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Original article**Hip Fractures after 60 Years of Age in France in 2005–2017: Nationwide Sample of Statutory-Health-Insurance Beneficiaries**

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ABSTRACT

Background: Proximal femoral fractures (PFFs) constitute a heavy medical, social, and economic burden. Overall, orthopaedic conditions vary widely in France regarding the

patients involved and treatments applied. For PFFs specifically, data are limited. Moreover, the ongoing expansion of geriatric orthopaedics holds promise for improving overall post-operative survival. The objectives of this retrospective study of a nationwide French database were: 1) to describe the pathway of patients with PFFs regarding access to care, healthcare institutions involved, and times to management; 2) and to look for associations linking these parameters to post-operative mortality.

Hypothesis: Across France, variations exist in healthcare-service availability and time to management for patients with PFFs.

Material and Methods: A retrospective analysis of data in a de-identified representative sample of statutory-health-insurance beneficiaries in France (*Échantillon Généraliste des Bénéficiaires*, EGB, containing data for 1/97 beneficiaries) was conducted. All patients older than 60 years of age who were managed for PFFs between 2005 and 2017 were included. The following data were collected for each patient: age, management method, Charlson's Comorbidity Index (CCI), home-to-hospital distance by road, and type of hospital (public, non-profit private, or for-profit private), and time to surgery were collected. The study outcomes were the incidence of PFF, mortality during the first post-operative year, changes in mortality between 2005 and 2017, and prognostic factors.

Results: In total 8026 fractures were included. The 7561 patients had a median age of 83.8 years and a mean CCI of 4.6; both parameters increased steadily over time, by 0.18 years and 0.06 points per year, respectively ($p < 10^{-4}$ for both comparisons). Management was by total hip replacement in 3299 cases and internal fixation in 4262 cases; this information was not available for 465 fractures. The overall incidence increased from 90/100 000 in 2008 to 116/100 000 in 2017 ($p=0.03$). Of the 8026 fractures, 5865 (73.1%) were managed in public hospitals (and this proportion increased significantly over time), 1629 (20.3%) in non-profit private hospitals (decrease over time), and 264 (3.3%) in for-profit private hospitals. The

home-to-hospital distance ranged from 7.5 to 38.5 km and increased over time by 0.26 km/year (95% confidence interval [95%CI]: 0.15–0.38)($p < 10^{-4}$). Median time to surgery was 1 day [1–3 days], with no significant difference across hospital types. Mortality rates at 90 days and 1 year were 10.5% (843/8026) and 20.8% (1673/8026), respectively. Two factors were significantly associated with day-90 mortality: the CCI (hazard ratio [HR], 1.087 (95%CI: 1.07–1.10)($p < 10^{-4}$)) and time to surgery > 1 day (HR 1.35 (95%CI: 1.15–1.50) ($p < 0.0001$)). Day-90 mortality decreased significantly from 2005 to 2017 (HR 0.95 (95%CI: 0.92–0.97)($p < 10^{-4}$)), with no centre effect.

Conclusion: The management of PFF in patients older than 60 varied widely across France. Time to surgery longer than 1 day was a major adverse prognostic factor whose effects persisted throughout the first year. This factor was present in over half the patients. Day-90 mortality decreased significantly from 2005 to 2017 despite increases in age and comorbidities.

Level of evidence: IV, retrospective cohort study

Key words: Proximal femoral fractures; Osteoporotic fractures; Epidemiology; Healthcare organization

1. Introduction

Proximal femoral fractures (PFFs) are a major public health issue, for several reasons. First, they are common, with about 80 000 cases annually in France, and their incidence is increasing further due to the ageing of the population [1–3]. Second, PFFs occur chiefly in older individuals, many of whom have multiple comorbidities or frailty factors [4–6], leading to high frequencies of both medical and surgical complications at the time of the fracture and over a long period after the surgical treatment. A PFF is a life-changing event that can hasten death or impair self-sufficiency. Dependency then places a medical, social, economical, and psychological burden on the patient and family [2,7–9].

PPFs are associated with an increase in mortality that extends over several years after the event [10].

Published studies have documented considerable variability in the management of PPF, both across [11–13] and within countries. One point of variability is time to surgery [4,5], which has been recognised as a key prognostic factor. A recent study done in France found that time to surgery exceeded 48 h for 6.3% of all traumatic injuries [14], and another study indicated that surgery was best performed within the first 24 h [15]. PPF is a major burden for which a specific study of management throughout France is therefore in order. Importantly, time to surgery is amenable to modification. Another point of variability is the distribution of patients between public and private hospitals [13,16], as documented by a French nationwide 2022 report on a broad spectrum of orthopaedic procedures [17]. Potential effects of this source of variability on mortality are unknown. Healthcare organisation in France was modified by two major reforms during the last two decades. The first introduced a price-per-procedure funding system [18] and the second connected healthcare institutions into local then larger co-operative clusters (starting in 2009) to achieve efficiency savings [19]. This last reform probably changed the map of available forms of care in each geographic region. The impact of these reforms on the management of PPF is unknown. Finally, the strong development of geriatric orthopaedic units over the last decade is expected to decrease mortality over time [20–22].

France has a nationwide healthcare database that is the only one of its kind in the world (*Système National des Données de Santé*, SNDS) [23]. The statutory health insurance system covers nearly all residents, and the SNDS database was initially intended for administrative and economic purposes. The introduction of the price-per-procedure reform, however, has converted the SNDS to a powerful clinical research tool [24]. Moreover, since

2005, de-identified data from a sample of 1/97 healthcare insurance beneficiaries are entered into a specific database (*Échantillon Généraliste des Bénéficiaires*, EGB).

The objectives of this retrospective study of a nationwide French database were: 1) to describe the care pathway of patients with PFFs regarding access to care, healthcare institutions involved, and times to management; 2) and to look for associations linking these parameters to post-operative mortality. The working hypothesis was that, across France, variations existed in healthcare-service availability and time to management for patients with PFFs.

2. Material and methods

2.1 Study design and source of data

A retrospective study was conducted in all patients who had surgery for PFF after 60 years of age and were registered in the EGB. The SNDS, from which the EGB is derived, coalesces several administrative databases including the national health insurance database (Système National d'Information Inter-Régimes de l'Assurance Maladie, SNIIRAM), the healthcare informatics system (*Programme de Médicalisation des Systèmes d'Information*, PMSI), and the causes-of-death database (*Centre d'épidémiologie des causes de décès*).

The EGB contains healthcare data for a representative sample of 1/97th of all statutory health insurance beneficiaries. For each patient, the data are collected along the healthcare pathway, over a long period, for services obtained both in the community and in healthcare institutions. The EGB is thus an excellent tool for studying healthcare service utilisation and costs for each beneficiary and each type of care, as well as changes in these parameters over time. A preliminary study demonstrated that the EGB sample was representative of the French population in terms of age, sex, and place of residence [25]. The earliest data were entered into the EGB in 2003. Data for patients who die are kept in

the database, with no further modifications. Initially, only data for salaried workers were entered into the EGB but, over time, individuals with most of the other income profiles were included. Thus, in 2016, the sample was drawn from 95.6% of health insurance beneficiaries. The total number of individuals with data in the EGB is known for each year.

2.2 Population

Inclusion criteria were age older than 60 years at admission and surgery for PFF between January 2005 and December 2017. Patients were identified based on a main diagnosis code containing S72 and a procedure code present in an exhaustive list consistent with the management of PFF (Appendix). The codes used were those assigned by each orthopaedic surgery department. The use of two codes for each patient minimised the risk of classification error due to mistakes in the code assigned before orthopaedic-surgery department admission (e.g., pelvic fracture coded as a PFF at the emergency department). Thus, only patients who had had surgery for PFF were included.

2.3 Data collection

The following demographic data were recorded: age at admission, sex, and place of residence. Diagnoses other than PFF were collected for each admission. The Charlson's Comorbidity Index (CCI) [26] was determined using the *icd* package of the R programme (R Studio 4.2.1, R Core Team 2021, Vienna, Austria). Among other diagnoses, those of interest were flagged. Discharge modalities were recorded as discharge home or to an institution, transfer to another healthcare department, or death in the hospital. The number of patients with PFF on both sides was estimated by identifying patients with two recordings of PFF and PFF management, during two different hospital admissions.

The following time data were collected: date of first admission to the hospital where PFF surgery was performed, hospital stay length, time to surgery and, for patients who died before January 2018, date of death.

The geographic data were the main place of residence of the patient and the location of the healthcare institution where PFF management was provided (determined based on the FINESS code of geographic location of healthcare institutions in France). The list of French healthcare institutions was downloaded from the official site (www.data.gouv.fr) and used to determine the physical address of each institution. The official address site (www.adresse.data.gouv.fr) then provided the GPS coordinates for each place of residence and each healthcare institution. The PMSI database contains the geographic code of residence, with is extrapolated from the postal code. The *mapdist* application in the *ggmap* package in R [27] served to compute the distance by road, in km, between the place of residence and healthcare institution for each admission, as well as the duration of the trip by motor vehicle, in minutes.

Data characterising each healthcare institution were obtained from the site for nationwide, annual, healthcare institution statistics (*Statistique Annuelle des Etablissements de Santé*, SAE, www.sae-diffusion.sante.gouv.fr). By matching these data to the FINESS code, the following were obtained: type of healthcare institution classified as public, non-profit private, and for-profit private; the size of the institution with the number of beds; and the case load defined as the number of treated PFFs.

2.4 Outcome measures

The incidence of PFFs was estimated for each year between 2008 and 2017 by dividing the number of PFFs by the total number of beneficiaries entered into the EGB during the relevant year. The incidence for patients older than 60 years and the incidences for males and females were also computed. The results are reported as the incidence rates per 100 000 individuals.

Mortality was determined at 90 days, 6 months, and 1 year after surgery. Changes in day-90 mortality over the 13-year period from 2005 to 2017 were sought.

2.5 Bias, missing data

Outlying values were identified during the descriptive analysis. For instance, some patients whose place of residence was given as in the overseas French territories had surgery in continental France, producing irrelevant home-to-hospital distances; other patients had three PFF codes for three different admissions. These outliers were identified and the relevant data deleted during the analyses of these variables. The longest acceptable home-to-hospital distance was defined as the value that resulted in inclusion of 98% of the patients.

Missing data for individual patients regarding the variables extracted from the EGB occurred only for time to surgery, for which 10% of patients had no recorded value. For the SAE database, the number of beds was not always available. Missing data were ignored for the descriptive statistics and survival analysis. Nonetheless, a sensitivity analysis was done using multiple stochastic imputation of missing data.

2.6 Statistical methods

Quantitative variables were described as mean and median [25th–75th quartiles] and categorical variables as n (%). Comparisons were by univariate analyses using generalised linear regression.

Random geographic department and centre effects were tested using mixed models, since these variables related to clusters of data for several patients. For instance, time to surgery might increase or decrease over time, but these changes might be more marked in some geographic areas than in others.

Day-90 survival was evaluated using the Kaplan-Meier method.

Potential associations of variables with day-90 mortality were assessed using the log-rank test. Variables associated with p values <0.2 were entered into a multivariate Cox model. The period (2005–2017) was to be forced into the multivariate model even in the absence of a significant association by log-rank testing. The sensitivity analysis with

imputation of missing data was done using the *mice* package in R [28]; this produced 50 datasets corresponding to 50 alternative scenarios for missing data. Cox regression analysis was then applied to these 50 datasets, and the results (coefficients and p values) were coalesced. The findings were deemed robust if the coefficients and p values were similar between the complete-case analysis (with the missing data disregarded) and the imputation analysis.

The alpha risk was set at 0.05.

All EGB data are fully de-identified and are handled according to stringent rules. The French national institute for healthcare statistics and research (*Institut National de Statistiques et de Recherche Médicale*, INSERM) has continuous access to the EGB. However, this access is subject to regulations and is closely monitored. In compliance with French law on studies of de-identified healthcare data, ethics committee approval at the individual level was not required for this work.

3. Results

3.1 Patients and comorbidities

The study included 8026 PFFs in 7756 patients, 1786/8026 (22.3%) in males and 5970/8026 (77.7%) in females. Median age at admission was 83.8 [Q1: 78– Q3: 89] years (range, 60–108 years) (Table 1). Age increased over time by a mean of 0.18 years per year ($p < 10^{-4}$) (Figure 1). Of the 8026 fractures, 694 (8.6%) occurred in patients with two PFFs during two different admissions. Median CCI was 4 [4– 6]. The CCI increased steadily over time, by a mean of 0.06 points per year (95%CI: 0.04–0.07)($p < 10^{-4}$) (Figure 1). The mean and median CCI increased from 4.3 and 4 [3–4] in 2005 to 5.0 and 4 [4–6] in 2017. Removing the impact of age on the CCI did not change the increase over time ($p < 10^{-4}$). The CCI was lower by a mean of 0.29 points in private vs. public hospitals (95%CI: -0.42 to -

0.16)($p < 10^{-4}$). The most common comorbidity was dementia, present for 1889/8026 (23.5%) fractures, followed by heart disease (798/8026, 10%).

3.2 Incidence rates

Overall, the PFF incidence rate increased from 90/100 000 in 2008 to 116/100 000 in 2017. The mean increase over time was 3 cases/year/100 000 ($p = 0.03$). The mean incidence rate in patients older than 60 years was 473/100 000 overall, 664/100 000 in females, and 260/100 000 in males. In this age group, although the incidence did not increase significantly over time ($p = 0.3$), trends towards increases of 8/year/100 000 in females and 1.6/year/100 000 in males were found (Figure 2).

3.3 Types of hospitals that managed PFFs

Overall, of the 8026 PFFs, 5865 (73.1%) were managed in public hospitals, 1628 (20.3%) in non-profit private hospitals, and 262 (3.3%) in for-profit private hospitals. The distribution across these three categories changed significantly between 2005 and 2017 ($p = 0.0006$): the proportion of PFFs managed in public hospitals increased (from 2451/3481 [70%] before 2011 to 3414/4545 [75%] after 2011), while the proportions decreased in non-profit private hospitals (from 784/3481 [22%] before 2011 to 844/4545 [18%] after 2011). The change in distribution varied significantly across departments ($p < 10^{-4}$) with, for instance, over 15% of PFFs managed in private hospitals in five French territory departments (#23, #33, #69, #92, and # 94).

After deletion of outliers, the mean home-to-hospital distance was less than 150 km for 98% of PFFs and the median distance was 14 [5.9–27.6] km with a median travel time of 22.6 [11.9–29.4] minutes. The median distance was shorter by 8.11 km (95% CI: -10.4 to -5.8)($p < 10^{-4}$) for patients going to for-profit private vs. public hospitals and by 4.33 km (95% CI: -5.3 to -3.3)($p < 10^{-4}$) for non-profit vs. public hospitals. The mean distance increased over time by 0.26 km/year (95% CI: 0.15–0.38)($p < 10^{-4}$) (Figure 3). Distance

varied significantly across hospital categories and across departments ($p < 10^{-4}$) (Figure 4 and Table 1), ranging for instance from 7.5 km in department #93 to 38.5 km in department #48. The change in median distance before and after 2011 (the median of the study period) differed across departmentd (Figure 3): for example, the distance decreased by a mean of 17 km in department #77 and increased by a mean of 13 km in department #36.

When all possible sites were considered, the median number of surgery beds per hospital was 310 [63–164]. A trend was seen towards an increase in bed number over time, by a mean of 3.8/year (95%CI: -1.2 to 9.0)($p=0.06$).

3.4 Hospital stays

Median hospital stay length was 10 [8–14] days and decreased over time by a mean of 0.37 days/year (95%CI: -0.41 to -0.32)($p < 10^{-4}$). Median time from admission to surgery was 1 [1–3] days (mean, 2.3 days). Mean time to surgery decreased slightly over time, by a mean of 0.08 days/year (95%CI: -0.10 to -0.05)($p < 10^{-4}$). Time to surgery did not differ significantly across the three hospital categories. Significant variability was noted across hospital categories and departments ($p < 10^{-4}$ and $p=0.001$, respectively) (Figure 4). Of the 8026 PFFs, 2731 (34%) were followed by home discharge and 266 (3.3%) by death before hospital discharge.

3.5 Mortality

Overall, 4939 patients died. Of the 8026 fractures, 358 (4.5%) were followed by death within 30 days, 843 (10.5%) within 90 days, 1226 (15.3%) within 6 months, and 1673 (20.8%) within 1 year. Two factors were significantly associated with higher day-90 mortality, namely, higher CCI ($p < 10^{-4}$) and longer time to surgery ($p=0.0001$). In the Cox model analysis of day-90 mortality, the hazard ratio (HR) for the CCI was 1.087 per additional point (95%CI: 1.07–1.10)($p < 10^{-4}$) (Table 2). Times to surgery longer than 1 day and 2 days had HRs of 1.35 (95%CI: 1.15–1.50)($p=0.0001$) and 1.40 (95%CI: 1.18–1.6)

($p < 10^{-4}$), respectively (Figure 5). The adverse effect of a longer time to surgery persisted throughout the first year, with HRs for times >1 day and >2 days of 1.18 (95%CI: 1.05–1.30) and 1.22 (95%CI: 1.1–1.4), respectively, by multivariate analysis. No significant random centre or department effect was demonstrated ($p=0.2$ and $p=0.4$, respectively).

Day-90 mortality as assessed using the log-rank test did not change significantly over time (HR =, 0.95 (95%CI: 0.97–1.01)($p=0.5$)). However, after adjustment for the CCI and time to surgery, being treated during the more recent years was significantly protective (HR = 0.95 (95%CI: 0.92–0.97)($p < 10^{-4}$)) (Table 2). In neither the unadjusted nor the adjusted analyses was day-90 mortality associated with the hospital category ($p=0.9$), case load ($p=0.14$), home-to-hospital distance ($p=0.5$), or treatment method (replacement or internal fixation) ($p=0.33$).

4. Discussion

This study confirms the increasing incidence of PFF in France among patients older than 60 years, with associated increases in both mean age and comorbidity burden. Despite this increase, in the adjusted analyses, day-90 mortality decreased from 2005 onwards, in keeping with previous data [29]. The number of surgery beds has increased only very slightly since 2005. This study also found evidence of considerable variability in PFF management both across geographic departments and across hospital categories. More specifically, home-to-hospital distance and time to surgery varied across departments. Importantly, time to surgery significantly predicted day-90 mortality. Time to surgery decreased slightly over the study period. Finally, over time, PFFs were increasingly managed in public rather than private hospitals.

The findings from this study are consistent with the most recent data in the literature. The increasing incidence in France was also reported by Briot et al. [1]. The about 10% day-

90 mortality rate is in agreement with other reports [4,5,30,31]. Similarly, the occurrence of a contralateral PFF in about 8.6% of cases is consistent with the mean value of 10% and maximum value of 13% in earlier work [32,33]. Whether time to surgery was associated with mortality remained debated until about 2010 [5,34–36] when studies of national databases established clearly that a longer wait was associated with a higher risk of death. Most published papers advocate surgery within 48 hours, as recommended by the International Fragility Fracture Network [37]. However, our findings support the conclusions of a previous French study recommending earlier surgery, within 24 hours. Time to surgery is among the few modifiable risk factors. Ravery et al. [14] demonstrated that organisational issues were among the main sources of longer waits until surgery.

In France, the incidence of PFF varies across departments, notably among females [38,39]. Variability in management strategies is a recent field of research, and significant differences exist across countries, for instance between Denmark and the UK [12]. A nationwide study in Australia [40] found that 65% of patients had surgery within 24 h, compared to slightly less than 50% in our cohort. Our study evidenced variations across France in hospital categories managing PFFs, home-to-hospital distances, and time to surgery. There was no evidence of a major centre effect on day-90 mortality.

Sound data indicate that most PFFs are managed in public hospitals in France [16], despite some evidence of cooperation between public and private institutions [41]. The contribution of private hospitals to the management of PFFs seems to have diminished in recent years. The home-to-hospital distance was shorter for non-profit and for-profit hospitals than for public hospitals. Thus, the decreasing role for private hospitals probably explains the increase in home-to-hospital distance over time. A more granular analysis including data on complications is needed to estimate the impact of PFF management heterogeneity in France.

This study has several limitations. First, coding errors or omissions may have occurred. In France, healthcare institutions receive funding based on the procedures performed, in part since 2007 and completely since 2012. Some procedures, main diagnoses, or secondary diagnoses may not have been coded before this period. Details may have been lacking, for instance regarding the affected side. Moreover, femoral neck fractures cannot be formally differentiated from inter-trochanteric fractures. Huff et al. [42] reported that inter-trochanteric fractures were associated with higher mortality, although this finding was not replicated in the present study, with no difference between treatment types. However, the sensitivity analysis with imputation of missing data established that the associations, notably with time to surgery, were very robust. Second, details may have been lacking on patient circumstances before admission for PFF. For instance, Erivan et al. [43] found an excess risk of death among institutionalised patients. Moreover, the place of residence was used for the study but did not necessarily reflect the location of the patient at the time of the fracture, which was not available in the database. However, this potential source of bias was minimised by deleting the outlying values and using only distances that allowed the inclusion of 98% of patients. Third, a detailed description of time trends in healthcare institutions and local care organisation patterns was not feasible. The SAE database only provided estimates of human resources and bed availability, without giving information on organisational factors. The slight increase in surgery beds should be interpreted with circumspection. Although there may have been an actual increase, other possible explanations to this finding include the closing of small healthcare institutions over time and coding bias related to the administrative clustering of healthcare institutions. Finally, an inherent limitation of administrative databases is that they provide no clinical information (e.g., laboratory findings) at this large scale.

5. Conclusion

Across regions of France, considerable differences exist in the type of hospital managing PFFs, home-to-hospital distance, and time to surgery. A time to surgery longer than 24 h significantly predicted higher mortality up to 1 year after surgery. Time to surgery decreased slightly over the study period but was longer than 24 hours in half the patients. Despite increases in the incidence of PFF and in the age and comorbidity burden of affected patients, day-90 mortality decreased between 2005 and 2017. The incidence of PFF increased but the number of surgical beds showed little change. The contribution of private hospitals to the management of patients with PFF decreased over time, probably explaining the increase in the home-to-hospital distance. This study found no evidence of a centre effect on day-90 mortality after PFF.

Conflicts of interest

In a manner unrelated to the present work, Baptiste Boukebous has received advantages from Corin, Sanofi, and Coloplast; and David Biau has received fees and advantages from Lilly, Sanofi, Johnson & Johnson Medical, SERF, Stryker, and Zimmer. None of the other authors has any conflicts of interest to declare.

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None

Contributions of each author

Baptiste Boukebous contributed to design the study, collect the data, perform the statistical analysis, and draft the manuscript.

Fei Gao contributed to collect the data, provided methodological and statistical support, and contributed to draft the manuscript.

David Biau contributed to design the study, provided methodological and statistical support, contributed to draft the manuscript, and revised the final version of the manuscript for important intellectual content.

Use of artificial intelligence

The authors used no form of artificial intelligence to obtain or interpret the study data.

Journal Pre-proof

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Orthopaedics & Traumatology: Surgery & Research 2021;107:102876.

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FIGURE LEGENDS

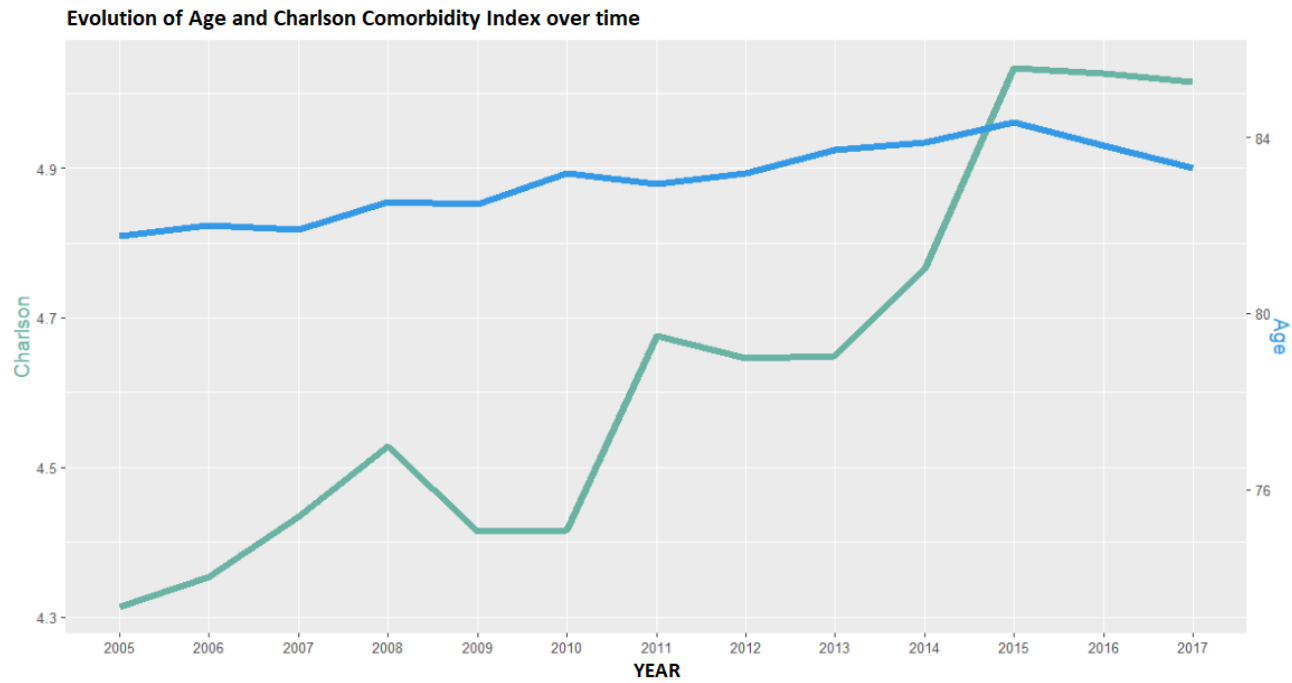


Figure 1: The Charlson Comorbidity Index (CCI) and age increased between 2005 and 2017. This increase persisted after excluding age and body weight from the CCI.

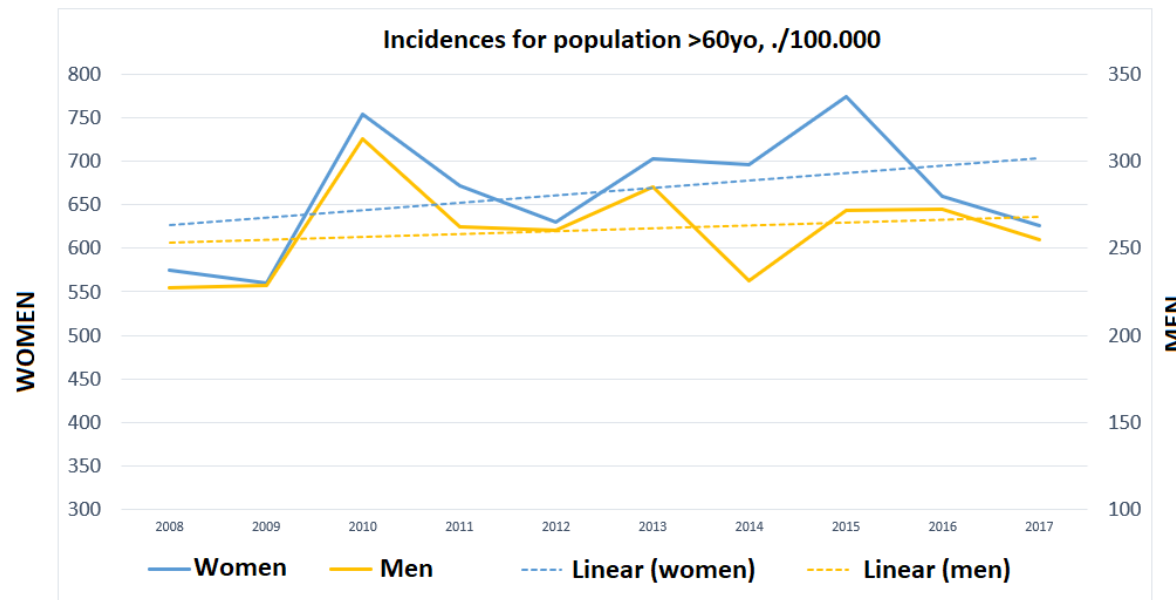


Figure 2: Incidence rates over time in the population older than 60 years of age

A non-significant increase was noted, which was larger in females than in males. The dotted lines are the linear regression lines.

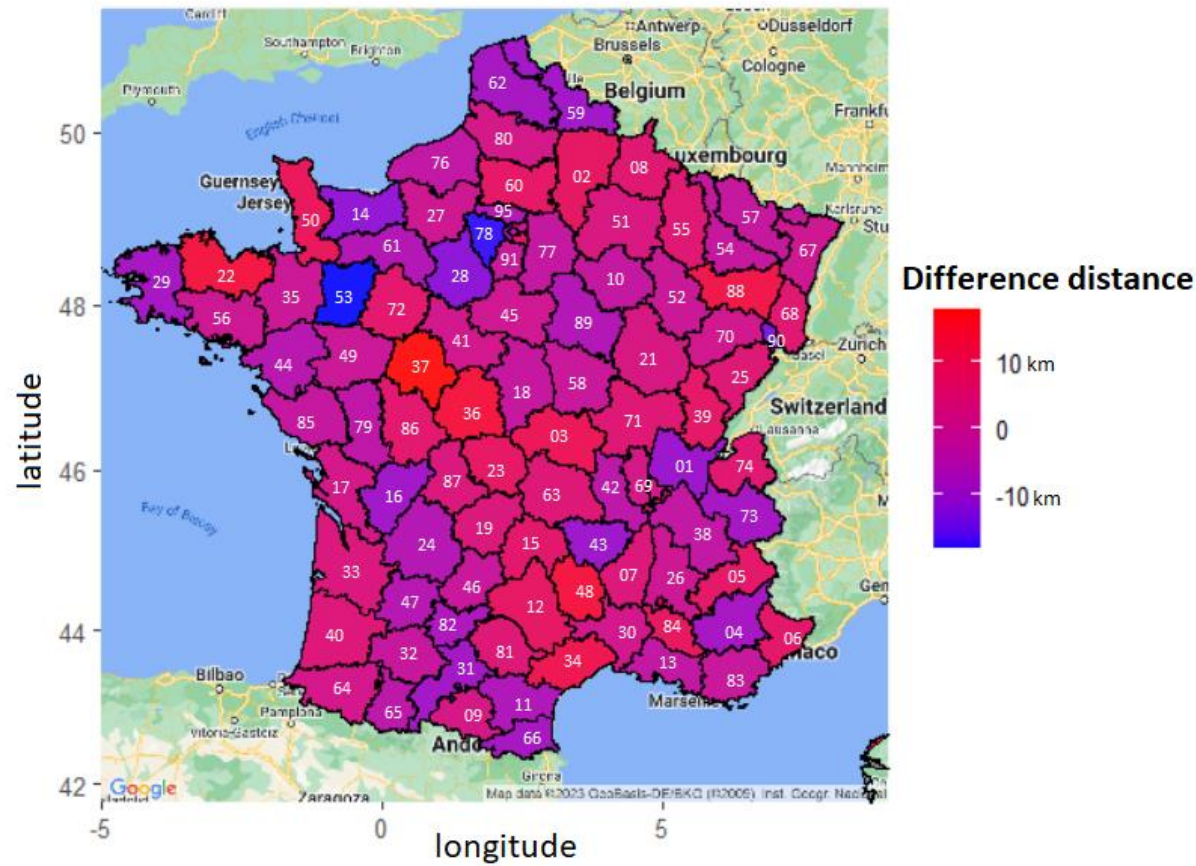


Figure 3: Change in median home-to-hospital distance before vs. after 2011 in each department. Greater red colour intensity indicates a greater increase after 2011 and greater blue colour intensity a greater decrease after 2011. This map illustrates the changes in healthcare institution availability across France and the differences across departments.

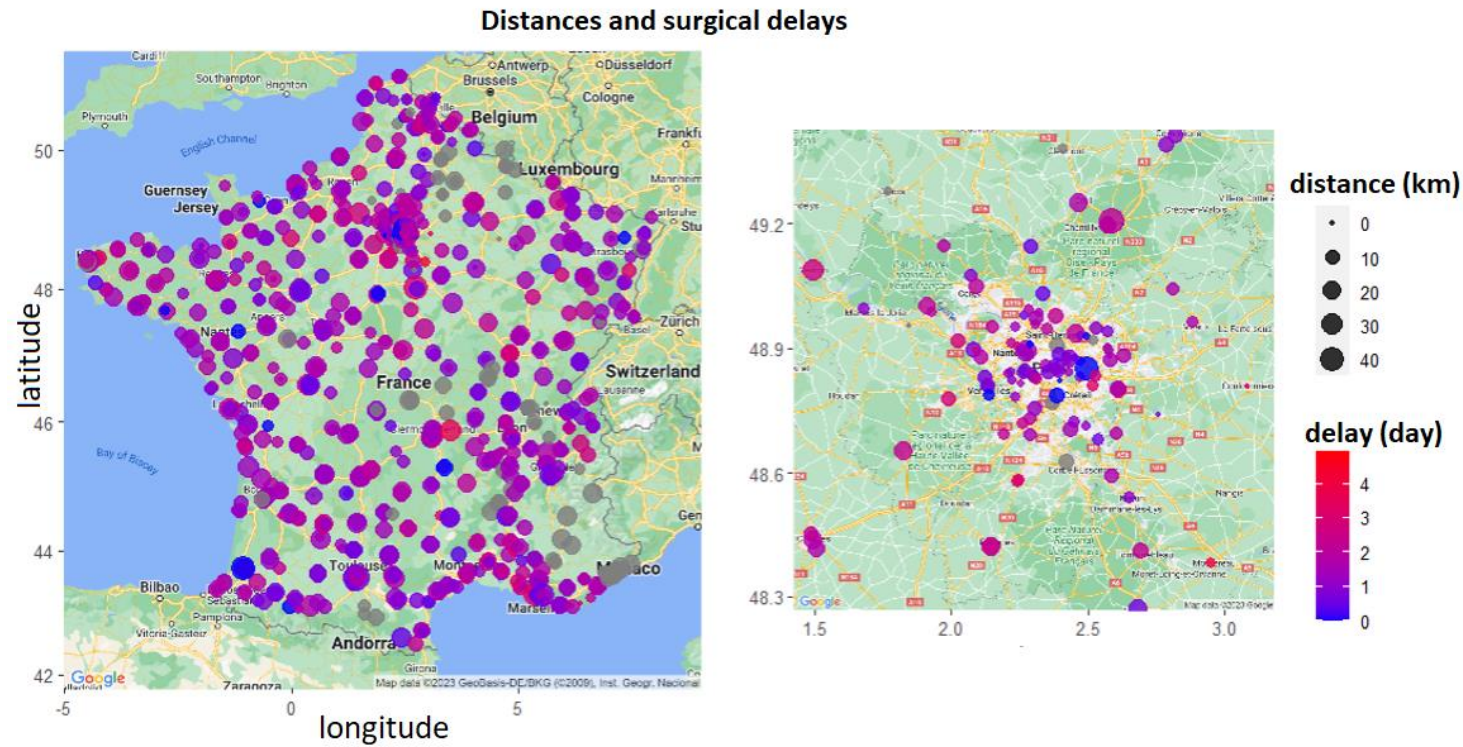


Figure 4: Map showing the mean home-to-hospital distance (diameter of the circles) and times to surgery (colour of the circles). Greater intensity of the red colour indicates longer time to surgery. The grey circles indicate the 10% of hospitals with missing data on time to surgery. Considerable variability was found across hospitals, even within a given department. The inset on the right shows data for the Paris region (Île de France).

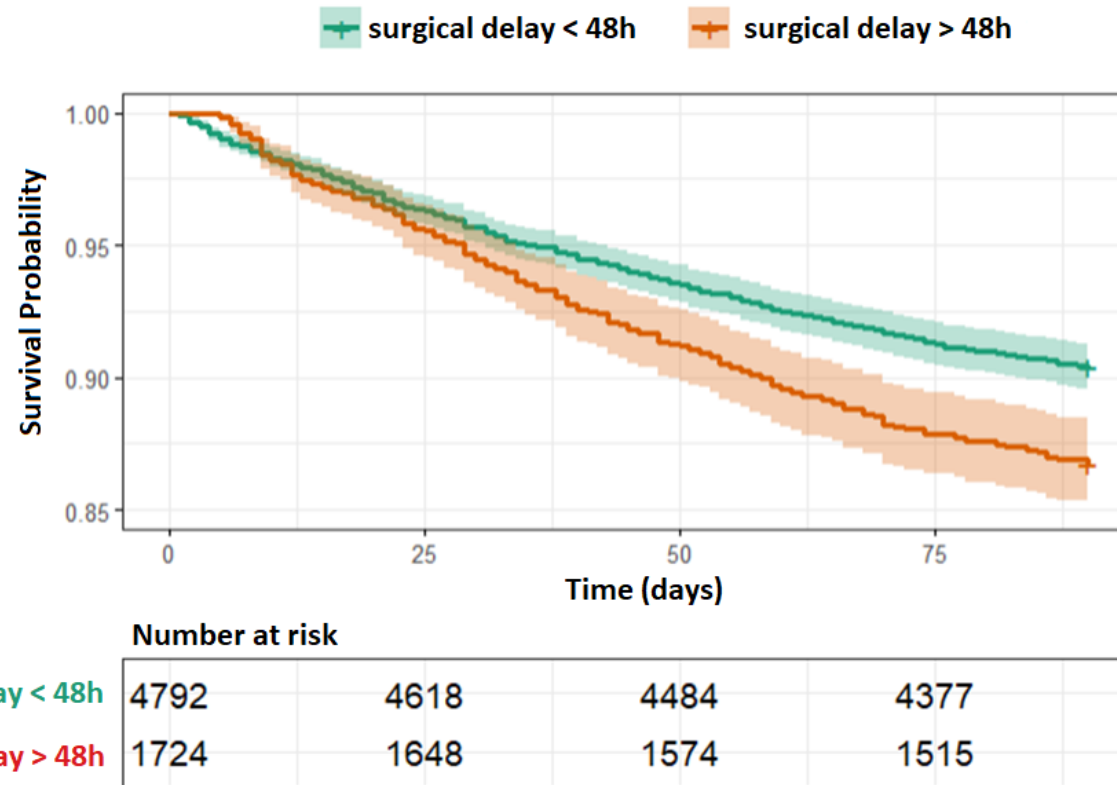


Figure 5: Kaplan-Meier curve of day-90 survival. Day-90 survival was about 90%. Time to surgery longer than 1 year was significantly associated with higher day-90 mortality (hazard ratio, 1.4; 95% confidence interval, 1.18–1.60; $p < 10^{-4}$).

Table 1: Main features of the patients and proximal femoral fractures *Starting at admission with censoring in 2017 or at death

Variables	Overall cohort	Public hospitals	Non-profit private hospitals	For-profit private hospitals	p value
Age	83. 84 (78 - 89)	83. 85 (78 - 89)	82. 84 (78 - 89)	83. 84 (79 - 89)	0.10
Sex					0.57
males	1842 (23)	1358 (23)	366 (22)	62 (24)	
females	6184 (77)	4507 (77)	1262 (78)	200 (76)	
Treatment type					<0.0001
arthroplasty	3299 (44)	2000 (41)	644 (51)	115 (51)	
Internal fixation	4262 (56)	2855 (59)	613 (49)	110 (49)	
Follow-up* (years)	3.5. 2.7 (1.1 – 5.2)	3.5. 3 (1 - 5)	3.8. 3 (1 - 6)	3.5. 3 (1 - 5)	<0.0001
Time to surgery (days)	2.33. 1 (1-3)	2.25. 1 (1-3)	2.19. 1 (1-3)	2.57. 1 (1-3)	0.93
Charlson's Comorbidity Index	4.6. 4 (4 - 6)	4.7. 4 (4 - 6)	4.4. 4 (4 - 5)	4.7. 4 (4 - 6)	<0.0001
Hospital category					-
Public	5865 (76)	-	-	-	
Non-profit private	1628 (21)	-	-	-	
For-profit private	262 (3)	-	-	-	
Home-to-hospital distance (km)*	19.5. 14 (6 - 28)	20. 17 (7 - 31)	16.4. 11 (5 - 24)	12.6. 7 (3 - 16)	0.041
Home-to-hospital travel time (min)	22.6. 19 (12 - 29)	23. 21 (13 - 32)	20. 17 (11 - 28)	17. 14 (9 - 20)	0.012
Died within 90 days					0.81
no	6934 (89)	5236 (89)	1461 (90)	236 (90)	
yes	822 (11)	629 (11)	167 (10)	26 (10)	

Categorical variables are reported as n (%) and quantitative variables as mean and median [interquartile range].

*98% of the cohort after removal of outlying values

Table 2: Risk factors for day-90 mortality

Variables	Univariate		Multivariate 90 days		Multivariate 1 year	
	HR (95%CI)	p value	HR	p value	HR	p value
Age	1.05 (1.05–1.07)	<10 ⁻⁴	Included in the CCI		Included in the CCI	
Charlson's Comorbidity Index (CCI)	1.1 (1.08–1.1)	<10 ⁻⁴	1.1 (1.07–1.1)	<10 ⁻⁴	1.09 (1.08–1.1)	<10 ⁻⁴
Year of treatment	1 (0.97–1.01)	0.5	0.95 (0.92–0.97)	<10 ⁻⁴	0.98 (0.96–0.99)	0.02
Male	1.7 (1.5–2)	<10 ⁻⁴	1.8(1.5–2)	<10 ⁻⁴	1.7(1.5–1.9)	<10 ⁻⁴
Treatment type	1.07 (0.9–1.2)	0.3	1.07 (0.9–1.3)	0.4		
Time to surgery >24h	1.3 (1.1–1.5)	0.0001	1.2 (1.04–1.4)	0.01	1.18 (1.05–1.3)	0.003
Time to surgery>48h	1.4 (1.2–1.6)	<10 ⁻⁴	1.3 (1.1–1.5)	0.001	1.22 (1.1–1.4)	0.001
Hospital category	0.95 (0.8–1.1)	0.5	0.97 (0.8–1.1)	0.7	0.97 (0.9–1.1)	0.7
Case load	1.001 (0.99–1.003)	0.07	0.99 (0.99–1)	0.14	1 (1–1)	0.21
Home-to-hospital distance	1 (1–1)	0.5	1 (1–1)	0.5	1 (1–1)	0.45

HR: hazard ratio; 95%CI: 95% confidence interval

APPENDIX: List of codes for surgical procedures used to treat proximal femoral fractures

S720: Fracture femoral neck:

NEKA011	Replacement of the hip joint by a prosthetic femoral head and neck and a mobile cup
NBCA005	Internal fixation of an intra-capsular femoral neck (transcervical) fracture, epiphyseal detachment, or epiphysiolysis of the proximal femur
NBCA010	Internal fixation of an extra-capsular femoral neck fracture
NEKA018	Replacement of the hip joint by a prosthetic femoral head and neck
NEKA020	Replacement of the hip joint by a total prosthesis

S721: Fracture of the trochanter (inter-trochanteric femoral fracture)

(CIM):

NBCA006	Internal fixation of a sub-trochanteric or trochanteric-diaphyseal femoral fracture
NBCA010	Internal fixation of an extra-capsular femoral neck fracture
NBCA008	Internal fixation of a fracture of the greater trochanter

S722: Sub-trochanteric fracture (sub-trochanteric femoral fracture):

NBCA006	Internal fixation of a sub-trochanteric or trochanteric-diaphyseal femoral fracture
NBCA010	Internal fixation of an extra-capsular femoral neck fracture
NBCB004	Internal, closed fixation of a diaphyseal femoral fracture using distally locked

	intra-medullary material
NBCA008	Internal fixation of a fracture of the greater trochanter

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