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Who gets injured at home? Evidence from older people in France

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Abstract

The study analyses unintentional home and leisure injuries (HLIs) for the French senior population using data from the 2012 wave of the French health, health care and insurance survey. The results of our logit models reveal that health status, age, and risky attitudes are the main characteristics associated with HLIs for older people. When the severity of injuries is taken into consideration, the highest exposure to HLIs concerns the oldest seniors, aged 85 years old or older, with deteriorated health. This result is confirmed in the case of severe indoor HLIs, whereas for severe outdoor injuries, the most vulnerable individuals seem to be younger seniors, that is, 75–79 years old. Moreover, our findings suggest that HLIs, and mainly severe home HLIs, generate a short-term influence on a person's health.

KEYWORDS
health problems, home and leisure injuries, logit models, older people

JEL CLASSIFICATION
I10 – I12 – C25

1 | INTRODUCTION

Unintentional home and leisure injuries, generally known as home and leisure injuries (HLIs), are one of the leading causes of death and disability, particularly for the senior population (Inder et al., 2017). This type of injury represents a significant public health problem because of the medical expenditures and the loss of work productivity they cause (Fragar et al., 2013). Indeed, according to the World Health Organization (WHO), the number of deaths caused by the four main types of HLIs (falls, poisoning, burning, and drowning) was approximately 1.5 million in 2012, which is higher than the number of deaths caused by road traffic injuries in the same year (1.2 million). Moreover, falls are estimated to become the 17th cause of death in the world in 2030, compared to the 21st position in 2012 (WHO).

The main objective of this study is to identify the profile of senior people who are more exposed to different types of HLIs. We will thus identify a set of individual characteristics related to HLIs, and then we will analyze the evolution of the probabilities of injuries associated with those characteristics.

Our analysis focused on the senior population because among the people affected by HLIs, seniors seem to be the most vulnerable group. For instance, in Italy, the rate of HLIs was 8.1% for people over 65 years compared to 5.2% for the general population for the period 1999–2006 (Ferrante et al., 2014). In the United States in 1998, the rate of nonfatal HLIs for people over 65 years old was almost twice the rate estimated for children (Runyan et al., 2005). In terms of fatal injuries, the rate of death for people aged 65–84 was over 67 per 100,000 in the United States in 1999, which is 10 times higher than that for children aged 0–14 (Zhang et al., 2017). Two types of factors contribute to an increase in the probability of HLIs for older people. First, the general characteristics that are common for all types of populations include gender, general health, home hazards, living in rural areas, and disabilities (Ferrante et al., 2014; Fragar et al., 2013; Shi et al., 2015). Second, some specific factors associated with the aging process include coexisting medical problems, loss of muscular tone, loss of bone density and strength, medical drug consumption, visual impairment, cognitive degradation, and so forth (Zhang et al., 2017; Ferrante et al., 2014).

Furthermore, the relevance of HLIs as a public health problem for seniors is accentuated by the aging of the general population worldwide, which is expected to intensify in the coming decades (Zhang et al., 2017). In fact, the estimation for people aged 65 years or older in 2050 is over 1.5 billion, which will represent 16% of the total population, whereas seniors represent only 9.3% of the total population in 2020. If we consider the evolution of the population for regions and subgroups, projections are even more salient. In Europe, the elderly population is already 10% higher than the world average in 2020, and it is expected to be 28.14% and 30.4% in 2050 and 2100, respectively. For Organization for Economic Co-operation and Development (OECD) countries, the share of very older people (80 years or older) is expected to reach 10% by 2050, compared to only 1% in 1950 (Colombo & Mercier, 2011). In France, the actual rate of the senior population is 20.1%, which is substantially greater than the world average and slightly greater than the European rate. Moreover, given the evolution of life expectancy, the rate of people aged 75 or older is estimated to increase from 9.3% in 2020 to 16.4% by 2050 (INED, 2019).

Based on this world scenario, the consequences of the increase in the share of older people in terms of HLI epidemiology are straightforward. In France, approximately 2.3 million seniors have an HLI each year, representing approximately 21% of the total number of this type of injury (Paget & Thélot, 2017). Moreover, more than two-thirds of seniors died from HLIs. For instance, from the 21,000 fatal HLIs recorded in 2012, approximately 15,000 concerned older people (Lasbeur et

Thélot, 2017). Given both their severity and their frequency, HLIs thus represent a serious threat to public health, which is even more pronounced for older people.

In addition to a higher exposure to HLIs, the senior population seems to be affected by specific injuries compared to the younger population. Indeed, Dalichampt and Thelot (2008) suggest that home injuries are more frequent for senior people, whereas sport and school injuries are mainly associated with children and younger adults. This segmentation in the nature of injuries represents a supplementary argument to justify focusing our study on the senior population.

Concerning the financial costs of HLIs, the few estimations that are available indicate an important diversity among the countries and populations analyzed, suggesting that the results are highly sensitive to the nature of the health care systems. Moreover, the relevance of the potential international comparisons is also limited by the heterogeneity of the estimation methods used to compute the aggregate costs of HLIs. Nevertheless, a common characteristic of the different estimations highlights that older people represent the highest consumers of financial resources due to the higher frequency of injuries, the longer hospital stays, and the more specialized health care needed (Ferrante et al., 2014).

Kopjar and Wickizer (1996) estimated the cost of HLIs for the United States and Norway to be $7 billion and $125 million, respectively. According to their results, people aged 75 and older represent half of the total expenditures realized. Hoffman et al. (2017) developed a comparison group method to estimate the cost of fall-related injuries for people aged 65 and older using American data from 2007 to 2009. Their results indicate an average expenditure of $9389 per case and a total Medicare expenditure of $13 billion for the period. Scuffham et al. (2003) measured the costs associated with unintentional falls for people aged 60 and over in the United Kingdom to be equivalent to £981 million in 1999 and positively related to age.

In addition to the financial cost of HLIs, concepts such as disability-adjusted life-years (DALYs) or quality-adjusted life-years (QALYs)[1] help to understand the implications of HLIs for older people. A senior has a higher risk of losing years in good health after this kind of trauma due to the problems associated with the aging process, which decreases the possibility of a full recovery. For instance, HLIs caused more than 138 million DALYs in 2004 (Chandran et al., 2010), and they represented $162 billion lost in QALYs in 1998 in the United States (Zaloshnja et al., 2005)[2]. For older people, the burden of falls can also be expressed as DALYs and was equivalent to 27.5 million people worldwide in 2013 (Haagsma et al., 2016).

The literature dealing with HLIs focuses mainly on the epidemiological dimension and aims to identify the factors associated with the occurrence of this type of injury[3]. Nevertheless, three main gaps can be identified in this literature. First, it considers all injuries perfectly homogeneous. However, some criteria of differentiation within HLIs must be used to better seize the characteristics that increase the odds of this type of injury and consequently to identify the potential preventive measures of those injuries. This segmentation could consider both the age of the population and

[1] QALYs are a measure of years lived in perfect health gained. DALYs are a measure of years in perfect health lost and they are calculated as the addition of all years lost and all years lived with disability. The 138 million DALYs means the quantity of years lost plus the quantity of years lived with disability because of an HLI.

[2] The authors estimated the cost of a QALY by calculating the nonmonetary value of it and translating this value into monetary terms. They first added the years lost because of death plus the years lived with impairment after a home injury. They then measured the earnings lost because of death or impairment and finally asked people to indicate how much they will be willing to pay for surviving or having a safe living.

[3] These factors are similar as those already mentioned in the case of older people: gender, health problems, disabilities, etc.

the nature of the injuries (type, severity, place of occurrence, etc.). Second, it does not discriminate between health status before and after trauma. Third, to the best of our knowledge, no study has explicitly taken into consideration the issue of HLIs for seniors in the French population.

The study aims to fill those gaps in the literature by exploring the factors associated with a larger probability of HLIs in the senior French population by explicitly taking into consideration the heterogeneity among injuries. Two main criteria are used to refine this analysis. The first concerns the severity of the injury, and it is measured by an indication of professional medical care received by the individuals (Alexandrescu et al., 2009). The second criterion concerns the place where the injury happened, as the home environment has been largely identified in the literature as particularly risky for HLIs (Ferrante et al., 2014; Mack et al., 2013). We thus consider two types of HLIs: those that occurred at home (the house and its surroundings) and those that occurred outdoors.

Given the main characteristics identified as correlated with the probability of HLIs, we estimated the evolution of the individual exposure to HLIs. More precisely, for each type of HLI, we selected the most significant variables related to injuries, and we measured their marginal effect on the individual probabilities of HLIs. We thus identified the profiles most exposed to different types of HLIs. This approach could be useful to improve preventive measures aiming to limit both individual exposure to HLIs and their collective health and negative financial consequences.

Another element of originality of our study lies in the role played by health status in explaining the probability of HLIs. Given that health problems could be associated with HLIs and that HLIs could explain general health, our study proposes a methodological approach to discriminate between these two channels.

The study is organized as follows. In the next section, we briefly present the databases, variables, and methodology. Section 3 presents the descriptive statistics, the results, and a discussion of our main findings. The final section concludes.

2 | DATA, VARIABLES, AND METHODS

2.1 | Data sources and sample

We used the 2012 wave of the French health, health care and insurance survey (ESPS) carried out by the Institute for Research and Information in Health Economics since 1988. This database gathers information at the individual level about health status, health access, type of health care, lifestyle, and working conditions. The database identifies people having at least one HLI (regardless of its nature) in the 3 months preceding the survey. Different questions allow us to describe the injury and its consequences (place of occurrence, resulting body lesion, medical care received, and limitations in the following 48 h). For further details about the ESPS, see Paget et Thélot (2017).

For the two complementary macro variables at the district level, we use the Annual Statistical Yearbook of the Directorate-General for Local Government, which provides essential statistical information on local authorities, and The National File of Health and Social Establishments[4].

Our study focuses on people aged 65 years and older for a sample of 2381 individuals who provided complete information about HLIs and met all the inclusion criteria.

[4] The FINESS is a national directory managed by the Ministry of Social Affairs and Health covering information on health, social and medico-social establishments.

2.2 | Variables

2.2.1 | Endogenous variables

Home and leisure injury

The WHO defines unintentional injuries as "the physical damage that results when a human body is suddenly or briefly subjected to intolerable levels of energy" (Holder et al., 2001, p. 5). HLIs are a subcategory of unintentional trauma, and according to article 63 of the Law of Modernisation of the French Health System (2016), they exclude road injuries and work injuries. To follow this definition, we considered that HLIs are any unintentional trauma that happened in the 12 months preceding the moment the person answered the ESPS survey. We thus excluded injuries whose information did not match the definition of HLIs (any traumas related to violence, road injury, or undetermined conditions), and we created a binary variable to indicate whether the person had an HLI. This is the analysis of Model 1.

HLIs with or without professional medical care

We extended our research by including the possible heterogeneity of HLIs in the analysis. Not all injuries have the same consequences or the same characteristics. In this sense, one of the main concerns about HLIs is the physical damage they can cause. Usually, they are classified depending on their severity or according to the medical attention received[5]. A severe injury is defined by one of the following elements: it causes a limitation of at least 48 h in the normal activities of the person, requires health care and assistance (emergency room attendance, hospitalization, nurse attention, physiotherapist, etc.), and causes limitations requiring professional care assistance. We create a categorical variable of three levels: the first level indicates that the person did not have an HLI (not HLI), the second level concerns minor injuries (HLIs without PMC) and the third level concerns severe injuries (HLIs with PMC). This is the analysis of Model 2. Regarding Model 1, we split the HLIs into two categories: those with PMC and those without PMC.

HLIs with professional medical care at home or outdoors

French legislation also identified HLIs according to the place where they occur or according to the activity the person was doing at the moment of the injury. In this sense, they are considered *home injuries*, that is, they occur in the house environment or its perimeter (not just the inside of the house but also the garden, parking space, swimming pool, etc.) or *outdoor injuries*, that is, they occur in any public place or anywhere outside the house (sidewalk, neighborhood, someone's else house, etc.). To capture this type of heterogeneity, we built a categorical variable with three levels: the first level concerns people without injury, the second level concerns people suffering from severe HLI occurring at home (HLI with PMC at home), and the third level concerns people who had severe HLI outdoors (HLI with PMC outdoors). This classification is used for Model 3. Regarding Model 2, we split the HLIs with PMC into two categories: those with PMC at home and those with PMC outdoors.

[5] For instance, the injury pyramid depicts four levels of injury: Level 1—injuries treated outside the health system, not treated, or not reported, Level 2—injuries requiring visits to emergency departments, Level 3—injuries requiring hospitalizations, Level 4—fatal injuries (World Health Organization, 2014).

Present health status

In the last section of the study, we will analyze the relation of different types of HLIs with the health status declared at the moment of the survey. The hypothesis is that HLIs can significantly modify a person's health in the short term. Consequently, we use two supplementary dependent variables:

1. Present health index (PrHI): A continuous health index ranging from 0 to 18 and built from a set of variables that describes the health problems of the people when they answered the survey and during the preceding month. All the details about the questions used for the construction of the index are indicated in Appendix A and Table A1.
2. Present health score (PrHS): A continuous variable ranging from 0 to 10 that scores the perception of the person of his or her own health at the moment of the survey. The question proposed to respondents is as follows: on a scale between 0 and 10, how do you evaluate your health? We consider 0 to represent excellent health and 10 to represent poor health[6].

2.2.2 | Exogenous variables

Health measures

The 2012 ESPS report (Célant et al., 2014) reveals that people who had an injury were mainly seniors and declaring health troubles and limitations. The ESPS database has an extensive collection of health measures, but due to temporality problems, not all of them can be used to explain the probability of HLIs. Indeed, most of the health questions are observed in the month preceding the survey, while HLI questions refer to the three months preceding it. Without any further information to contextualize the answers, it is thus difficult to know the direction of the causality: are HLIs the result of prior health problems (consequences) or, on the contrary, they cause a poor health status? To avoid an eventual reverse causality problem, we have discarded the health variables whose information concerns a period less than 3 months preceding the survey, and we built an aggregated measure for the health problems. The past health index (PaHI) is an aggregated measure of the following variables: sleeping trouble, memory trouble, involuntary weight loss, hearing and visual impairment, chronic disease, and limitations due to health problems. This continuous index was categorized into four binary variables according to the number of health problems: any health problem, one health problem, two health problems, and three or more health problems (see Appendix A, Table A2).

Socioeconomic variables

1. Age, sex, and living with a partner.
2. Socioprofessional category: given that most of the people in the sample were retired when the survey took place, the variables measure whether the person had a managerial position, an elementary occupation, or was out of work during the last job.
3. Diploma measures the educational attainment of the person. The binary variable indicates whether the person has a diploma or not.

[6] In the original question of the survey, 10 represents excellent health and 0 represents poor health. However, we inverted the scale to homogenize all the health measures. As our health measures are an aggregation of health problems or limitations, the bigger the score, the worst the health of the person. This is similar to the method used in other health questionnaires as the frailty score (Fried et al., 2001).

4. Complementary healthcare insurance: whether the person has complementary healthcare insurance[7].
5. Living zone: according to the number of jobs, we classified them into large cities (more than 10,000 job positions), suburbs (more than 10,000 jobs, but employees work in the neighboring city), small cities (all medium and small towns with 5000 to 10,000 jobs), and rural zones (areas outside the influence of cities with 1500 to 5000 jobs).
6. Financial troubles: a binary variable indicating whether the person had problems paying the bills or daily life expenses at any moment of life.
7. Body mass index (BMI): defined as the weight divided by the square of the height. A binary variable was created for each of the BMI categories, that is, underweight = <18.5, normal weight = 18.5–24.9, overweight = 25–29.9 and obesity = BMI of 30 or more[8].
8. Social life was measured by the weekly visits of relatives, friends, and participation in group activities[9]. There is a binary variable for each category of social life: no social life, average social life (one or two social connections), and important social life (three or more social connections).

Behavior and preferences

1. Alcohol, tobacco, and fruit/vegetable intake: whether the person consumes any of these on a regular basis.
2. Risky or cautious attitude: the scale varies from 0 (cautious person) to 10 (adventurous person). We consider as "risky" the individuals answering at least five to this question.
3. Concern about future: the scale varies from 0 (person living one day at a time, taking life as it comes without thinking about tomorrow or planning) to 10 (person concerned about the future having a clear idea about her or his long-term project). We consider as "concerned about future" the individuals answering at least six to this question.

The classification of these two variables was made using a decision tree learning method. The regression models validated the selected breaking points.

Macrovariables

These variables are available only at the district level. The French territory is divided into 95 districts.

1. EHPAD beds: ratio of beds in nursing homes to dependent seniors in the district[10].

[7] In the French healthcare system, the State is in charge of the biggest proportion of the medical expenses of all citizens, whereas the remaining share are paid by each person through a complementary healthcare insurance. Our study thus takes into consideration this complementary insurance.

[8] There were no people in the underweight category.

[9] The question in the survey asks, "In the last 12 months, how often did you meet and spend time with the following people: family, friends, and groups or associations." Each type of relationship was considered a social connection, and there were different frequencies (daily, weekly, monthly, and less than monthly). All this information was aggregated to construct the three categories of social life.

[10] In the French healthcare system, the Etablissement d'Hébergement pour Personnes Agées Dépendantes (EHPAD) are specialized nursing homes for dependent seniors. Dependent seniors are those receiving financial aid because of dependence. This financial aid, known as Allocation Personnalisée d'Autonomie (APA), represents an individualized monthly payment provided by the regional government to people over 60 years old who have problems completing daily life activities and need assistance at home.

2. Percentage of social expenses: the ratio of mandatory social aid expenses for people aged 75 years or older over the district budget.

2.3 | Empirical strategy

2.3.1 | Probability of HLI

To estimate the probability of having an HLI, we used logistic models. The latent variables depending on a set of exogenous individual characteristics X_j are written as follows:

$$Y^*_{jk} = X_j\,\gamma_k + u_{jk},\ j = 1,\ldots,N;\ k = 0,\ldots,K, \tag{1}$$

where γ_k are the set of parameters associated with modality k ($k = 0,\ldots,K$). Since we cannot estimate the parameters associated with all of the categories, we take "not injured" as the category of reference, with $\gamma_0 = 0$. u_{jk} are random error terms that are independent and identically distributed following a logistic distribution. N is the sample size, and j is the individual's index. According to the characteristics of the injury, three models are considered:

$$\text{Model1}: K = 1,\ Y_j = \begin{cases} 1 \text{ if } j \text{ had an HLI,} \\ 0 \quad \text{otherwise.} \end{cases}$$

$$\text{Model2}: K = 2,\ Y_j = \begin{cases} 2 \quad \text{if } j \text{ had an HLI with PMC,} \\ 1 \text{ if } j \text{ had an HLI without PMC,} \\ 0 \qquad\quad \text{otherwise.} \end{cases}$$

$$\text{Model3}: K = 3,\ Y_j = \begin{cases} 3 \text{ if } j \text{ had an HLI with PMC outdoors,} \\ 2 \text{ if } j \text{ had an HLI with PMC at home,} \\ 1 \text{ if } j \text{ had an HLI without PMC,} \\ 0 \qquad\quad \text{otherwise.} \end{cases}$$

The probabilities associated with each category are as follows:

$$P\left(Y_j = k\right) = \frac{\exp\left(X_j\gamma_k\right)}{\sum_{k=0}^{K}\exp\left(X_j\gamma_k\right)},\ j = 1,\ldots,N;\ k = 0,\ldots,K \tag{2}$$

2.3.2 | Present health status

As we have already stated, for an extension of our analysis, we investigate whether having an HLI could modify the short-term health of the person. To model the relationship between present health status and HLIs, we use an ordinary least-squares (OLS) linear regression with robust

standard errors. The model specifications are as follows:

$$Z_j = \beta_0^z + \beta_1^z \,\mathrm{PaHI}_j + \beta_2^z \,\mathrm{HLI}_j + \beta_3^z \, X_j + u_j^z,\ j = 1, \ldots, N, \tag{3}$$

with Z is PrHS or PrHI being the present health score and the present health index, respectively. PrHS_j and PrHI_j are the two measures of present health for individual j, PaHI_j is the health status of the individual before the injury, HLI_j is the type of injury the person had, X_j are the individuals' characteristics of j, and u_j is the robust error term.

3 | RESULTS AND DISCUSSION

3.1 | Descriptive statistics

The quarterly rate of injuries for seniors is 7.4%. According to Paget and Thélot (2017), the mean quarterly rate for all respondents to the ESPS is 4.8%, which indicates that older people are more prone to HLIs. According to different health indicators, Table 1 compares the structure of the general sample with the structure of the population with or without an HLI. The interpretation is straightforward: the occurrence of HLIs largely modifies the structure of the studied population for each health indicator, whereas the absence of HLIs keeps this structure practically unchanged. Moreover, HLIs seem positively correlated with health problems, suggesting that they are a worsening factor for HLIs. The scores of "past health status" support the idea that the proportion of people having at least 3 health problems is considerably higher for those who had only an HLI (57.9% versus 33.4%). Finally, 80% of the injuries requiring medical care occur at home, and two out of three are severe injuries (mainly falling and burning). The main descriptive statistics of the remaining variables are presented in Appendix B.

3.2 | Probability of HLI

We can see from Model 1 (Table 2) that only a few social variables are associated with the probability of HLIs. The individual's sex, health status, BMI, and age are characteristics related to this type of trauma. Men have a probability 2.1% larger than women to suffer from HLIs, and the risk of HLIs significantly increases with the number of health problems. People aged 75 years or older have a higher probability of HLIs than younger seniors in the age category of 64–65, while being overweight marginally decreases the odds of HLIs by approximately 2.6%. Concerning the person's habitudes and behaviors, our results suggest that having a cautious attitude decreases the chances of HLI by approximately 2.7%.

Our results also show that a larger supply of EHPAD beds for seniors with limitations and dependence is negatively associated with the probability of HLI, while people living in a district with higher social expenses for seniors over 75 years old have larger odds of injury. A person's educational level, socioprofessional category, social life, complementary health insurance, and living zone are not associated with this kind of injury[11].

[11] Two extra logit models are estimated. One model is without any health measure and a second one includes each different health problem instead of an aggregated health index (a binary variable for each one of the following indicators: sleeping or memory trouble, involuntary weight loss, limitations, or other conditions). As the results of this second model are

TABLE 1 Health problems and home and leisure injury (HLI) descriptive statistics

					%
Past health status (prior to HLIs observation period)		**Total sample**	**No HLI**	**HLI**	**HLI rate by health trouble**
Sleeping trouble***	Yes	36.6	35.3	52.3	10.6
	No	63.4	64.7	47.7	5.6
Memory trouble***	Yes	10.3	9.5	20.5	14.6
	No	89.7	90.5	79.5	6.6
Involuntary weight loss***	Yes	8.8	8.1	17.1	14.4
	No	91.2	91.9	82.9	6.7
Limitations as a result of a health problem***	None	52.0	53.9	28.4	4.0
	Yes, but not strong limitations	32.0	31.2	41.5	9.6
	Yes, strong limitations	16.0	14.9	30.1	13.9
Chronic diseases***	Yes	41.4	42.4	29.5	5.3
	No	58.6	57.6	70.5	8.9
Visual impairment***	Yes	5.4	4.9	10.8	14.8
	No	94.6	95.1	89.2	7.0
Hearing impairment***	Yes	12.1	11.4	20.5	12.5
	No	87.9	88.6	79.5	6.7
Past health index***	Any health problem	21.9	22.9	9.1	3.1
	One health problem	23.5	24.1	16.5	5.2
	Two health problems	21.2	21.5	16.5	5.8
	At least three health problems	33.4	31.5	57.9	12.8

Notes: Independence chi-squared test between each variable and HLIs.
Reading: A total of 36.6% of older people had sleeping trouble. This percentage is 52.3 for older people who had an HLI.
***Rejection of the null hypothesis at 1%.
Source: 2012 ESPS Survey. Author's calculations.

Based on these results, we can identify the profiles of the individuals having the lowest and the highest probability of HLIs[12] (Table 3). For seniors, the main characteristics associated with injury are age and health problems. The highest probability of HLIs (26.32%) concerns men with risky attitudes, aged 85 years or older and having at least three health problems. In contrast, the minimal probability (1.81%) is associated with women aged 65–69 years old with a cautious attitude and without health problems.

3.3 | Heterogeneity of HLIs and profile of injured people

As only a few individual characteristics are correlated with the probability of HLIs, we can suppose that some injuries are random or explained by a specific circumstance (negligence, bad

quite similar to the model presented in this study, only the marginal effects of the model with the aggregated health index (PaHI) are indicated in Table 2 (with better Akaike and Schwarz criteria). The exhaustive results of the regressions and the marginal effects for the two mentioned models are available upon request.

[12] The probabilities are estimated with the individual characteristics.

TABLE 2 Marginal effects associated with the probability of having a home and leisure injury (HLI)

					%	
		Model 1	Model 2		Model 3	
	HLI	Yes	No PMC	With PMC	With PMC at home	With PMC outdoors
Variable	Number of injured people	176	36	140	87[a]	53[a]
Men	Yes	2.14*	0.98*	1.21	−0.22	1.40*
Diploma	Yes	−0.94	−0.05	−0.92	0.18	−1.11*
Age	65–69	Ref.	Ref.	Ref.	Ref.	Ref.
	70–74	−0.74	0.03	−0.87	−0.46	−0.36
	75–79	3.19**	0.03	3.25**	0.36	2.36***
	80–84	2.73	−1.64	3.77**	3.16***	0.15
	85 and older	5.80***	0.47	5.48***	3.83***	0.96
Socioprofessional Category	Manager/professional/independent	Ref.	Ref.	Ref.	Ref.	Ref.
	Worker/elementary occupation	0.32	0.09	0.33	−0.96	1.17
	Out of work	−0.66	0.28	−0.94	−0.98	−0.17
Complementary healthcare insurance	Yes	−1.05	0.32	−1.24	−1.17	−0.07
Financial troubles	Yes	1.31	−1.20*	2.24**	1.54*	0.70
BMI	Normal	Ref.	Ref.	Ref.	Ref.	Ref.
	Overweight	−2.57**	−1.22*	−1.36	−1.37	0.13
	Obese	−2.17	−1.08	−1.11	−1.88*	0.83
Glasses	Yes	1.86	1.63	0.66	0.63	−0.19
Audio device	Yes	−2.11	−0.95	−1.32	−1.09	−0.23
Lives in couple	Yes	−0.12	−0.50	0.29	−0.11	0.57
Social life	None	Ref.	Ref.	Ref.	Ref.	Ref.
	Average	−0.61	−0.14	−0.34	0.08	−0.43
	Important	−1.95	−0.30	−1.61	−1.66	−0.20
Regular intake						
Alcohol	Yes	−1.80	−0.38	−1.42	0.37	−1.75**
Tobacco	Yes	−0.39	−0.77	0.48	−0.50	0.88
Fruits and vegetables	Yes	−0.79	−0.65	−0.17	−0.53	0.22
Risky attitude	Yes	2.69**	0.34	2.40**	1.70**	0.89
Concern about future	Not concern	Ref.	Ref.	Ref.	Ref.	Ref.
	Concern	−0.87	−0.34	−0.64	−0.73	0.17
	Did not answer	1.89	−0.95	2.37	−0.02	1.82
Living zone	Large city	Ref.	Ref.	Ref.	Ref.	Ref.
	Suburbs	−1.45	−0.88	−0.63	0.17	−0.94
	Small city	−1.62	0.46	−2.55*	−2.33*	−0.40
	Rural zone	0.68	−2.02	1.97	2.72**	−1.92

(Continues)

TABLE 2 (Continued)

					%	
		Model 1	**Model 2**		**Model 3**	
	HLI	**Yes**	**No PMC**	**With PMC**	**With PMC at home**	**With PMC outdoors**
Health problems (PaHI)	Any	Ref.	Ref.	Ref.	Ref.	Ref.
	One	3.55*	0.42	3.72*	2.68	1.15
	Two	4.13**	−0.22	5.44**	2.18	2.66**
	At least three	9.22***	−0.10	10.04***	7.42***	2.65**
District	EHPAD beds/100	−0.08**	0.00	−0.08***	−0.06**	−0.03
Variables	% of soc. expenses (75 y.o. or elder)	0.47**	0.24**	0.23	0.07	0.15
Pseudo-R2		0.079	0.104	0.126		
Log-likelihood		−577.91	−642.15	−707.58		
Akaike criterion		1219.82	1412.31	1607.16		
Schwarz criterion		1404.62	1781.92	2161.59		

Notes: For each model, the first column corresponds to the marginal effect (calculated from the average of the individuals ME), and the second column corresponds to the significance of the parameter; at *10%; **5%; ***less than 1%. All the models were estimated over the whole population with $n = 2381$. The standard errors are available upon request.

Abbreviations: BMI, body mass index; PaHI, past health index; PMC, professional medical care.

[a]For this model, the remaining 36 HLI without PMC are included, but the results are not presented because they are similar to those of Model 2.

Source: 2012 ESPS Survey. Author's calculation: Number of uninjured people: 2205 (ref.).

movement, inadequate supervision, etc.). Hence, it is less appropriate to analyze all HLIs equally. Based on the HLI classification proposed in section 2.2.1, we discriminate our results according to the severity of the injury (Model 2) and the place of occurrence of the injury and severity (Model 3).

3.3.1 | Severity of the injury

The results of the multinomial logit model (Model 2, Table 2) show that HLIs without PMCs are not associated with almost any individual characteristics. Consequently, we can suppose that this type of injury is random and cannot be anticipated (especially minor lesions such as cuts). Regarding HLIs with PMC, the three main variables highlighted in Model 1 also have significant coefficients: age, particularly for people aged 85 or older, risky attitude, and health status (the number of health troubles significantly increases the probability of HLIs with PMC). Moreover, people with financial troubles during their lifetime have a greater chance of needing medical attention due to unintentional trauma (more than 2%). Concerning the variables at the district level, we observe a negative association between the number of EHPAD beds and the odds of injuries needing medical attention. The estimated probabilities (Table 3) suggest that the greatest exposure (27%) to HLIs with PMCs concerns seniors aged 85 years or older with financial troubles, a risky attitude, and at least three health problems. The lowest probability (less than 1%) is associated with a healthy person aged between 65 and 69 years old, without financial troubles and who has a cautious attitude.

TABLE 3 Estimated probabilities for some individual profiles

Individual profile	Estimated probabilities of having an HLI	% 95% CI
HLI: Model 1		
Mean values of the sample	5.91	5.88–5.93
Woman, aged 65–69 years old, with cautious attitude and without health problem	1.81	1.69–1.94
Man, age 85 years older, with a risk attitude and with at least three health problems	26.32	23.97–28.67
HLI with PMC: Model 2		
Mean values of the sample	4.04	4.02–4.06
Aged 65–69 years old, with cautious attitude, without financial troubles and health problem	0.89	0.82–0.95
Aged 85 years older, with a risk attitude financial troubles and with at least three health problems	27.24	22.33–32.15
HLI with PMC at home: Model 3		
Mean values of the sample	1.97	1.95–1.98
Aged 65–69 years old, without financial troubles, with a cautious attitude, lives in an urban zone, without health problem	0.22	−0.08–0.51
Aged 85 years or older, with financial troubles and a risky attitude, lives in a rural zone, with at least three health problems	42.5	26.4–58.5
HLI with PMC outdoors: Model 3		
Mean values of the sample	1.40	1.39–1.41
Aged 65–69 years old, consumes alcohol, without health problem	0.26	−0.07–0.59
Aged 75–79 years or older, does not consume alcohol, with at least three health problems	11.45	9.84–13.06

Note: The standard errors are computed by the delta method. The other independent variables are taken at their average values.
Abbreviation: CI, confidence interval.
Source: Author's calculation.

According to the different estimated models, we can draw the individual exposure path to HLIs depending on the variations in both age and health status, that is, the two highly discriminating variables explaining the unintentional trauma. Figure 1 suggests that for injuries with PMC, the largest marginal exposure occurs when the person moves from 70−74 to 75−79 years old (and not when the person is 85 years or older, as we have found in the case of all injuries).

3.3.2 | Injury at home or outdoors

Following the idea that minor injuries are mainly random, we focus on the profile of people suffering from severe HLIs at home and outdoors. Our results, presented in Table 2 (Model 3), show that the probability of HLIs with PMCs at home increases with age, especially for people aged 85 years old and older. Moreover, people living in rural areas are more exposed to severe HLIs at home, with an approximately 3% higher risk. In contrast, living in a small city marginally decreases the

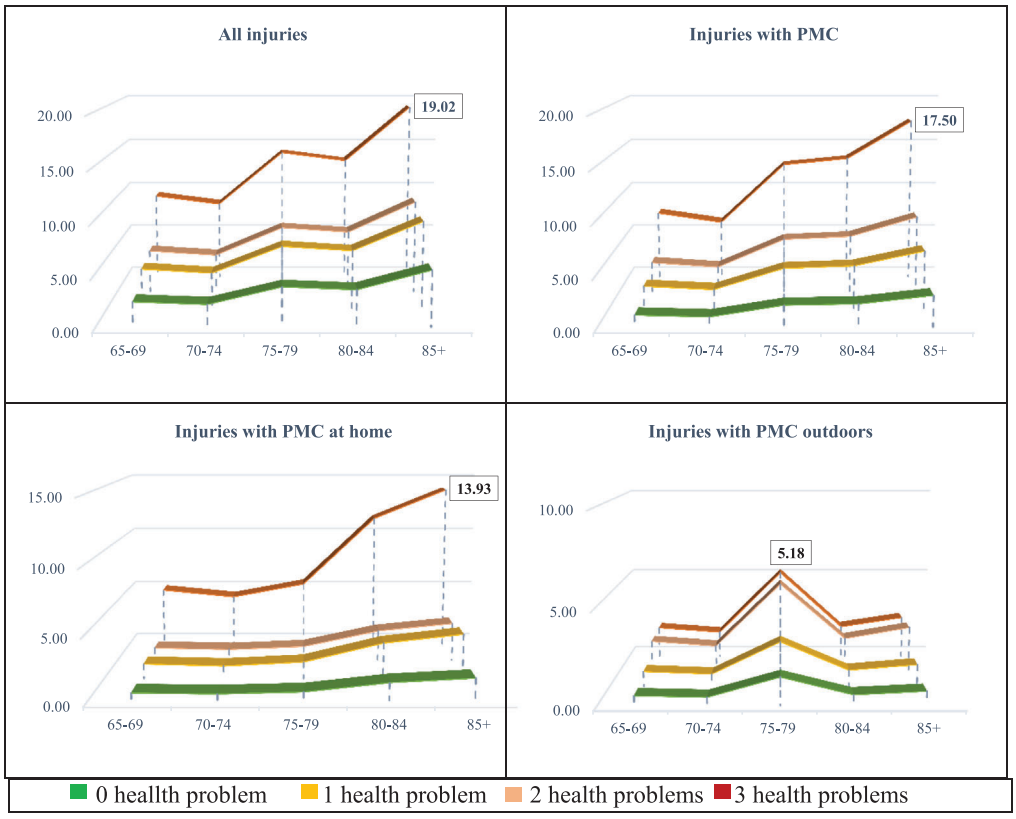

FIGURE 1 Estimated probability of home and leisure injuries (HLIs) by age group and health problems [Colour figure can be viewed at wileyonlinelibrary.com]

probability of HLIs by approximately 2%. A risky attitude marginally increases the probability of injury by approximately 1.7%. In the case of financial troubles, our findings indicate an increase in probability by 1.5%. Obese people have a smaller chance of HLIs by almost 2%. Finally, the number of EHPAD beds also reduces the rate of severe injuries for this type of injury. The maximal exposure to severe HLIs at home is estimated to be 42.5% for a senior aged 85 years or older with financial troubles, a risky attitude, who lives in a rural zone and has at least three health problems. In contrast, a healthy and younger senior (65–69 years old) with all the opposite characteristics does not have a significant probability of severe HLI at home.

In the case of severe injuries outdoors, being 85 years old or older is no longer significant. The association between age and HLIs outdoors is significant for the group of people in the category of 75–79 years old, with an approximately 2.4% greater chance of HLIs. The probability of unintentional trauma outdoors decreases by approximately 2% for alcohol consumers. Severe injuries outdoors are the least frequent type of injury for seniors, with a maximal probability of 11.5%, associated with men aged between 75 and 79 years or older who do not consume alcohol and have at least three health problems. Individuals with opposite profiles do not have a significant probability of being seriously injured outdoors.

Comparing the exposure paths to HLIs at home and outdoors (Figure 1), we can see that the probability of being injured at home greatly increases with the age and the presence of health problems of the person, especially from 75 years old. In contrast, for severe outdoor injuries, the

TABLE 4 Average present health indices and home and leisure injuries (HLIs)

Injury type	Present health status	
	PrHS	PrHI
Whole sample	3.486	3.322
HLI: No	3.440	3.170
HLI: Yes		
All HLIs	4.045***	5.267***
Without PMC	3.056	3.556
With PMC	4.300***	5.707***
With PMC at home	4.494***	6.529***
With PMC outdoors	3.981**	4.358***

Abbreviations: PMC, professional medical care; PrHI, present health index; PrHS, present health score.
Legend: *10%; **5%; ***1%; conclusion of the mean comparison test of health indices of the individuals who had an HLI and those who did not.
Source: 2012 ESPS Survey. Author's calculations.

marginal exposure increases by approximately 4% when moving from 70−74 to 75−79 years old and decreases in the same proportion afterward, which means that the peak risk for these two types of injuries is different. Finally, our analysis also identifies a disparity between men and women: severe HLIs at home are mainly related to women, whereas exterior injuries are mainly related to men. For further details about the sex component of HLIs, the estimations are available upon request.

3.4 | HLIs and present health

The results in the previous section of the analysis show that past health status (the information covering at least three months preceding the survey) is significantly associated with the probability of HLIs. To measure a possible short-term correlation between HLIs and health status after the injury, we consider the two present health definitions described in section 2.2.1 as dependent variables and regress them over the control variables and HLIs.

Table 4 provides the averages of the present health-related measures by type of HLI. As we could expect, these measures are, on average, significantly worse for people who had an HLI.

Because past and present health indices do not refer to the same variables, it would be hazardous to draw conclusions by comparing them directly. We test the exogeneity of HLIs before including them as explanatory variables (further details in Appendix C). A significant and positive coefficient associated with the variable HLIs would indicate that, in the short term, HLIs are negatively correlated with the present health status of seniors. The results of the estimations are shown in Table 5. Our findings indicate that, regardless of the definition considered, present health status is worse if past health status is also poor.

We also noticed that HLIs were not significantly associated with the PrHS. In contrast, the PrHI seems to be sensitive to the nature of HLIs. According to our results, health is significantly worse when the person has an acute injury at home, whereas all severe injuries are associated with a worse health status in the short term. This is quite predictable, as severe injuries are frequently associated with burnings or falling, which are injuries that can leave sequelae at least in the short term.

TABLE 5 Estimated association between past and present health

Past health and injury type	PrHS			PrHI		
Any health problem	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
One health problem	0.319***	0.319***	0.319***	0.464***	0.464***	0.464***
Two health problems	0.604***	0.604***	0.604***	1.409***	1.407***	1.419***
At least three health problems	1.200***	1.201***	1.201***	4.006***	4.002***	3.987***
No HLI	Ref.			Ref.		
All HLI	0.078			0.885***		
No HLI		Ref.			Ref.	
Without PMC		0.131			0.693	
With PMC		0.063			0.937***	
No HLI			Ref.			Ref.
Without PMC			0.131			0.692
With PMC at home			0.065			1.398***
With PMC outdoors			0.060			0.199

Note: Coefficients of control variables are available upon request.
Abbreviations: HLI, home and leisure injury; PMC, professional medical care; PrHI, present health index; PrHS, present health score.
Legend: significance of the parameter; at *10%; **5%; ***1%. Robust standard errors were computed.
Source: 2012 ESPS Survey. Author's calculations.

4 | DISCUSSION

Regarding the general factors associated with HLIs, a first interpretation concerns the relationship between risky attitudes and HLIs. Our results confirm those provided by the literature associating risk-loving people with greater chances of falling (Paget & Thelot, 2017). A risk loving attitude might limit the investment in preventive health care earlier in life, which could lead to reduced health capital during late life, thus generating an increase in the probability of HLIs. However, because health status is controlled in all of our models, we capture here the net linkage of risky behavior and injuries. A disclaimer must be made regarding the risky attitude in later life. It seems difficult to think that seniors, particularly individuals aged 85 years and older, are ready to take big risks, such as engaging in extreme physical activity, vigorous leisure, or sports. However, attitudes and behaviors are individual characteristics that barely change in a lifetime, and in the case of seniors, a risky attitude could thus be as simple as going outside without help or without any walking aid when needed.

Concerning the association of HLIs and obesity, the smaller odds of HLIs for obese people could be explained by a relatively reduced mobility and/or to a higher formal/informal home assistance received. The literature is divided in this regard. On the one hand, an overweight person can have comorbidities and movement difficulties, which could increase the probability of HLIs (Xiang et al., 2005), but on the other hand, overweight people are probably less likely to become involved in physical activities, thus decreasing the probability of injuries (Bouchard et al., 2010; Xiang et al., 2005). Moreover, a complementary medical argument can be used to explain our result that overweight people have a smaller probability of injury: bone mass is relatively higher for overweight people, which implies a decrease in the probability of bone fracture in general and hip fracture in particular (Buclin Thiébaud et al., 2010).

The inclusion of two macro variables at the district level helps us to understand whether some disparities among regions or districts can explain the differences in the rates of HLIs in the French territory. The variable of EHPAD beds could be a proxy of specialized health care availability in the district, which could limit the occurrence and severity of the injuries for the highly dependent individuals who are the residents of this type of nursing home. Even though people in our sample live at home and not in institutions, this variable could account for the general infrastructure for older people available in the district. Consequently, a larger offer of beds in nursing homes means fewer dependent people at home without help (especially handicap, limited, or frail people). Regarding the second district variable, the mandatory expenses on social aid are proportional to the share of older people in each district (budgets are built according to the district needs), implying a higher rate of social expenses for districts with a higher share of people over 75 years old.

The significant correlation of these two variables with HLIs advocates for increasing both the number of institutions providing specialized care for dependent seniors and the accessibility of seniors in institutions. This could also be a proxy for a rural/urban disparity. Usually, cities are better equipped and benefit from larger budgets. Our results suggest that specialized care could be associated with fewer HLIs, thus calling into question French mainstream policy, which defends the idea of keeping people at home as long as possible, as it seems to be the preferred option for seniors and less disruptive to their mental health[13].

Our results also suggest that financial distress during the lifetime is associated with larger chances of HLIs, thus confirming the findings of the literature (Alptekin et al., 2007; Ferrante et al., 2014). This positive relationship between financial problems and greater exposure to HLIs could be explained by the fact that individuals with low income could have less access to preventing care services (Trujillo et al., 2011). In this case, as our variable refers to financial troubles during one's lifetime, it is possible that people who have health deprivation or poor working conditions in early life have decreased health capital in senior years (Grossman, 1972). Because health status is controlled, there is indeed a net relationship between financial problems and the probability of HLIs. People who have experienced financial problems during their lifetime are also more likely to live in poorly equipped houses, which could be less safe for older people (unsuited domestic appliances, inadequate house adaption for mobility restricted people, etc.). Moreover, financial problems could considerably limit access to professional assistance (domestic help, nursing), thus increasing exposure to HLIs.

The results of alcohol consumption can be justified by the fact that in France, 65% of men and 33% of women aged 65–75 consume alcohol daily: 2.6 glasses for men and 1.5 for women (INPES). Some were already consuming alcohol at a younger age, and their consumption continues at older ages. For the rest of them, alcohol consumption is explained by specific factors such as feeling of unease (feeling of futility, loss of the meaning of life, etc.) or losses (passing into retirement, death of people close to them, etc.). It seems that in France, older people who drink alcohol tend, regardless of their physical condition, to leave their homes less often (Michaud & Lécailler, 2003; Savary et al., 2018), which could explain the reduced probability of HLIs for alcohol consumers[14].

[13] A specific cost–benefit analysis measuring the effectiveness in terms of individual and family well-being of home versus institution as solutions for the long-term care coverage could thus be particularly useful for making reliable policy recommendations.

[14] As opposed to other countries as Spain or the United Kingdom, old people in France do not have the habit of going out to bars.

Regarding the analysis of the heterogeneity of HLIs, no previous work, to the best of our knowledge, has considered minor and major injuries or injuries at home or outdoors at the same time, which is one of the main contributions of our analysis to the literature. Most of the works focus only on severe or home injuries. For major injuries at home, we could suppose that people living in rural zones have a larger rate of injuries due to the presence of a garden around the house, which is an acknowledged risk factor for HLIs (Ferrante et al., 2014). Concerning severe injuries outdoors, our analysis provides an interesting result. The highest probability for this type of HLI is associated with people aged between 75 and 79 years old with several health problems. The explanation relies on the fact that being injured outdoors supposes a relative autonomy of the person, which is highly unlikely for a very old individual with a deteriorated health status.

This result is not just original but also important because an acute HLI that permanently modifies the health status of the person (for instance, causing dependency or disability, at the beginning of the senior years) supposes an important loss in QALYS and permanent financial assistance, which could represent a burden to the person and to the health system. Previous research suggests that for elderly individuals, medical expenses related to HLIs are higher and more persistent (Do et al., 2015; Runyan et al., 2005). For instance, severe injury outdoors for an individual aged 70 years old can translate into several years of limitations requiring highly expensive and permanent specialized care.

Furthermore, it seems essential for future research to study in detail the characteristics of younger seniors who are more exposed to injuries outside. We could suppose that these individuals are more tempted to overestimate their physical condition, thus explaining a higher exposure to risky activities. Prevention programs, which are usually focused only on the elimination of physical hazards in the household (securing stairs, amenities for the bathroom, protection for radiators and fireplaces, etc.), should thus be adapted to also consider the issue of education about the risks of HLIs later in life[15].

Finally, we notice a gender component of HLIs that can be explained by both the differences in habits and the time spent at home between men and women and by the differences in the willingness to engage in risky activities at home and outdoors.

Our results have specific public policy implications. We can thus distinguish between general preventive measures, which do not strictly concern seniors, on the one hand, and more specific measures targeting the high-risk groups of older people, on the other hand. The former measures could thus be oriented toward the reduction of both health inequalities and inequalities in access to healthcare services to reinforce the sustainability of the healthy aging process among the population. At the same time, the measures could also aim to create awareness about the different direct and indirect, individual and social costs of HLIs and to encourage cautious attitudes (stimulating people to enroll in health care programs, learning about safety procedures in the home environment, etc.) allowing us to reduce both the severity and the frequency of HLIs. Concerning the more specific preventive measures, they could mainly contribute to reinforcing the assistance mechanisms provided to risk-sensitive older people. According to the level of exposure to HLIs, these measures could facilitate access for older people to both professional assistance tools (domestic help, nursing) and technical help products and services (housing adaption, home automation systems, connected objects, walkers, wheelchairs, etc.).

Our analysis presents some limitations. Concerning the characteristics of our population, we did not include any information about the people's housing conditions or about their daily life

[15] An analogy can thus be made with the preventive measures aimed at educating the population about the health risks of smoking, the risks of HLIs for children, and so forth.

environment. Indeed, as seniors spend most of their time at home, the quality of their home environment is crucial to accurately identify other characteristics associated with HLIs and consequently to adjust preventive measures aiming to limit exposure to these injuries. Concerning the methodology, we did not address the possible endogeneity of health status. As we have already stated, both trauma and health are a measure of the physical condition of the person at a precise moment, and we could assume that there are some unobserved factors affecting both the health and the probability of injury. We did not find suitable instrumental variables to treat both variables as endogenous. Further specific research should be conducted to technically respond to this issue of endogeneity[16].

5 | CONCLUSION

The main objective of this study is to identify the characteristics associated with unintentional home and leisure injuries in the senior French population. Our findings support the idea that health problems and age are the two main factors particularly associated with the probability of HLIs for people 65 years old or older. The probability of having HLIs, regardless of the nature or the place of occurrence, also increases with a risky attitude and marginally with sex (men with a larger probability than women). Concerning severe HLIs, a social component such as financial troubles also plays a role in explaining the probability of injuries. Severe home HLIs are the most likely type of trauma for older people because seniors spend most of their time at home and are more exposed to a major injury due to diminished health and body functioning.

The individual exposure paths to HLIs suggest that the peaks of exposure generally concern the oldest seniors with deteriorated health status. Nevertheless, there is a notable exception regarding severe outdoor HLIs, which seem to be more frequent in the case of relatively younger seniors, that is, 75–79 years old. Our findings also state a considerable acceleration of exposure to severe HLIs at the beginning of the senior period, that is, the period moving from 70–74 to 75–79.

Based on the evidence indicating that people who have an HLI declare worse present health, we explicitly analyzed the short-term association of HLIs and health status. Our results suggest that only the aggregated measure of health is influenced by HLIs and mainly by severe home HLIs.

In summary, seniors' features related to HLIs can be structured around two main dimensions, according to their relevance in terms of public health policies. First, we have ineluctable factors, such as age and health status, and particularly the association between advanced age and deteriorated health status. Due to their natural evolution, these variables are slightly affected by health policies. Second, exposure to HLIs is highly reinforced by risky attitudes and financial troubles. Moreover, in the case of severe outdoor HLIs, the probability of injuries seems considerable for younger seniors. These variables could be sensitive to health policies, and consequently, preventive measures aiming to limit the frequency of severe HLIs should mainly focus on them.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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[16] The Lewbel's instrumental variables method could potentially be used for this purpose.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A: HEALTH DEFINITIONS

Present health index (PrHI)

It was created following the same method used for the past health index, with information about health at the moment of the survey. The information these two indices recollect is not the same, but they proxy health status before and after an HLI.

TABLE A1 Questions and variable construction of the present health index (PrHI)

Variable	Question in the ESPS survey
Fatigue	During the last 4 weeks, have you had a generalized weakness feeling, fatigue, or lack of energy? • No at all (0 points) • A little (1 point) • A lot (2 points) Total max: 2 points.
Feelings	During the last 4 weeks, have you felt: • very nervous (1 point if the answer is 1 or 2), • so discouraged that nothing could cheer you up (1 point if the answer is 1 or 2), • sad and depressed (1 point if the answer is 1 or 2), • calm and relaxed (1 point if the answer is 4 or 5), • happy (1 point if the answer is 4 or 5)? 1. All the time/2. Most of the time/3. Some of the time/4. A little of the time/5. None of the time.Total max: 5 points.
Physical activity	Do you have difficulties for: • walking 500 m (1 point), • going up or down 12 steps in a stair (1 point if the answer is 3 or 4), • carrying a bag of 5 kg like a big grocery bag (1 point if the answer is 3 or 4), • standing during a long period (1 point if the answer is 3 or 4), • bending down or kneeling without help (1 point if the answer is 3 or 4)? 1. Any/2. Some/3. A lot/4. I cannot do it at all.Total max: 6 points.
Daily life activities	Do you have difficulties for doing any of the following activities: • eating (1 point if the answer is 3 or 4), • going to bed (1 point if the answer is 3 or 4), • sitting-in or standing from a chair (1 point if the answer is 3 or 4), • dressing, or undressing (1 point if the answer is 3 or 4), • using the toilettes or taking a shower? (1 point if the answer is 3 or 4) 1. Any/2. Some/3. A lot/4. I cannot do it at all.Total max: 5 points.
Present health index	Addition of the code of the four different variables, the index varies between 0 and 18. Total max: 18 points.

Past health index (PaHI)

It was created by adding all the health variables that refers to health before HLI, since the name of "past health status." We used the method proposed by the Mental Health Inventory and the Short-Form Health Survey (Ware and, Sherbourner, 1992). The included information was as follows:

TABLE A2 Questions and variable construction of the past health index (PaHI)

Variable	Question in the ESPS survey
Sleeping problem	Have you had, during at least 1 month, sleeping problems (troubles for falling asleep, constant awakenings during night-time, not feeling well rested after sleeping or waking up too early or too shortly after going to sleep) at least three times per week? - Yes (1 point) - No (0 point)
Memory problem	Is it possible for you to forget in which moment of the day you are living? - Yes (1 point) - No (0 point)
Involuntary weight lost	Have you involuntarily lost weight during the last 12 months, without following a diet? Yes/NoIf yes, the next question is: how many kilograms have you lost? - 1 point if the weight lost is superior to 5% of the original weight. - 0 otherwise.
Chronic disease	Do you have a health problem that is chronic or permanent? Yes/No - Yes (1 point) - No (0 point)
Limitation due to a disease	Have you been limited for doing general daily life activities because of a health problem, during at least 6 months? - Strongly limited (2 points) - Mildly limited (1 point) - Not at all (0 point)
Visual impairment	Do you have seeing problems (even when using glasses or contact lenses if you use them)? - 1. Any/2. Some (0 points) - 3. A lot/4. I cannot see at all (1 point)
Audition impairment	Do you have problems for hearing what is said in a conversation with another person in a noisy room (even when using your hearing device if you use any)? - 1. Any/2. Some (0 points) - 3. A lot/4. I cannot hear at all (1 point)
Continuous "past" health index	Addition of the points of the seven questions, the index varies between 0 and 8 (limitation due to disease can take three values: 0, 1, or 2)
"Past" health index	The continuous "past" health index has been divided in four binary variables correspond to four health level: - 1 if any health problem, 0 otherwise - 1 if one health problem, 0 otherwise - 1 if two health problems, 0 otherwise - 1 if at least three health problems, 0 otherwise.

APPENDIX B: DESCRIPTIVE STATISTICS AND HLIs

				%
			HLI	
		Total	No	Yes
Frequency		2,381	2,205	176
Sex	Women	51.8	52.0	48.9
	Men	48.2	48.0	51.1
Diploma	Yes	49.6	49.8	46.6
	No	50.4	50.2	53.4
Age	65–69 years old	35.6	36.4	26.1
	70–74 years old**	21.1	21.7	14.2
	75–79 years old	19.5	19.2	23.3
	80–84 years old	14.0	13.8	17.1
	85 years and older***	9.7	8.9	19.3
Socioprofessional category	Manager/professional/ independent	54.8	54.5	58.5
	Worker/elementary occupation	26.7	26.8	24.4
	Out of work	18.5	18.6	17.6
Complementary healthcare insurance	Yes	94.5	94.5	93.7
	No	5.5	5.5	6.3
Financial troubles	Yes	26.0	25.7	30.7
	No	74.0	74.3	69.3
Body mass index	Normal	40.9	40.4	47.2
	Overweight	39.0	39.4	34.1
	Obese	20.1	20.2	18.8
Glasses	Yes	89.7	89.2	96.0
	No	10.3	10.8	4.0
Audio device	Yes	9.2	9.2	9.1
	No	90.8	90.8	90.9
Lives in couple	Yes	74.3	74.7	69.9
	No	25.7	25.3	30.1
Has a social life: family, friends, association	None	18.5	18.4	20.5
	Average	69.0	68.7	73.3
	Important**	12.5	13.0	6.3
Regular intake	Alcohol***	63.3	63.9	54.0
	Tobacco	7.3	7.3	6.8
	Fruits and vegetables	59.1	59.4	56.3
Risky attitude	Cautious (5 or less)	64.0	64.3	61.4
	Risky or adventurer (more than 5)	36.0	35.7	38.6

(Continues)

				%
			HLI	
		Total	No	Yes
Concern about future	Not concern (6 or less)	54.3	54.1	56.8
	Concern (more than 6)	41.8	42.1	38.1
	Did not answer	3.9	3.8	5.1
Living zone	Large city	48.4	48.1	52.3
	Suburbs of a large city	26.4	26.8	21.6
	Small city	17.7	17.7	17.1
	Rural zone	7.5	7.4	9.1
District variables (average)	EHPAD beds/100	52.64	52.84	50.18
	% of social expenses for 75 y.o. or elder	11.59	11.57	11.93

Notes: We made an independence chi-squared test between each variable and having an HLI. Rejection of the null hypothesis of independence at *10%; **5%; ***less than 1%.
Source: 2012 ESPS Survey. Author's calculations.

APPENDIX C: IDENTIFICATION TESTS

		All HLI				HLI with PMC			
		PrHS		PrHI		PrHS		PrHI	
Test or statistic	Null hypothesis	Empirical value	*p* Value	Empirical value	*p* Value	Empirical value	*p* Value	Empirical value	*p* Value
Anderson canonical correlation	Under-identification	9.340	0.009	9.340	0.009	8.130	0.017	8.130	0.017
Cragg-Donald Wald	Under-identification	9.370	0.009	9.370	0.009	8.160	0.017	8.160	0.017
Sargan	Over-identification	0.569	0.451	0.190	0.663	0.455	0.500	0.106	0.745
Anderson Rubin Wald	Over-identification	0.580	0.749	0.250	0.881	0.580	0.749	0.250	0.881
Endogeneity of HLI	Variable is exogenous	0.000	0.999	0.279	0.597	0.080	0.777	0.394	0.530

To include HLI as an explanatory variable of the different measures of present health status, we tested the exogeneity of injuries using instrumental modeling. We considered that regional variables are instruments. If a variable is a valid selection instrument, it will affect the probability of HLI, but it will not affect the health variable. Regional variables seem to be valid instruments. Finally, in continuous instrumental modeling, we have to test for identification. Because overidentification tests are only adapted to endogenous continuous variables, we consider two linear probability equations for HLI. In the first model, we tested all the injuries, while in the second model, we used only the injuries requiring professional medical care. The table above presents the results of the different tests. The Anderson canonical correlation and the Cragg-Donald Wald statistic were used to identify the model. In all cases, they reject the null hypothesis of

underidentification at less than 1%, while the Sargan and the Anderson Rubin Wald[17] tests analyze the overidentification of the models. We do not reject the null hypothesis that the overidentifying restrictions are valid. Regarding the endogeneity of injuries, we do not reject either the null hypothesis of exogeneity of injuries in any case, which allows us to proceed with the estimation used in Section 3.2. Treating injuries with professional medical care against people with minor or no injuries is justified for the random nature of minor injuries that did not require medical attention. Finally, since severe injuries at home and severe injuries outdoors are a subdivision of injuries with professional medical care, the extension of the results could be applied to these injuries.

[17] Robust to the presence of weak instruments.