

# Incidence and costs of hip fractures vs strokes and acute myocardial infarction in Italy: comparative analysis based on national hospitalization records

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**Objectives:** As osteoporotic fractures are becoming a major health care problem in countries characterized by an increasing number of older adults, in this study we aimed to compare the incidence and costs of hip fragility fractures in Italian elderly people versus those of major cardiovascular diseases (strokes and acute myocardial infarctions [AMI]) occurring in the whole adult population.

**Methods:** We analyzed hospitalization records maintained at the national level by the Italian Ministry of Health for the diagnosis of hip fractures (ICD-9-CM codes 820–821), AMI (code 410), hemorrhagic (codes 430, 431, 432) and ischemic strokes (codes 433–434), and TIA (code 435) between 2001–2005. Cost analyses were based on diagnosis-related groups.

**Results:** The incidence of hip fractures in elderly people has increased (+12.9% between 2001 and 2005), as well as that of AMI (+20.2%) and strokes (hemorrhagic: +9.6%; ischemic: +14.7%) occurring in the whole adult population; conversely, hospitalization due to TIA decreased by a rate of 13.6% between 2001 and 2005. In 2005, the hospital costs across the national health care system that were associated with hip fragility fractures in the elderly were comparable to those of strokes (both hemorrhagic and ischemic), which occurred in the whole Italian adult population. Moreover, these costs were higher than those generated by AMI and TIA. Rehabilitation costs following strokes reached about 3 billion Euros in 2005, but rehabilitative costs of hip fractures and AMI were comparable (about 530 million Euros in 2005).

**Conclusion:** The burden of hip fragility fractures in Italy is comparable to that of AMI and strokes.

**Keywords:** hip fractures, strokes, acute myocardial infarction, incidence, hospital costs, rehabilitation costs

## Introduction

Demographic trends from the last 50 years have indicated an increased life expectancy in developed countries. Among those countries, Italy has one of the highest life expectancies, which has increased up to 77.9 years for men and 87.4 years for women in 2010.<sup>1–3</sup> For these reasons, Italy represents an interesting international case study about the effects of aging on chronic, degenerative illnesses such as hip fractures, cardiovascular diseases (CVD), and cerebrovascular accidents (CVA), which currently pose major health care challenges in many countries. Both acute myocardial infarctions (AMI) and strokes are known to be a relevant cause of morbidity, mortality, and disability, with their incidence progressively increasing in the oldest age groups.<sup>4–16</sup> CVD are the primary causes of morbidity and mortality in Italy,<sup>2</sup> with AMI representing a leading cause of hospitalizations and health care costs, as shown by our previous research.<sup>17</sup>

CVA, including transient ischemic attacks (TIA), as well as ischemic and hemorrhagic strokes, represent the second most prevalent causes of mortality worldwide,<sup>4,5</sup> and are considered to be the main cause of disability in the elderly.<sup>6–8</sup> One-third of patients experiencing a stroke show high levels of disability after 1 year.<sup>9,10</sup> About 7%–12% of patients who experienced a previous TIA will experience an ischemic stroke within 1 year (with an additional 4%–7% of patients experiencing strokes after 5 years from the initial TIA).<sup>10,18</sup> AMI and strokes are associated with a 15%–25%<sup>11–16</sup> and 30%–60%<sup>9</sup> 1-year mortality rate, respectively. The risk of recurrence is remarkable for strokes.<sup>9</sup> The Italian Longitudinal Study on Aging (ILSA) has estimated an annual incidence of 196,000 strokes, of which 20% represent relapsing episodes.<sup>19</sup>

On the other hand, hip fractures in the elderly Italian population are progressively increasing, with a 15%–25% 1-year mortality rate,<sup>20,21</sup> and a high risk of disability.<sup>22–25</sup> In Italy, about 18,000 elderly people per year become completely disabled as a consequence of hip fractures.<sup>2</sup> For these reasons, the World Health Organization considers osteoporosis and osteoporotic fractures to be as critical a health problem as AMI and strokes.<sup>3</sup> In our previous research, we have shown how the incidence and costs of hip fractures are comparable to those of AMI.<sup>26</sup> As osteoporotic fractures are becoming a major health care problem in countries characterized by an increasing number of older adults, in this study we aimed to compare the incidence and costs of hip fragility fractures suffered by elderly people in Italy versus major cardiovascular events (strokes and AMI) occurring in the whole adult population.

## Materials and methods

### Hospitalizations

Information concerning all hospitalizations that have occurred in Italy is registered in hospital discharge records maintained at the Italian Ministry of Health. This information is anonymous and includes patients' age, diagnosis, procedures performed, and length of hospital stay. In the present study we have analyzed the number of hospitalizations occurring in Italy because of hip fractures, AMI, and strokes, considering also the direct costs related to hospitalization and rehabilitation. As these were observational analyses of anonymous numerical data, no approval from an ethical committee was required.<sup>27</sup> We focused on the hospitalization data available for consultations, which corresponded with the period from 2001 to 2005.

Some data concerning hip fractures and AMI partially overlapped with those presented in our previous studies

about these topics (from the years 2001 to 2005, both for hip fractures and AMI), with the number of hospitalizations and their associated costs being consistent with some previously published figures.<sup>17,28–30</sup> Hip fractures were defined by the following ICD-9-CM diagnosis codes for major diagnosis: 820.0–820.1 (femoral neck fractures); 820.2–820.3 (pertrochanteric femoral fractures); and 820.8, 820.9, and 821.1 (other femoral fractures). Given that we intended to assess the burden of femoral fragility fractures, we excluded patients aged 45 to 64 from the analysis of hip fractures, which represented no more than 8% of all hip fractures. Strokes were defined by ICD-9-CM diagnosis codes 430, 431, 432 (hemorrhagic strokes); 433 and 434 (ischemic strokes); and 435 (TIA). AMI was defined by the ICD-9-CM diagnosis code 410 (all extensions). We have only included patients with a primary diagnosis of AMI.

Population data were obtained from the Italian Institute for Statistics for 2001–2005.<sup>1</sup> All data were stratified by sex and age groups (45–64, 65–74, and  $\geq 75$  years; in the analysis of hip fractures, the youngest age group was not included as these fractures were not likely to be a consequence of osteoporosis), and were processed by using Stata (StataCorp, College Station, TX) and Excel (Microsoft Corporation, Redmond, WA) software programs. Descriptive statistical analyses were performed in order to calculate the incidence of each condition in each sex and age subgroup across the 5 examined years.

### Cost analyses

The analysis of direct costs was based on diagnosis-related groups (DRGs), which were considered to be a proxy for computing hospitalization costs. Ministerial Decree DM 549/1997 defined the national DRG rate list that was adopted during the 5 years examined in our study. Italian regions are allowed to reduce these rates locally, by an average rate of 15%. For this reason, in our analysis we used the 1997 DRG rates reduced by 15%, in order to be more conservative.

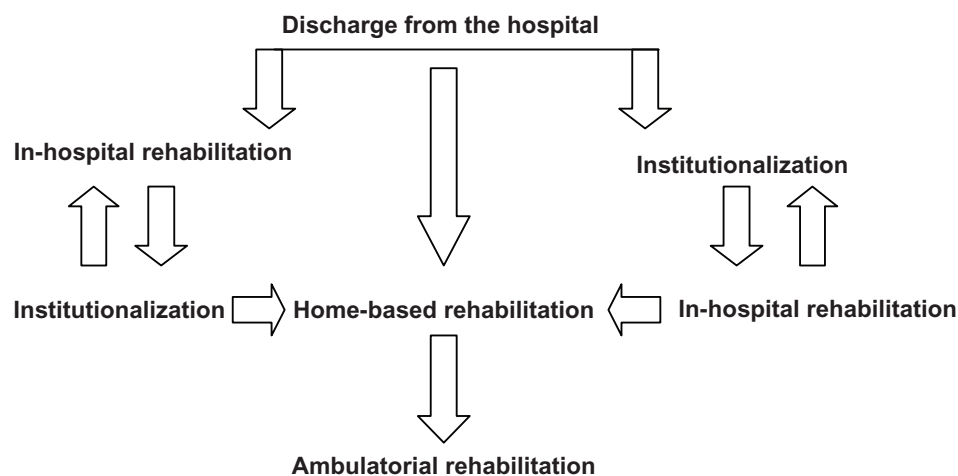
As was the case in our previous research,<sup>26,28–30</sup> the DRGs that were considered relevant to hip fractures were: 209 (surgical procedures on major joints and hip replacement), 210–211 (hip and femur surgery), and 235–236 (hip, femur or pelvis fractures). Since not all patients that were assigned these DRGs had a main diagnosis of hip fracture (actually, osteoarthritis accounts for a substantial number of hip replacements), only 30% of costs ascribed to DRG 209 and 80% of costs ascribed to DRGs 210, 211, plus 100% of costs ascribed to DRGs 235 and 236 were attributable to a main diagnosis of hip fracture.<sup>26,28–30</sup> We considered these rates to represent the weight of hip fracture-related costs

for each DRG, based on national estimations provided by the Ministry of Health, which were confirmed by specific analyses performed on the whole hospitalization database from the Tuscany region (about 4 million inhabitants), and on those of the Local Health Authorities of Lecce (about 1 million inhabitants).<sup>26,28–30</sup> As was the case in our previous studies, we also included rehabilitation costs following hip fractures in the analysis, assuming a 5% acute mortality rate.<sup>26,28–30</sup> Detailed figures of the rehabilitation path following hip fractures have been published previously in separate articles and are summarized in Figure 1.<sup>26,30</sup>

Cost analysis concerning strokes was based on DRG 14 (hemorrhagic and ischemic strokes) and DRG 15 (TIA). We have also provided an estimation of the rehabilitation costs following strokes; actually, patients experiencing a stroke may be treated as an inpatient or outpatient in order to perform specific rehabilitative interventions. According to the ministerial guidelines for rehabilitative interventions approved on May 7, 1998, patients with stroke undergo intensive rehabilitation (in hospital settings or while institutionalized immediately after hospital discharge) for the recovery of major disabilities, and require at least 3 hours of specific exercises per day for a maximum of 60 consecutive days, including both in-hospital and day hospital rehabilitative programs (code number 56, rate fixed at 250 Euros per day). Patients who complete intensive rehabilitation usually start a 6-month ambulatorial or home-based rehabilitation program in order to recover residual disabilities or to preserve their achieved progress (this corresponds to a cost of 80 Euros per day for 180 consecutive days, according to the Ministerial Decree DM May 7, 1998).

To be conservative, we assumed that only one out of five patients do not perform in-hospital intensive rehabilitation because an ambulatorial or home-based rehabilitative program for 180 days usually begins immediately (at a rate of 80 Euros per day). We have not excluded readmissions of the same patients from our analysis because – as is the case of relapsing stroke – the path of rehabilitation is repeated as described above. Conversely, when computing rehabilitation costs, we have excluded patients with TIA because these kinds of CVAs are defined as events that do not result in residual disability, and therefore they do not need rehabilitative interventions. At the same time, we have taken into account an average 20% overall acute mortality rate following stroke (patients who have not started rehabilitative programs), as reported by the ILSA.<sup>19</sup>

As we did in our previous studies when we computed direct costs due to AMI,<sup>17,26</sup> we have included DRG 121 (CVD with AMI and cardiovascular complications, patient alive), DRG 122 (CVD with AMI without cardiovascular complications, patient alive), and DRG 123 (CVD with AMI leading to death). We also included DRGs used for surgical procedures performed following AMI (bypass and angioplasties) on the basis of regional estimations from the Lazio region, and from the Local Health Authorities of Lecce in Southern Italy, as in our previous studies.<sup>17,26</sup> These analyses showed that 1% of surgical DRG 107 (coronary bypass) and 15% of surgical DRG 112 (angioplasty) were attributable to a main diagnosis of AMI, whereas the majority of coronary bypasses and angioplasties were matched with other ICD-9-CM diagnosis codes, but not with AMI.<sup>17,26</sup> Hospitalization costs were evaluated for all patients ( $\geq 45$  years of age), as well as for elderly



**Figure 1** Rehabilitative path of hip-fractured patients.

patients separately ( $\geq 75$  years old). We also computed the costs associated with postoperative rehabilitation following AMI, while examining the rate fixed by the Italian Rehabilitation Guidelines for intensive rehabilitation (rate classified as code n.56; ie, 250 Euros per day). According to the Italian Ministry of Health guidelines for rehabilitative activities published on May 7, 1998, the average length of rehabilitation is 21 days, including both inpatient and outpatient, or home-based rehabilitative programs. We computed only rehabilitation costs for 85% of the patients, assuming a 15% acute mortality rate following AMI.<sup>11–16</sup>

## Results

As shown in Table 1, a total of 85,762 hospitalizations due to hip fractures (17,597 men and 66,674 women) were recorded in 2005 for people  $\geq 65$  years old (+12.9% compared to 2001). As summarized in Table 1, the majority of hospitalizations due to hip fractures occurred in patients  $\geq 75$  years old ( $n = 72,072$ ; 15,285 men and 56,787 women; +13.6% compared to 2001), particularly among women of this age group ( $n = 56,787$ ; +12.2% compared to 2001). Hospitalizations due to hip fractures in men  $\geq 75$  years old ( $n = 15,285$ ) increased by a rate of 19.0% from 2001, thus representing the highest increase observed in the subgroup analyses. Patients  $\geq 85$  years old ( $n = 29,308$ ; 5661 men and 23,647 women) accounted for 37% of overall fractures among members of the population  $\geq 65$  years old (data not presented). As shown in Table 2, hospital costs were 467 million Euros in 2005 (+25.2% compared to 2001), with rehabilitation costs reaching 532 million Euros in the same year (+27.0% compared to 2001). Pooling all data together, hospitalizations due to hip fractures in the elderly resulted in expenditures of approximately 6.8 billion Euros over the 5-year period (including both hospital and rehabilitation costs).

The total hospitalizations for hemorrhagic and ischemic strokes (including TIA) were 187,883 in 2005 (97,941 men and 89,942 women), with a general increase of 5.1% when compared to 2001 ( $n = 178,703$ ; men: 92,451; women: 86,252). This observed increase was due to a +19.4% rise in the number

of ischemic and hemorrhagic strokes experienced by people  $\geq 75$  years old (12,198 additional hospital admissions in this age group occurred between 2001 and 2005). The total number of hospital admissions following hemorrhagic strokes was 30,263 in 2005 (men: 15,760; women: 14,503) and 27,613 in 2001 (men: 14,261; women: 13,352), showing a +9.6% increase over the 5-year period (Table 3). As shown in Table 3, the number of hospitalizations due to ischemic strokes and TIA was 109,707 (men: 59,065; women: 50,642), plus 47,913 (men: 23,116; women: 24,797) in 2005, and 95,613 (men: 51,614; women: 42,999) plus 55,477 (men: 26,576; women: 28,901) in 2001, respectively. Thus, while ischemic strokes increased by a rate of +14.7%, the number of hospitalizations that occurred as a result of TIA showed a –13.6% reduction over the 5-year period.

When looking at the data by age group, the number of hospital admissions following TIA decreased in both younger and older patients, while there was a significant increase in patients over 75 years old with respect to both hemorrhagic and ischemic strokes. In 2005, the last year examined, among the subgroup of patients aged 45–64 years old, 20,589 men and 11,121 women (total: 31,710) were hospitalized following hemorrhagic or ischemic strokes (including TIA). In people aged 65–74, 31,988 hospital admissions among men and 20,640 hospitalizations among women were registered (total: 52,628), while in the oldest group ( $\geq 75$ ) we recorded 45,364 and 58,181 hospitalizations (total: 103,545) following strokes in men and women, respectively. Men accounted for 52% of the total hospital admissions in 2005, but women  $\geq 75$  years old were the most represented affected population. The number of men hospitalized because of both hemorrhagic and ischemic strokes (including TIA) was always higher than women in each examined year, with the only exception being patients  $> 75$  years old, where a higher number of hospital admissions among females versus males was always recorded both for hemorrhagic (8428 versus 7115 in 2005) and ischemic strokes (33,120 versus 26,498 in 2005), including TIA (16,633 versus 11,751 in 2005).

**Table 1** Number of hospitalizations due to hip fractures in the elderly Italian population ( $\geq 65$  years old) by age group and sex (Italian Ministry of Health national hospitalization records, 2001–2005)

Age group (years)	2001		2002		2003		2004		2005	
	M	F	M	F	M	F	M	F	M	F
65–74	3619	9350	3630	9689	3560	9459	3923	10,010	3803	9887
>75	12,837	50,604	13,315	52,639	14,352	53,916	14,205	54,157	15,285	56,787
Total	75,960		79,273		81,287		82,295		85,762	

**Abbreviations:** M, male; F, female.

**Table 2** Estimated direct hospital and rehabilitation costs following hip fractures occurring in people aged  $\geq 65$  years (Italy 2001–2005)

Year	Hospital costs (€)	Rehabilitation costs (€)	Total costs (€)
2001	373	419	792
2002	394	432	826
2003	433	480	913
2004	448	485	933
2005	467	532	999

**Note:** Values are expressed in million Euros.

As shown in Table 4, the overall hospitalization costs sustained for strokes in adults  $\geq 45$  years of age decreased from 658 million Euros in 2001 to 640 million Euros in 2005 ( $-2.7\%$ ), with hemorrhagic and ischemic strokes showing an average cost per patient of 3515 Euros in 2005, and TIA generating costs of 3089 Euros per patient in the same year. Hospitalization costs totaled 3.3 billion Euros over the 5-year period, with people  $\geq 75$  year old accounting for about 60% of these expenditures (1.9 billion Euros). As summarized in Table 4, rehabilitation costs following strokes were estimated between 2.6 billion Euros in 2001 and about 3 billion Euros in 2005 (an increase of  $+13.6\%$  over the 5 years), and rose from 1.3 billion Euros to 1.6 billion Euros ( $+19.3\%$  in 5 years) when only data for patients  $\geq 75$  years old were examined. Total rehabilitation costs from 2001 to 2005 were estimated to be about 14 billion Euros, with people  $\geq 75$  years old accounting for 7.4 billion Euros. When considered together, hospitalization and rehabilitation costs reached a total of 3.6 billion Euros

in 2005 alone. Rehabilitation costs per patient were estimated to be 15,733 Euros in the same year.

Table 5 presents the number of AMI cases that occurred in adults between 2001 and 2005. The total number of hospitalizations due to AMI among patients  $\geq 45$  years old were 97,913 in 2001, 106,842 in 2002, 113,315 in 2003, 116,303 in 2004, and 117,750 in 2005, showing an increase in hospitalizations of  $20.3\%$  over the 5-year period. In 2005, 75,586 men and 42,164 women were hospitalized with a primary diagnosis of AMI, with an increase of  $17.2\%$  and  $26.2\%$ , respectively, over the 5-year period. The number of patients hospitalized that were  $\geq 65$  years old constantly increased over this period, rising from 65,275 in 2001 to 82,382 in 2005, with a corresponding increase of  $26.2\%$ . In the youngest age group (45–64 years old), a total of 29,925 AMI hospitalizations in men and 6443 hospitalizations in women were recorded during 2005. In the same year, among the subgroup aged 65–74, 21,621 men and 10,145 women were hospitalized for AMI, with the number of hospitalizations among the oldest group ( $\geq 75$  years old) being 24,040 and 26,576 in men and women, respectively. The increasing rates across the 5-year period among men and women were  $9.4\%$  and  $22.0\%$  in the youngest age group,  $14.3\%$  and  $17.5\%$  in people aged 65–74, and  $31.8\%$  and  $36.3\%$  in the oldest subgroup, respectively. It should be noted that among AMI patients  $\geq 75$  years old, the number of women hospitalized was always higher than the number of men, while almost 5000 AMI hospitalizations per year involved people under 45 years old (data not shown).

**Table 3** Number of hospitalizations following hemorrhagic or ischemic strokes and transient ischemic attacks, presented by age group and sex (Italian Ministry of Health national hospitalization records, 2001–2005)

Age group (years)	2001		2002		2003		2004		2005	
	M	F	M	F	M	F	M	F	M	F
<b>Hemorrhagic strokes</b>										
45–64	4140	2921	4215	2931	3992	2776	4047	2728	4015	2729
65–74	4416	3233	4682	3292	4430	3147	4733	3346	4630	3346
>75	5705	7198	6224	7607	6450	7829	6441	7757	7115	8428
Total	27,613		28,951		28,624		29,052		30,263	
<b>Ischemic strokes</b>										
45–64	10,719	4712	11,317	5176	11,398	5050	12,032	5431	12,085	5463
65–74	19,064	11,058	19,434	11,798	19,857	11,656	20,927	12,244	20,482	12,059
>75	21,831	28,229	24,186	30,939	25,415	32,344	25,298	31,905	26,498	33,120
Total	95,613		102,850		105,720		107,837		109,707	
<b>Transient ischemic attacks</b>										
45–64	5690	3539	5394	3549	4901	3113	5038	3183	4489	2929
65–74	8060	6462	8029	6257	7367	5837	7157	5696	6876	5235
>75	12,826	18,900	12,969	18,503	12,274	17,851	11,684	16,996	11,751	16,633
Total	55,477		54,701		51,343		49,754		47,913	

**Abbreviations:** M, male; F, female.



**Table 4** Estimated hospital and rehabilitation costs following strokes (including TIA, hemorrhagic and ischemic events) in the Italian population among those aged 45–100 years old

Year	Overall adults $\geq 45$ years old				Elderly people $\geq 65$ years old			
	Hospital costs		Rehabilitation	Total costs	Hospital costs		Rehabilitation	Total costs
	Strokes	TIA	costs		Strokes	TIA	costs	
2001	486	172	2602	3260	285	94	1330	1709
2002	505	169	2783	3457	300	93	1456	1849
2003	506	159	2837	3502	306	89	1524	1919
2004	496	155	2891	3542	294	85	1508	1887
2005	492	148	2956	3596	299	84	1587	1970

**Notes:** Data concerning people aged  $> 65$  years old are also presented separately. Values are expressed in million Euros.

**Abbreviation:** TIA, transient ischemic attack.

Overall hospitalization costs incurred for AMI admissions and treatment for adults  $\geq 45$  years of age ranged between 305 million Euros in 2001 and 370 million Euros in 2005 (Table 6), with an average cost of 3142 Euros per patient in the latter year. Rehabilitation costs following AMI were estimated at between 437 million Euros in 2001 and 525 million Euros in 2005 (an increase of 20.1% over the 5-year period), which rose from 291 million Euros to 368 million Euros (+26.5%) from 2001 to 2005, when only data for patients  $\geq 65$  years old were examined.

Figure 2 shows how the incidence of hip fractures among elderly people has increased between 2001 and 2005, and how the incidence of AMI and strokes occurring across the whole adult population also increased during this time; conversely, hospitalization due to TIA has decreased. Figure 3 shows that hospital costs incurred in 2005 by the national health care system for hip fragility fractures among the elderly were comparable to those associated with strokes (both hemorrhagic and ischemic), which occurred in the whole Italian adult population. These costs were higher than the costs resulting from AMI and TIA. Furthermore, rehabilitation costs following strokes reached about 3 billion Euros in 2005, but rehabilitative costs associated with hip fractures and AMI have been found to be comparable (about 530 million Euros in 2005).

## Discussion

This is the first study conducted that aimed to compare the incidence and costs of hip fractures in the elderly with

those generated by strokes and AMI in Italy. This research is based on data from a reliable institutional database (national hospitalization records). The number of hospitalized patients with hip fractures has been presented, excluding patients who were readmitted, and specific figures have been provided regarding the oldest age groups (ie, people  $\geq 75$  and  $\geq 85$ ), where the higher prevalence of osteoporosis is acknowledged.

Our results concerning the incidence of strokes in Italy seem to be consistent with rates provided by the ILSA study group.<sup>19</sup> The number of hospitalizations following hemorrhagic and ischemic strokes per 10,000 inhabitants has increased year over year between 2001 and 2005, with this trend being remarkable in people aged 75 years and over. Breakdown by age and sex confirmed the marked increase with age and the predominance of hospitalizations in men. Conversely, the number of hospitalizations for TIA decreased consistently over the 5-year period, possibly as an effect of medical efforts in the prevention of CVAs. However, many TIAs may go unreported (such as so-called silent strokes) in community dwelling people.<sup>31</sup>

Relevant differences (mostly due to rehabilitation costs) were found between our results and those of the Economic Longitudinal Incidence-based Project for Stroke Evaluation (EcLIPSE) study, which had previously assessed an overall cost of 11,600 Euros per patient within 6 months from hospital admission following stroke.<sup>32</sup> Our findings concerning individual costs are higher, mostly due to a comprehensive

**Table 5** Number of hospitalizations following acute myocardial infarction in the Italian population aged  $\geq 45$  years old

Age group (years)	2001		2002		2003		2004		2005	
	M	F	M	F	M	F	M	F	M	F
45–64	27,359	5279	28,594	5673	29,434	5972	30,294	6400	29,925	6443
65–74	18,909	8637	20,109	9149	20,995	9543	21,476	10,080	21,621	10,145
$>75$	18,234	19,495	20,804	22,513	22,908	24,463	22,935	25,118	24,040	26,576
Total	97,913		106,842		113,315		116,303		117,750	

**Abbreviations:** M, male; F, female.

**Table 6** Total hospitalization and rehabilitation costs due to acute myocardial infarction (2001–2005) in the overall population ( $\geq 45$  years old) and among the elderly ( $\geq 65$  years old)

Year	Overall population $\geq 45$ years old			Elderly $\geq 65$ years old		
	Hospital costs	Rehabilitation costs	Total costs	Hospital costs	Rehabilitation costs	Total costs
2001	305	437	742	195	291	486
2002	310	477	787	213	324	537
2003	324	506	830	229	348	577
2004	332	519	851	234	355	589
2005	370	525	895	274	368	642

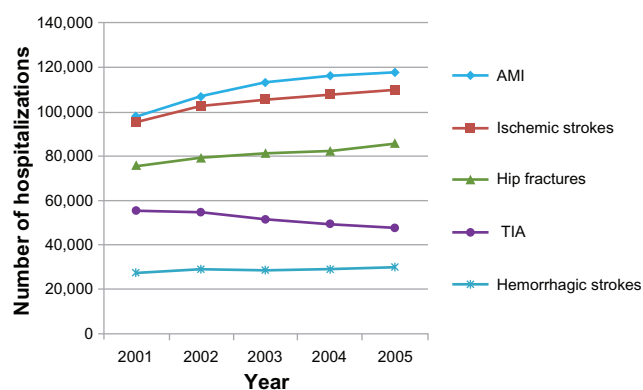
**Note:** Values are expressed in million Euros.

evaluation of the rehabilitative process followed by the patients, and because the EcLIPSE study involved only 449 patients from eleven Italian hospitals.<sup>32</sup> However, the EcLIPSE study estimated that the overall social burden of strokes in Italy costs up to 3 billion Euros per year, thus being close to the results of our analyses (3.6 billion Euros in 2005). Our estimations concerning individual costs generated by strokes in Italy (about 30,000 Euros per patient within 12 months) seem to also be consistent with findings from an international review, which considered values between 7975 USD and 54,546 USD as a reliable estimation of the annual cost per patient.<sup>33</sup> Annual health care expenditures for each patient experiencing a stroke have been computed to be 17,800 Euros by a recent French study,<sup>34</sup> while a multicenter study carried out in France, Germany, Sweden, and the UK reported a value of 9800 USD as being a minimum annual cost per patient.<sup>35</sup>

The main limitation of our study was represented by the fact that, for strokes, we were not able to detect readmissions of the same patients, although this did not influence the cost analysis. Actually, DRGs are entirely paid for if a person is hospitalized twice or more, and if the rehabilitation cycle is repeated for each CVA experienced by the patient. Another limit in this study is that rehabilitative paths followed by the patient may present with some regional differences.

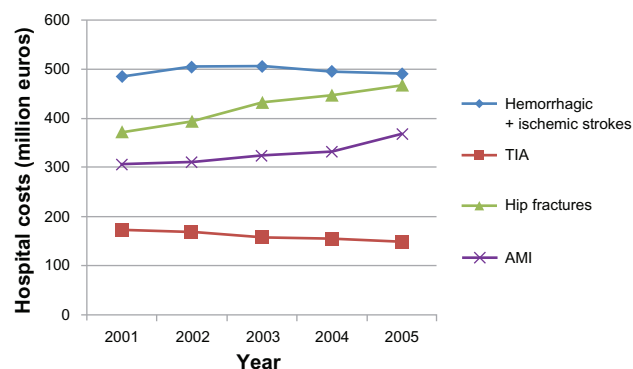
In actuality, many people do not complete 60 days of intensive rehabilitation or 180 days of ambulatorial or home-based exercises. A cycle of extensive rehabilitation (including in-hospital, nursing home, ambulatory, or home-based rehabilitative programs) may be performed for the completion of a previous intensive rehabilitative cycle, or in the case of transient or minor functional restrictions. Extensive rehabilitation requires 1–3 hours of physical therapy per day for a maximum of 120 consecutive days (corresponding to a cost of 125 Euros per day, as defined by code n.60 in the Ministerial guidelines of May 7, 1998). After these 120 days, patients may enter home-based rehabilitation programs to recover residual disabilities or to preserve any achieved progresses. On the other hand, a proportion of patients (difficult to estimate) continue intensive rehabilitation cycles for more than 2 months per year, or they can prolong their outpatient rehabilitative program for more than 6 months. These cases, as well as the financial aids granted by the government (7500 Euros per year) for individuals with permanent disabilities following strokes, have not been considered in our cost analysis.

Sudden mortality has not been considered when computing AMI incidence,<sup>11,15</sup> although this did not underestimate our cost analysis. The observed increase in the incidence of AMI may reflect the efficacy of the newly established emergency



**Figure 2** Number of hospitalizations following hip fractures in elderly people ( $>65$  years old) versus strokes (both hemorrhagic and ischemic), TIA, and AMI occurring in the whole adult population (Italy 2001–2005).

**Abbreviations:** TIA, transient ischemic attack; AMI, acute myocardial infarction.



**Figure 3** Estimated direct hospital costs following hip fractures in elderly people ( $>65$  years old) versus strokes (both hemorrhagic and ischemic), TIA, and AMI occurring in the whole adult population in Italy between 2001 and 2005.

**Abbreviations:** TIA, transient ischemic attack; AMI, acute myocardial infarction.

service (with a reduction of sudden deaths and the transfer of the same patients from a hospital to another hospital for angioplasty), but this increase could also result from the publication of new diagnostic criteria, which occurred in 2000. The very high increase of AMI cases occurring in women between 45 and 64 years old (almost double that of men in the same age group) is perhaps a consequence of new risk factors that are becoming more prevalent among younger women (ie, smoking), and highlights the need to implement preventive strategies among women in this younger age group. A complete evaluation of AMI consequences would also require the analysis of data concerning postacute phase costs (pharmacological treatments and long-term follow-up), as well as indirect costs, which represent an issue that is very difficult to assess. Some authors have suggested that these latter costs may have a high economic impact.<sup>36-40</sup>

## Conclusion

The results of our study confirm the extremely high burden of hip fractures in Italy, which is actually comparable to that of strokes and higher than that of AMI, both in terms of hospitalizations and health care expenditures.

## Disclosure

The authors report no conflicts of interest in this work. Disclosures concerning the past 5 years include: PP has received grants for consulting/speaking by Sanofi-Aventis, Amgen-Dompè, Servier, and Eli-Lilly. AM, MG, AM, AB, RG, RDB, LR, CG, FG, MLB, LM, DD, and GI have received research grants and funding for consulting/speaking by Merck, Sanofi-Aventis, Novartis, Stroder, Servier, Ely Lilly, Roche, Nicomed, and Amgen Dompè. AA, GC, CN, GM, MS, DD, MB, VM, SM, MG report no conflicts of interest.

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