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## Health trajectories of elderly living in French senior housing: a longitudinal perspective

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2

3 **Health trajectories of older persons living in French senior housing: A Longitudinal Perspective**

4

5 **Abstract**

6 Senior housing for older adults could be an alternative or a transitional care model between home care  
7 and nursing home care. Using two longitudinal cohorts of community dwellers aged 65 years or older,  
8 we compared risks of mortality and of nursing homes admission between older adults who did or did  
9 not move to senior housing over time. In the 3C study (n=2104, 17 years of follow-up), 143 (6.8%)  
10 participants moved into a senior housing during the follow-up. This move was associated with a lower  
11 risk of mortality (hazard ratio (HR): 0.64; 95% confidence interval (CI) 0.46 to 0.77) and a higher risk  
12 of nursing home admissions (HR: 1.54 (1.10-2.15)). The risks of hospitalizations (HR: 0.54 (0.40-  
13 0.73)) and falls (HR: 0.63 (0.50 to 0.79)) were lower. In the PAQUID study (n=3777, 27 years of  
14 follow-up), 161 (4.3%) participants moved into a senior housing. This move was also associated with  
15 a lower mortality risk (HR: 0.72 (0.58 to 0.88)) and a higher risk of nursing home admissions (HR:  
16 1.39 (1.05-1.86)). Our results showing lower risks of mortality suggest that senior housing may be a  
17 relevant model for vulnerable older adults.

18 **Keywords:** Senior housing; mortality; nursing home; health trajectories.

19 **Introduction**

20 The aging of the population in developed countries poses significant challenges for health policy  
21 worldwide. Finding the appropriate care option for dependent or vulnerable older adults remains  
22 difficult (1). The WHO, within the framework of Decade of Healthy Ageing, promotes the integration  
23 of care and services that meet the individual needs of older people and access to long-term care (2). To  
24 date, the most widespread social model revolves around home care and nursing home care – for people  
25 with or at risk of unmet home care needs. It has been previously reported that the majority of people  
26 aged 50 and over would like to age in their current home (85% according to a French national survey  
27 institute (3)), regardless of their functional status. Several services promote aging in place for this  
28 purpose (remote monitoring, telemedicine, home care services) (4,5). Nonetheless, social isolation,  
29 social vulnerability, and loneliness among older people living at home (6) increase the risk of adverse  
30 health events; they are respectively associated with a 29%, 26%, and 32% increase in mortality risks  
31 (7). On the other hand, voluntary or involuntary nursing home admission is often the result of a  
32 deterioration in health caused mainly by falls, cognitive impairment, dependence in daily activities, or  
33 strokes (8, 9). Nursing homes are the last place of residence as well as the place of death for most  
34 institutionalized older people, after an average length of stay of three years and four months in France  
35 (10).

36 The transition from one's home to a nursing home usually disrupts residents' social life and lifestyle  
37 (11). Institutionalized older adults experience greater cognitive decline than community-dwelling  
38 individuals (12), a decreased in quality of life (13) and increased psychotropic medication use (14)  
39 after moving into nursing home. For these reasons, we need to study alternative and transitional care  
40 models between home care and nursing home care. Among these models, "senior housing" (also called  
41 "residential care facilities ", "independent living communities", "assisted living facilities", or  
42 "continual care retirement communities") have been developed over the last decades. Usually, each  
43 resident has a private apartment and access to common areas and services. Senior housing differ in  
44 size, type (residence or village), services offered, and costs. These facilities aim to promote the  
45 autonomy of older people and help them maintain an active social life (15). In the United States,  
46 between 980,000 and 2 million people live in these community-based residential care settings,  
47 depending on the definition we use (16). In France, there are about 2,300 residences of this type  
48 (representing approximately 120,000 accommodation places), called "Residences for autonomous  
49 seniors" accommodating an average of 48 residents each. Two-thirds are public, 30% are private non-  
50 profit and 4% are commercial. These structures have a social vocation, they receive funding and the  
51 rents are moderate. External service providers (private doctors, home nursing services, private nurses)  
52 most often provide medical care and routine care for residents. In some senior housing, there are  
53 medical staff on site, such as care assistants or nurses. Staffing levels are lower in senior housing than  
54 in nursing homes, with a staff ratio of 13 per 100 beds compared to 64 per 100 beds in nursing homes

55 (17). The mean age at admission is 81 years, and the mean length of stay is five years (16). Most  
56 residents have no disability, but more than half meet the criteria for frailty (53.7%) and suffer from  
57 depressive disorders (53.5%) (18).

58 Few studies have assessed the effectiveness of senior housing in preventing adverse health events  
59 (deaths or hospitalizations) compared to home care. Available studies (19-22) suggest a higher risk of  
60 mortality in senior housing compared with home care or community. However, these studies are of  
61 short duration (1-5 years of follow-up) and the baseline medical characteristics of the older adults were  
62 not comparable between these two populations. Regarding hospitalization, one longitudinal study  
63 observed a decrease for heavy hospital use over time for older people living in senior housing  
64 compared with older people remaining at home (23).

65 The choice to invest in a senior housing is an important issue for a village or a town. Thus, assessing  
66 the relevance of this investment is crucial for the community. Research is necessary to determine  
67 whether this type of geriatric facility can be an effective alternative to home care and promote higher  
68 survival rates. The present study uses data from two population-based cohorts (3C and PAQUID) of  
69 older people living at home initially and followed over time, contrary to previous studies (18-21). Its  
70 primary objective was to compare mortality and risks of nursing home admission between older  
71 people who moved to a senior housing during follow-up and older people who did not moved into  
72 senior housing. Secondary objectives were to compare the risk of hospitalization, fall, and frailty that  
73 might explain a potential difference in survival, using data from the 3C cohort.

74

## 75 **Materials and Methods**

### 76 The 3C study

77 The 3C Study is an on-going multicenter prospective cohort study conducted in France. Its primary  
78 objective was to assess the relationship between vascular factors and dementia in people aged 65 years  
79 and over. The detailed study protocol has been published elsewhere (24). Briefly, noninstitutionalized  
80 men and women aged 65 years or over were randomly selected from electoral rolls of three French  
81 cities. The acceptance rate was 37%, resulting in 9294 participants (4931 from Dijon, 2104 from  
82 Bordeaux, and 2259 from Montpellier). Participants were followed-up every two to three years (7  
83 follow-ups) for 17 years, even if they entered a senior housing or a nursing home. The Bordeaux  
84 sample provided information on vital status at baseline (1999–2000) and at each follow-up (n=2104).  
85 The number of participants lost to follow-up in this sample was 277 at 17 years. By the end of the last  
86 follow-up, 1257 participants had died.

### 87 Data from the 3C Study

88 Trained nurses and psychologists collected the data during face-to-face interviews using standardized  
89 questionnaires. For the present study, the following variables were extracted at baseline and each  
90 follow-up: sociodemographic characteristics (gender, age, and educational level), transition to a  
91 nursing home or a senior housing, vital status, hospitalizations, falls, global cognitive performance,  
92 and functional status. The Mini-Mental State Examination (MMSE) score, ranging from 0 to 30,  
93 measured global cognitive functioning. The Instrumental Activities of Daily Living (IADL) scale  
94 (Lawton's IADL scale) and the Activities of Daily Living (ADL) scale (Katz's scale) assessed  
95 functional status. Depression was assessed with the CES-D (Center for Epidemiologic Studies-  
96 Depression) scale. Falls were self-reported.

97 Frailty was assessed using the five components of the phenotype proposed by Fried *et al.* (25). Weight  
98 loss was assessed in a self-reported manner (recent and unintentional weight loss of 3 kg or more or a  
99 body mass index (BMI, calculated from anthropometrical measurements) lower than 21 kg/m<sup>2</sup>).  
100 Participants assessed their level of exhaustion with two questions also used in the Cardiovascular  
101 Health Study: "I felt that everything I did was an effort" and "I could not get going.". Slowness was  
102 defined as the lowest quintile on a timed 6-meter walking test, at usual pace, adjusted for gender and  
103 height, among participants of this study. Participants answering "yes" to the question "Do you have  
104 difficulty rising from a chair?" were categorized as frail for weakness. Low physical activity  
105 corresponded to performing daily leisure activities (such as walking, gardening, or exercising) less  
106 than once a week. For the present study, participants meeting three or more criteria were considered  
107 frail and the others non-frail.

#### 108 Validation analysis in the PAQUID study

109 The PAQUID cohort started in 1988–1989 with a representative sample of 3777 participants aged 65  
110 years and over and living at home in two French departments (Gironde and Dordogne) (26). The  
111 selection was stratified by sex, age, and urban unit's size. Face-to-face interviews were conducted at  
112 home every 2–3 years by specially trained neuropsychologists. Sociodemographic, environmental, and  
113 health-related data, including entry into a nursing home or a senior housing, were collected  
114 prospectively at each wave with the participant or a proxy, when self-assessment was impossible or  
115 invalid. The PAQUID program included a systematic and regular record and check of deaths with the  
116 administrative data from death certificates obtained from general practitioners and the city  
117 administrative department (date and cause of death). Data on hospitalizations, falls, and frailty were  
118 unavailable for this cohort. The number of older people lost to follow-up in this cohort was 98. By the  
119 end of the study, 3665 participants had died.

#### 120 Statistical analysis

121 Descriptive analyses were conducted using frequencies and percentages for categorical variables and  
122 means and standard deviations (SD) for continuous variables.

123 In our analyses, nursing home admission and death were considered as competing risks in a semi-  
124 parametric illness-death model accounting for left-truncation and right censoring. We used a semi-  
125 parametric approach with M-splines approximation of baseline intensities in order to obtain smooth  
126 estimates of the hazard functions (27). This model allowed us to make predictions and obtaining the  
127 following probabilities:

- 128 • The probability of being alive without entering a nursing home
- 129 • The probability of being alive and entering a nursing home
- 130 • The probability of dying

131 We also presented the predictions in two subgroups: people who never moved to a senior housing and  
132 people who did so during follow-up. We performed univariate and multivariate models taking age as  
133 the baseline time and adjusted *a priori* for gender, educational level, and IADL disability (at baseline).  
134 The exponential of each regression coefficient can be interpreted as a hazard ratio (HR) like in Cox  
135 models. All regression coefficients were estimated simultaneously using the Smooth Hazard R  
136 package (28).

137 Cox proportional hazard models with delayed entry were performed to estimate the risks of  
138 hospitalizations, falls, and frailty, using data from the 3C Study. Models were adjusted for gender,  
139 educational level, and IADL disability (at baseline).

140 Ethics declarations: The Ethical Committee of the University Hospital of Kremlin-Bicêtre (Paris) has  
141 approved the protocol of the 3C study. Each participant signed a consent form. The ethical committee  
142 of the Bordeaux University Teaching Hospital has approved the PAQUID study according to the  
143 principles embodied in the declaration of Helsinki in 1988. The study investigators informed all  
144 participants and their proxies of the ongoing research activity. They were free to accept or refuse to  
145 participate. Participants provided written informed consent.

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147

## 148 **Results**

### 149 Characteristics of the 3C study sample

150 Table 1 shows the baseline characteristics of the 3C sample. The average age of the 2104 participants  
151 was 74.6 years old (SD: 5.3), and 61.2% were women. During the 17-year follow-up, 143 (6.8%)  
152 participants moved into a senior housing.

153 At the time of admission into a senior housing, the mean age of the 143 participants was 82.8 years old  
154 and most of them were women (80.4%). Their mean MMSE score was 25.9 and 48.6% were  
155 dependent in at least one IADL (table 1).

156

157

Variables	Baseline characteristics of the participants of 3C study		Characteristics of the residents at the time of entry into senior housing	
	n	Mean (SD) or n (%)	N Total	Mean (SD) or N (%)
Age (years)	2104	74.6 (5.1)	143	82.8 (5.9)
Gender (women)	2104	1288 (61.2%)	143	115 (80.4%)
High educational level	2099	1837 (87.5%)	143	119 (83.2%)
MMSE score	2081	27.2 (2.4)	139	25.9 (3.3)
Instrumental Activities of Daily Living (at least > 1IADL)	2095	296 (14.1%)	142	69 (48.6%)
Activities of Daily Living (at least > 1ADL)	2102	30 (1.4%)	143	14 (9.8%)
CESD score	2054	7.5. (7.7)	121	9.8 (8.6)

158 **Table 1: Baseline characteristics of participants of 3C study and characteristics of the residents at the time of entry into**  
159 **senior housing**

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Effects of moving into a senior housing on the risks of death and nursing home admission

In all three models (1. univariate, 2. adjusted for sex and education level, and 3. adjusted for sex, education level, and IADL score), moving into a senior housing was associated with a decreased mortality risk over time compared to older adults who did not move into a senior housing (table 2 and figure 1).

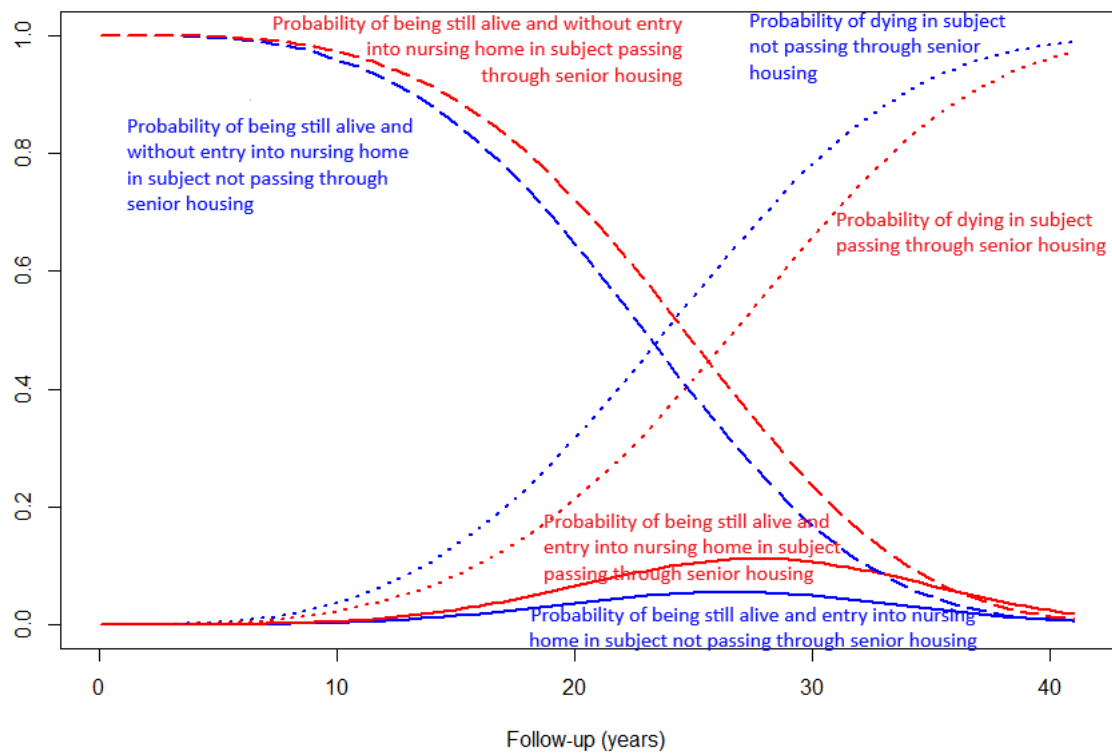
Of the 143 participants who moved into a senior housing during follow-up, 46 (32.2%) subsequently moved into a nursing home. They were 255 (13.0%) among those who never lived in senior housing. In all three models, having lived in a senior housing was associated with an increased risk of nursing home admission (table 2).

Having lived in senior housing did not affect the risk of death after nursing home entry in all three models (Table 2).

**Table 2: Estimated effects of moving into senior housing on the risks of mortality and nursing home admission, illness-death model. 3C study (n=2095).**

	<b>Model 1 (Univariate)</b>		<b>Model 2 (Adjusted by gender and education level)</b>		<b>Model 3 (Adjusted by gender, education level and IADL score)</b>	
<b>Transition</b>	HR (CI 95%)	p	HR (CI 95%)	p	HR (CI 95%)	p
Death	0.59 (0.46-0.77)	<0.001	0.65 (0.50-0.85)	0.001	0.64 (0.49-0.83)	<0.001
Transition to nursing home	1.63 (1.17-2.27)	0.004	1.58 (1.13-2.20)	0.007	1.54 (1.10-2.15)	0.011
Death after nursing home admission	0.94 (0.63-1.38)	0.739	0.96 (0.65-1.43)	0.843	0.96 (0.65-1.43)	0.845

Figure 1 shows the probabilities of death and nursing home admission at each follow-up according to whether the participants moved into a senior housing during follow-up. The probability of dying was higher for older persons who did not move into a senior housing. In contrast, the probability of being still alive without entering a nursing home was higher for those who went through a senior housing.



**Figure 1: Estimated probabilities of death, nursing home admission, and being alive according to residential status (no senior housing in blue versus senior housing in red)**

Risks of hospitalization, falls and frailty.

Among the 143 participants who moved into senior housing, 88 (61.5%) were hospitalized during follow-up, compared to 1389 (70.8%) among those who never moved into senior housing. In all three models, having moved into a senior housing was associated with a decreased risk of hospitalization and falls (Table 3).

For non-frail older adults, having moved to a senior housing was associated with a decreased risk of frailty incidence only in the univariate model (table 3). The HR estimates were similar but no more significant when we controlled for gender and educational level.

**Table 3: Estimation of the effects of a moving into a senior housing on the risks of hospitalizations, falls, and frailty, Cox model. 3C study (n=2095).**

Variables	Model 1 (Univariate)		Model 2 (Adjusted by gender and education level)		Model 3 (Adjusted by gender, education level and IADL score)	
	HR (CI 95%)	p	HR (CI 95%)	p	HR (CI 95%)	p
Hospitalization	0.52 (0.39-0.70)	<0.001	0.53 (0.39-0.71)	<0.001	0.54 (0.40-0.73)	<0.001
Fall	0.64 (0.51-0.80)	<0.001	0.64 (0.51-0.80)	<0.001	0.63 (0.50-0.79)	<0.001
Frailty	0.60 (0.42-0.86)	0.005	0.65 (0.40-1.06)	0.085	0.63 (0.39-1.05)	0.074

### **Validation analysis in the PAQUID study**

#### **Characteristics of the PAQUID study sample**

Table 1 presents the baseline characteristics of the study sample from the PAQUID study population. The mean age of the 3777 participants was 75.5 years old at baseline (SD: 6.9), and 58.2% of them were women. During the 30-year follow-up, 161 (4.3%) participants moved into a senior housing. At the time of entry into senior housing, the participants were 82.6 (SD: 6.6) years old, predominantly female (78.9%), and 63.8% were dependent in at least one IADL (table 4). On average, residents remained in senior housing for  $3.38 \pm 4.55$  years.

Variables	Baseline characteristics of the participants of PAQUID study		Characteristics of the residents at the time of entry into senior housing	
	n	Mean (SD) or n (%)	N Total	Mean (SD) or N (%)
Age (years)	3777	75.5 (6.9)	161	82.6 (6.6)
Gender (women)	3777	2200 (58.2%)	161	127 (78.9%)
High educational level	3777	2435 (64.5%)	161	93 (57.8%)
MMSE score	3697	25.5 (4.1)	157	24.5 (4.5)
Instrumental Activities of Daily Living (at least > 1IADL)	3770	1148 (30.5%)	160	102 (63.8%)
Activities of Daily Living (at least > 1ADL)	3772	182 (4.8%)	161	18 (11.2%)
CESD score	3628	10,0 (9.2)	149	12.8 (10.7)

**Table 4: Baseline characteristics of participants of PAQUID study and characteristics of the residents at the time of entry into senior housing**

## Effects of moving into a senior housing on the risks of death and nursing home admission

Of the 161 participants who moved into a senior housing during follow-up, 51 (31.7%) subsequently entered a nursing home. In all three models (1. univariate, 2. adjusted for sex and education level, 3. adjusted for sex, education level, and IADL score), moving into a senior housing was associated with a decreased risk of death and an increased risk of nursing home admission (table 5) compared older adults who did not use senior housing. Having lived in a senior housing did not affect the risk of death once individuals entered a nursing home (table 5).

**Table 5:** Estimated effects of the move into senior housing on the risks of mortality and nursing home admission, illness-death model. PAQUID cohort (n=3710).

Transition	Model 1 (Univariate)		Model 2 (Adjusted by gender and education level)		Model 3 (Adjusted by gender, education level and IADL score)	
	HR (CI 95%)	p	HR (CI 95%)	p	HR (CI 95%)	P
Death	0.63 (0.51-0.77)	<0.001	0.68 (0.56-0.84)	<0.001	0.72 (0.58-0.88)	0.002
Transition to nursing home	1.46 (1.10-1.94)	0.009	1.34 (1.00-1.78)	0.047	1.39 (1.05-1.86)	0.023
Death after entry in nursing home	0.94 (0.70-1.27)	0.693	0.98 (0.69-1.40)	0.943	1.05 (0.66-1.54)	0.980

## Discussion

With ageing of the population, the demand for long-term services and support for older people is rising. When staying at home becomes difficult (due to deteriorating health, loss of autonomy, absence or exhaustion of caregivers, loneliness, unsuitable housing...), it may be necessary to look for and assess alternatives, such as senior housing or foster families (29). In these two independent cohorts investigated in this study, we observed that mortality was reduced by about 30% in older adults who had moved into senior housing compared to their counterparts who had not. Moreover, the risk of hospitalization was also reduced by half, as previously described in a study by Park *et al* (23) (even though to a lesser extent). Finally, we observed a decreased risk of falling that is associated with a higher risk of death in the scientific literature (30).

Previous cohort studies have suggested an increased risk of mortality in senior housing compared with communities in US (20, 21), Australia (19) or Ireland (22). Nevertheless, the longitudinal design of our study, with older people initially in their homes, provides a better knowledge on the consequences

of entry into senior housing in a life-course perspective than these other short-term studies (1-5 years of follow-up). We noted that the clinical characteristics of older adults living in French senior housing are probably different compared to other countries. In the United States or Canada, the characteristics of older people in senior housing are closer to those of nursing home residents, since a majority of older adults suffers from dementia (58% in the Canadian study by Maxwell *et al.* (31) or 68% of individuals in the American study by Watson *et al.* (32)). In our cohorts, the mean age of older adults entering a senior housing was 82.8 years at admission and the mean MMSE score was  $25.2 \pm 3.3$ . Therefore, whereas senior housing is often considered in other countries as an alternative to nursing homes, our results suggest that senior housing in France is rather a stepping-stone between home care and nursing home care. Indeed, compared to older adults who did not move into a senior housing, the health trajectory of older adults who lived at home and then moved to a senior housing puts them at increased risk of nursing home admission. Indeed, about 30% of the residents of senior housing moved to a nursing home, likely due to cognitive or functional decline.

In France, the target population for senior housing is rather older people who are rather frail (or at risk of frailty) and for whom their housing is no longer suitable (17). A senior housing offers many potential advantages: safe housing (no stairs, adapted lightning, especially at night, bathrooms and toilets designed to avoid the risk of falling), personal support, and health care, along with the facilitation of social interactions. Senior housing could promote autonomy of older adults – the primary concern in this population – and help manage the health trajectory of vulnerable older people. We have observed that senior housing reduce mortality risks, often the primary concerns of families and health professionals (33). For practical and logistical reasons, senior housing may be a more appropriate setting for secondary prevention than the general population, where frail older people are scattered. The array of medical and support services in senior housing may help adapt to the constraints and needs of older adults to promote lifestyle-based group interventions such as diet, physical activity, and social interactions (34). Finally, staffing levels in these facilities, particularly nursing staff, are thought to play a pivotal role in preventing adverse health events. Stearns *et al.* (35) found an association between reduced rates of hospital admissions and a higher number of licensed staff in senior housing.

In this study, several limitations are noteworthy. The sample size was small for older adults who used senior housing. Nevertheless, the results are consistent across the two independent cohorts we investigated. The demographic characteristics of the participants were similar to those of a recent French cohort living in senior housing (18). As stated above, the clinical characteristics of older people in the French senior housing are different from those observed in other countries, which limits comparisons with the scientific literature. We hypothesize that housing security, improved care, and support management may explain the lower mortality observed in the senior housing group. Nevertheless, other factors could have been studied, such as medication use, marital status or cognitive

decline (36). Moreover, our cohorts do not include systematically collected information on patient characteristics, such as previous hospitalizations and comorbidities, which are often the main causes of admission into an institution and are significant predictors of mortality. Further research would be necessary to understand the most appropriate profile of senior housing residents, mainly in terms of cognitive functioning, and to determine the factors leading to nursing home admission in people living in senior housing (36). This transition may happen too late, as senior housing and nursing homes still suffer from a pejorative representation in the general population. Finally, from a public health perspective, medico-economic studies should assess the cost-efficiency of senior housing.

### **Conclusion**

Our results support the view that senior housing as appropriate transitional care option for older people when living at home becomes challenging. In the two independent cohorts investigated in this study, we observed lower risks of mortality and hospitalization in older adults who moved into senior housing compared to their counterparts who did not. We need to know more of the benefits of these facilities and the characteristics of older adults who might benefit most from them.

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**Figure legends :** Estimated probabilities of death, nursing home admission, and being alive according to residential status (no senior housing in blue versus senior housing in red)

