includes data from 12 months before the HF to 36 months after it. Finally, the CHSS data set is subjected to periodical audits, which guarantees the accuracy of expenditure data. On the other hand, we understand that our results may not fully reflect the scenario of HF patients in other countries because of the heterogeneity of health care systems and resources. Furthermore, the use of administrative data sets has some limitations. First, unlike clinical trials, in which committed investigators are responsible for data entering, the reliability of our data depends on the accuracy of hundreds of physicians acting as data collectors in their routine practice. Second, being a retrospective study, our analyses were bounded by predefined variables included in the CatSalut surveillance system, thus preventing the investigation of other variables that could contribute to dissect the expenditures associated with HF management. Importantly, the data set lacked data regarding the health care expenditure of patients institutionalized in nursing homes, which accounted for 26% of all patients alive 3 years after HF. Finally, our study provides average outcomes, thus losing sight of the individual paths of HF patients, which may not always follow the same trend. In this regard, the analysis of subgroups would provide more insights on the use of health care resources based on each patient's profile.

Conclusions

In summary, we can conclude that despite the posthospital rehabilitation and recovery, HF patients fail to restore the preinjury use of healthcare resources, which suggests that HF leaves a permanent footprint in the patient's expenditures, which may in turn reflect a persistent decline in his or her health status. Irrespective of the expenditures associated with HF per se, the remarkable increase in the frequency of hospitalization, primary care visits, and visits to the emergency department within the few months preceding hospital

admission supports the idea that HF is an ultimate consequence of a specific clinical picture characterized by osteoporosis, sarcopenia, and frailty.

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