The Impact of Frailty On Admission To Home Care Services And Nursing Homes: Eight-Year Follow-Up Of A Community-Dwelling, Elderly, Spanish Cohort

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Abstract

Background The aim of this study is to identify the factors that anticipate the future inclusion of community-dwelling individuals aged ≥ 70 years in home care programmes (HC) or nursing homes (NH) and to develop the corresponding prediction models.

Methods Study design: Prospective, multicentre, cohort study in 23 primary health care centres located in Catalonia, Spain, with an eight-year follow-up (2005-2013). Participants: the cohort was made up of 616 individuals. Data collection: Baseline interview included a multidimensional assessment carried out by primary health care professionals. Outcome variables were collected during follow-up by consulting electronic health care records, telephone contacts, and the Central Registry of Catalonia for mortality.

Statistical analysis: A prognostic index for HC and NH at eight years was estimated for each patient. Death prior to these events was considered as a competing risk event, and Fine–Gray regression models were used. The internal validity of the predictive models was tested for 150 bootstrap re-samples.

Results At baseline, mean age was 76.4 years, 55.5% were women, and 22% lived alone. During follow-up, 19.2% entered an HC program, 8.2% a NH, and 15.4% died without presenting an event. Of those who entered a NH, 31.5% had previously been in an HC program. Multivariate competitive risk models for HC and NH showed that the risk of HC entry was associated with older age, dependence on the Instrumental Activities of the Daily Living, and slow gait measured by Timed-up-and-go test. An increased risk of being admitted to a NH was associated with older age, dependence on the Instrumental Activities of the Daily Living, augmented number of prescriptions, and the presence of social risk.

Conclusions Prognostic models based on comprehensive geriatric assessments can predict the need for the commencement of HC and NH admission in community-dwelling older adults. Our findings underline the necessity to measure functional capacity, mobility, number of prescriptions, and social aspects of the elderly in the primary healthcare centres. In such a setting they can be offered longitudinal holistic assessments so as to benefit from preventive actions in order to remain independent in the community for as long as possible.

Background

Worldwide, progressive, population ageing presents increasingly multiple health, social, and economic consequences for systems with inadequate planning and resources. This demographic change is leading to an augmented prevalence of chronic diseases and frailty in the elderly resulting in the loss of their autonomy and placing a heavier burden on health and social care[1–4].

In Spain, 17% of the inhabitants is currently >65 years, and projections for 2050 indicate that the figure will reach 33% compared to the expected 29% in neighbouring European countries[4]. Many older individuals are, or will become, frail. Such a condition in the elderly is a multidimensional clinical entity that represents a state of vulnerability to stressors[5], including a reduction in physical, mental, and social functions, and predicts adverse events such as hospitalization[6], institutionalization[7], and death[8].

Frailty can be measured by various models such as the frailty phenotype[9] and the deficit accumulation model[10]. Other tools include performance tests (such as the Short Physical Performance Battery and the Timed-Up-and-go Test) and scales that assess the instrumental activities of daily life[11,12]. In addition, there is the comprehensive geriatric assessment (CGA), considered the gold standard approach for community evaluation and usually conducted following existing national strategies in supporting people living with frailty[13–15]. The CGA is a multidimensional process that can be performed in a number of healthcare settings to identify medical, social, and functional needs and develop a care plan[16,17].

Primary Health Care (PHC), with its community perspective and longitudinal approach is the ideal scenario for the early detection of frailty in the elderly. Nevertheless, simple evaluation tests are required to be incorporated into usual care practice. Early identification would allow targeted support from health and social services to help the elderly to improve their quality of life and live autonomously in their homes for as long as possible. In addition to respecting the preferences of most of them[18], it would provide a more cost-effective alternative to institutionalization.

Adverse outcomes in the progression of frailty include dependency and institutionalization. In Spain, one of the primary care resources available for these individuals is the Home Care programme (HC). It offers comprehensive, continuous health and social attention to individuals in situations of functional decline and/or dependency who cannot attend health centres with the aim of keeping them as long as possible in their home with the corresponding autonomy. The HC programmes offered by the PHC cover some 6% of individuals >65 years, those being a population generally considered to be in a state of advanced frailty or disability[19].

Nevertheless, as frailty advances the complexity of medical attention augments and the caregiver and/or social support may have difficulties maintaining the quality of care. At this point, nursing home (NH) services become the most appropriate resource, despite the considerable financial outlay for both the public health system and the family economy. In our region NH services cover 3% of those >65 years of age[20].

The present cohort study was designed to identify in individuals >70 years the determinants of frailty that lead to their admission into an HC programme or NH institutionalization. Both events are related to the progression of frailty, functional decline, and loss of autonomy which could be delayed/prevented by an adequate and early approach to those at risk.

Most studies have focused on validating instruments to identify and describe the characteristics of frail elderly individuals [11,21,22] in addition to those that have established the determinants of HC and NH use[23]. The aim of this study is to characterize the factors that will lead to the future inclusion of elderly, community-dwelling subjects into HC programmes/NH institutionalization, and to develop the corresponding risk prediction models. These individuals can then benefit from personalized preventive actions in order to remain independent in the community for as long as possible.

Methods

Study design

An eight-year follow-up, multicentre, cohort study was conducted in 23 PHC centres in Catalonia, Spain. The inclusion period was from October 2004 to June 2005.

Participants

The cohort was made up of a random sample of 616 subjects ≥70 years of age. Interview participation was turned down by 75 individuals with a higher proportion of women (73%), but there were no age differences compared to the study members. Exclusion criteria included subjects already receiving HC and NH services, those presenting severe mental disorders/terminal illness, and non-residents in the reference area.

Data collection and study variables:

Subjects were randomly selected from the daily schedule of the healthcare professionals taking part in the study, and were included once the informed consent was signed.

Participants were programmed for the interview and the Comprehensive Geriatric Assessment (CGA) in their corresponding PHC centre. Both the interview and CGA were carried out by healthcare professionals (nurses and doctors). The main information collected in interviews through standardized questionnaires included sociodemographic data, physical activity, body mass index (BMI), self-reported health[24], the presence of morbidities related to frailty, number of hospitalization and falls in the previous year, and prescribed drugs.

The CGA included:

Functional Assessment:

- Basic Activities of Daily Living (BADL) with the Barthel Index25 (from 0 to 100 points), <60 represents moderate/severe dependence.
- Instrumental Activities of Daily Living (IADL) with the Lawton and Brody Index26, the cut-off points for moderate/severe dependence are <6 points for women and <4 points for men, respectively.
- Mobility was evaluated with the Timed-up-and-go test (TUGT)27. It measures in seconds the time to rise from a chair, walk a distance of 3m, return to the chair and sit down. It includes aspects of gait, strength, balance, and speed. A score of > 10 seconds is usually considered as altered.

Mental health Assessment:

- Cognitive assessment was measured with the Lobo Mini Cognitive Examination (MCE)28, the Spanish validated version of the Folstein Mini-mental state examination29 (From 0 to 30 points), the cut-off point for cognitive deterioration is ≤ 23.
- For evaluation of the affective state, the Yesavage Geriatric Depression Scale (GDS)30 (from 0 to 15 points) was employed with a cut-off point for probable depression of > 5.

Biomedical assessment:

- Nutritional status was measured using the Mini Nutritional Assessment Short Form (MNA-SF)31 questionnaire (from 0 to 14 points), with a cut-off point ≤ 11 for risk of malnutrition.
- Near vision was evaluated with the Jaeger Card32 with a cut-off point of > 20/40 for visual acuity deficit.
- Hearing was assessed with the Handicap Hearing Impairment in the Elderly Screening Version (HHIE-S)33 (from 0 to 40 points). A cut-off point ≥10 was considered auditory limitation.
- Urinary incontinence was measured with the International Consultation on Incontinence Questionnaire Short Form (ICIQ-SF)34 (from 0 to 21 points) with a cut-off point ≥ 1 for the diagnosis of urinary incontinence.

Social Assessment:

- Social vulnerability was evaluated with the Socio-Family Rating Scale of the Elderly (SFRSE)35 (from 0 to 25 points). It assesses the family, economic situation, housing, social relations, and social support, with a cut-off point ≥10 for social risk.

Outcome variables were gathered during the eight-year follow-up by consulting the electronic primary healthcare records, and telephone contacts were made in case of incomplete information. In addition, the Central Registry of Catalonia was consulted for mortality.

Main outcome variables were:

- Inclusion in the HC program of the PHC: encoded in the electronic primary healthcare records when the service is requested by either the patient or healthcare professional, mainly due to considerable mobility difficulties.
- Inclusion in NH: this encompasses all types of institutions such as nursing homes, long-term care institutions, private or public. It is encoded in the electronic primary healthcare records when a patient is institutionalized with the care relationship usually transferred from the PHC to the institution.
- Mortality: date of death registered in the PHC record and the Central Registry of Catalonia.

Statistical analysis

Continuous variables were expressed as mean and standard deviation, or as median and interquartile (IQ) range, whenever appropriate. For HC and NH outcomes, death prior to these events was considered as a competing risk event, therefore the cumulative incidence function (CIF) of HC/NH risk was calculated taking it into consideration. To analyse the effect of baseline predictors for the CIF, we used the Fine–Gray[36] regression model for the sub-distribution hazard (sHR).Clinically meaningful variables showing a significant level in the univariate analysis ($P<0.05$) were thereafter included in the multivariate model. A backward stepwise method was used to identify independent risk predictors with $P<0.05$ for the inclusion or deletion criterion. The proportionality assumption of the models was verified using time-dependent variables. The discriminative ability of the models was assessed by Harrell's C-index[37]. The internal validity of the final predictive models was tested for 150 bootstrap re-samples. The calibration of models was checked by plotting the observed and predicted probabilities of the model in groups defined by the quartiles of the predicted event probabilities. A prognostic index for home confinement and institutionalization at eight years was estimated for each patient as the sum of the variables included in the final model multiplied by the log of the respective sHR. Patients were classified using the CIF approach into three groups according to their risk of HC/NH: low, medium, and high, by splitting the index according to terciles. Data analysis was performed using the statistical R–3.5.1 package. The discrimination and calibration analysis were carried out with the pec package[38].

Results

Baseline characteristics of the cohort and assessment of frailty dimensions are shown in Table 1. The mean baseline age was 76.4 years, 55.5% were women, 73.45% did not have complete primary education, and 22% lived alone (32% women vs 9.6% men). Health was rated as good by 47.4% and bad by 6.7%. Mean BMI was 28.5 and 4.5% smoked. Patients on average took 5 drugs a day, and 32% consumed psychotropic ones. At the functional level, the mean Barthel index score was 96.5, the majority were independent for the BADL (62.5%), and only 15.3% had moderate/severe dependence. The IADL, measured with the Lawton index, showed that 76.7% were autonomous, and only 6.5% presented moderate/severe dependence. Mobility, measured with TUGT, was 13 seconds on average, and 14.35% led a sedentary life. At the mental level, the average MCE score was 27/30 points, and the GDS scores showed 19.8% probable depression.

During follow-up 19.2% (n = 118) of the 616 participants entered an HC programme (30.6 incidence per 1000 person-years), while 8.2% (n = 51) were admitted to an NH one (13.1 incidence per 1000 person-years). Of those admitted to an NH, 31.5% (n = 17) had previously been in an HC one. Of the 616, mortality during follow-up was 15.4% (n = 95) for participants presenting no event and 46.2% (n = 78) for those who were in either an HC or NH programme. During follow-up 4.5% (n = 28) was lost with a greater proportion of men (64%, $p<0.05$). However, there were no

statistically significant differences in the rest of the main variables between those who completed the study and those who did not, see *Figure 1.*

Insert Figure 1 about here

The median follow-up was 91.8 months (IQ: 58.1–97.7) and 92.3 months (IQ: 59.7–97.9) for HC and NH subjects, respectively.

Table 1 shows the bivariate sHRs of admission to the HC and NC programmes during the eight-year follow-up period according to all baseline variables.

Insert Table 1 about here

Comparing those who entered the HC programme with those who did not, HC incidence increased with age (78.9 years versus 75.2 years, sHR = 1.14); sedentary life style (22.9% versus 11.3%, sHR = 2.38); poor self-perceived health (12.7% versus 6.7%, sHR = 2.30); worse functional status, Barthel index (94.1 versus 97.5, sHR = 0.97); and Lawton and Brody index, in light (22.2% versus 13.4%, sHR = 1.70) and moderate dependence (15.4% versus 3.2%, sHR = 4.82). It also augmented in individuals with worse cognitive scores (mean score 26.2 versus 27.4, sHR = 0.94); worse affective state (mean 4.31 versus 3.55, sHR = 1.05); urinary incontinence (59.3% versus 40.5%, sHR = 1.83); worse mobility (mean TUGT 16.2 versus 11.8., sHR = 1.06); and higher social risk (mean 9.44 versus 8.70, sHR = 1.09).

Admission to the NH programme was associated with age (mean 78.7 versus 75.8, sHR = 1.13); living alone (47.1% versus 19.4%, sHR = 2.83); higher number of specific morbidities (mean 1.04 versus 0.73, sHR = 1.31); and greater drug consumption (mean 6.62 versus 4.58, sHR = 1.15).

Functional impairment in BADL was related to NH and the Barthel index (mean 93.1 versus 97.1, sHR = 0.97). Unlike HC, however, NH entry was only associated with the highest degree of dependence in the Lawton and Brody index (moderate/severe dependence, with 15.7% versus 4.90%, sHR = 4.48). It was also related to worse cognitive scores (mean 25.6 versus 27.3, sHR = 0.91) and risk of depression (mean 5.10 versus 3.58, sHR = 1.11).

We found a higher risk of NH admission for urinary incontinence (66.74% versus 42.4%, sHR = 2.51); worse mobility (longer TUGT time, mean 15.5 versus 12.4, sHR = 1.05); and social risk (higher score on the socio-familial assessment scale of the elderly, mean 10.7 versus 8.66, sHR = 1.23).

A complementary, bivariate sub-analysis was carried out between the participant's social risk and the occurrence of any events (NH, HC; data not shown). We observed a dose-response association between increasing social risk and being first admitted to an HC programme; with a still higher baseline social risk, entering an NH one; and finally, the highest baseline social risk was associated with first an HC programme and later an NH facility.

The multivariate adjusted model showed that the incidence risk of HC entry was associated with older age, dependence on the IADL (moderate/severe dependence), and slow gait measured by TUGT. There was a significant association between the risk of being admitted to an NH programme and older age, dependence on the IADL (moderate/severe), more prescriptions, and the presence of social risk, see *Table 2.*

Insert Table 2 about here

Based on the results of the multivariate analyses, two prediction models were constructed according to the risk of inclusion in an HC or NH. Subjects with HC risk were classified into three groups: lower risk with a prognostic index (PI) between 7.5 and 8.3; medium risk, between 8.4 and 8.9; and higher risk > 9.0. The NH model was also categorized into three groups: lower risk between 7.9 and 9.5; medium risk between 9.6 and 10.2; and higher risk PI > 10.3, see *Table 2.*

The calibration plot showed that both models (HC and NH) presented a good calibration for predicting risk outcomes. In addition, discrimination was good for HC (C-index = 0. 726) and moderate for NH (C-index = 0.663), see *Figure 2.*

Insert Figure 2 about here

Figure 3 depicts the cumulative incidence for each of these prognostic groups for the two events. For HC in the lower risk group the cumulative incidence was 9.99 per 1000 patients-year; for the medium risk one it was 25.55 per 1000 patients-year; and for the higher risk one 63.07 per 1000 patients-year (p <0.001). For NH in the lower risk group the incidence was 1.9 per 1000 patients-year; the medium risk one was 4.17 per 1000 patients-year; and the higher risk one was 32.9 per 1000 patients-year (p <0.001).

Insert Figure 3 about here

Discussion

Incidence of Home Care and Nursing Home entry

In this eight-year cohort study, a follow-up of more than 95% participants was obtained, with 19% entering home care programmes, and 8% geriatric nursing homes, outcomes that are generally associated to advanced frailty, especially when it is not addressed early and adequately. Regarding HC, although it is difficult to compare different countries and health services, similar rates were observed between homebound incidence in Japan[39] (32.1 per 1000 individuals/year) and that of our study (30.6 per individual/year). With respect to NH entry, we found lower rates than those reported by the USA[40], 16.1% in two years, but closer to Germany, with rates of 4.7% in a three-year follow-up[41]. This could be explained by the fact that in southern European cultures the involvement of the family in the care of the elderly is considerable, whether for cultural or economic reasons [42,43].

Risk factors

Age and sex

In our results, increasing age was the main predisposing factor associated with frailty and both HC and NH placement. Although women had a higher incidence of NH inclusion it was not a statistically significant predictor. The higher life expectancy of women, and the greater percentage of their living alone, could explain this trend [44].

Functional status

In our study it was observed that IADL deterioration was associated with HC and NH. The ability to perform instrumental activities of daily life autonomously is essential to live at home independently. It is, therefore, a relevant measure to take into account when predicting the path to functional decline and dependence. We found that even mild dependence in the IADL was associated with future HC, and moderate to severe dependence with NH entry. IADL impairment has been described as a potential marker of frailty[45], implying losses in different functioning domains [46]. There is, however, controversy with respect to disability and its inclusion in the definition of frailty [47]. Nevertheless, early stages of IADL impairment could be useful in detecting individuals at risk, it is an easy measure to collect and has a long-established tradition in PHC settings. Our sample included very few subjects with dependence in basic activities of daily living as it was composed of community-dwelling, independent individuals. BADL thus had no impact on the prediction models.

Mobility

Mobility was measured in our study with the TUGT. It has been shown to have high sensitivity for identifying frailty[48], moreover, as it is a simple test requiring little equipment and space the TUGT is a valuable tool in a clinical setting. Savva et al[49] found that a cut-off point of more than 16 seconds was optimum to identify the frail population. Our results concur, we observed a mean score of 16.2 seconds for subjects entering the HC programme, and 15.5 seconds for the NH one. Due to the fact that the TUGT has been used as a proxy measure of frailty[50] and subsequent functional decline, it is a relevant factor in our HC prediction model.

Polypharmacy

Polypharmacy is a measure of medication-associated frailty, irrespective of the number of comorbidities and their severity[51]. It is associated with increased rates of falls[52] and hospitalization, disability, and mortality[53]. In our sample, polypharmacy, collected from the electronic primary healthcare records, was a prevailing factor. Present in 52% of the participants, it was higher than in other studies which reported a prevalence based on health surveys of between 26 and 40%[54]. It was, however, closer to those authors employing electronic healthcare records[55] who observed over 50%. In our study, polypharmacy predicted NH entry, a fact that might be related to multimorborbidity in addition to adverse drug reactions/interactions, and greater risk of falls, and negative health outcomes[56].

Particular emphasis should be placed on psychoactive drugs as 50% of those entering an NH were taking them. Moreover, inappropriate polypharmacy is a key issue to address in order to improve outcomes in the elderly[57] by means of active medication review and deprescription processes with tools such as STOPP START criteria and other available strategies[58].

Social vulnerability

We observed that whilst living alone had no effect on the need for HC it did influence NH entry (sHR = 2.83), a finding that has been already described in other countries[59–62]. Employing an exhaustive socio-family situation measure, the SFRSE scale, we found a strong association between greater social risk and a higher institutionalization rate, irrespective of functional status or comorbidities. It appears as one of the predictors in the NH entry equation highlighting the importance of social support and environment in maintaining the capacity to live in the community in one's home. Social and caregiver networks could help circumvent institutionalization, as has been observed in various studies

that only take either living arrangements or caregiver networks into account[63,64]. The need to assess the social sphere of the frail elderly is evident[65]. Indeed, as the issue of social frailty is increasingly conceptualized[66], the design of interventions to improve social support resources and promote inclusion of the elderly will become essential in granting their preferences for living in the community, and thus improving quality of life.

Other factors

Cognitive impairment and dementia are factors classically described as being related to NH placement[67]. Whilst we observed a bivariate association between cognitive status and adverse events it was not included in the final model. This was due to the low prevalence of dementia in our free-living, community-dwelling population. As we lacked a longitudinal measure of the incidence of cognitive impairment in our sample, we could not test the association with enough statistical power. The same pattern of bivariate association was also reported for depression, nutritional risk, and urinary incontinence. The latter is additionally usually found as a strong gender-specific predictor[68], negatively affecting daily life although our final model did not include it.

Strengths and limitations

Few longitudinal studies can be found in the literature analysing the transition of the frail elderly from the commencement of their requiring home care to later nursing home placement, both outcomes related to functional decline and loss of autonomy. Our cohort had an excellent follow-up rate, up to 95% of the sample, and was representative of the elderly patients attended in primary healthcare in Catalonia, around 12.6% of the total patient population. Although our external validity was limited to those who sought medical assistance at the PHC it should be noted that this was not a health survey aimed at representing all the elderly population in this region. Moreover, most of these individuals in Spain seek medical assistance in the public health sector.

Despite the fact that our models included the main CGA variables there might have been other factors influencing HC/NH admission. Nevertheless, the CGA is comprised of the most important known dimensions, and they were measured using standardised, validated questionnaires and scales. Finally, although an extensive follow-up was performed, changes in baseline variables during follow-up were not analysed as it was a prediction model based on the initial situation of the sample.

Conclusions

Prognostic models established with comprehensive geriatric assessments can predict the commencement of the need for HC and subsequent NH entry in community-dwelling, older adults. Our findings underline the necessity to measure functional capacity, mobility, inappropriate prescriptions, and social aspects of the elderly in primary care settings where they can be offered holistic, longitudinal assessments and tailored interventions.

Such models could also be useful for the risk classification of the frail elderly and in the planning of health care policies.

Recommendations

- Due to the relevance of mobility and instrumental activities of daily living in the prediction of adverse outcomes, community interventions based on physical and functional exercises should be prioritised to improve/maintain independence and quality of life in the elderly68,69.
- Tackling polypharmacy and inappropriate prescriptions through deprescription processes at the primary care level should also be prioritised69–69.
- Interventions to improve social resources and promote social support networks and inclusion in the community would improve the quality of life of the elderly. Moreover, they would enhance the efficiency of the health system and, given the high cost of residential centres, ease the financial burden for both for families and society70.

Abbreviations

BADL Basic Activities of the Daily Living

BMI Body mass index

CIF Cumulative incidence function

CGA Comprehensive Geriatric Assessment

GDS Geriatric Depression Scale

HC Home care

HHIE-S Handicap Hearing Impairment in the Elderly Screening Version

IADL Instrumental Activities of the Daily Living

ICIQ-SF International Consultation on Incontinence Questionnaire Short Form

IQ Interquartile

MCE Mini Cognitive Examination

MNA-SF Mini Nutritional Assessment Short Form

NH Nursing home

PHC Primary Health Care

SFRSE Socio-Family Rating Scale of the Elderly

sHR Subdistribution hazard

TUGT Timed-up-and-go test

Declarations

Ethics approval and consent to participate

Research was performed in accordance with the Declaration of Helsinki. Ethics approval for the study was received from: The Ethical Committee on Clinical Research IDIAP Jordi Gol, approval number P11/75. All study participants gave written informed consent.

Consent for publication

Not applicable

Availability of data and materials

The dataset supporting the conclusions of this article is available in the Open Science Framework repository, in [https://osf.io/sqty8/].

Competing interests

None declared.

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Authors' contributions

FC, FO coordinated the study. FC, FO were involved in the study conduct. RA, FO, FC, MP were involved in the analyses and interpretation. FC, FO, MP, RA were involved in drafting the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1. Admission frequency into the Home Care programme or Nursing Home and mortality during the 8-year follow-up in relation to the baseline characteristics of the cohort.

VARIABLES	N	[ALL] N=616	Death n=95	HOME CARE			NURSING HOME		
				No HC n=403	HC n=118	Sub-hazard ratio	No NH n=470	NH n=51	Sub-hazard ratio
Age, years, mean (SD)	616	76.4 (4.78)	78.0 (4.90)	75.2 (4.34)	78.9(4.80%)	1.14[1.10;1.18]	75.8 (4.56)	78.7(5.13)	1.13[1.07;1.19]
Gender, female, n (%)	616	342 (55.5%)	41 (43.2%)	233(57.8%)	68(57.6%)	1.03[0.72;1.48]	267(56.8%)	34 (66.7%)	1.48[0.83;2.65]
Educational level, n (%):	599								
Illiterate		52 (8.55%)	7 (7.53%)	33 (8.29%)	12 (10.3%)	Ref.	39 (8.39%)	6 (12.0%)	Ref.
Incomplete primary		395 (65.0%)	71 (76.3%)	251(63.1%)	73 (62.4%)	0.80[0.43;1.49]	290(62.4%)	34(68.0%)	0.72[0.31;1.75]
Primary		112 (18.4%)	9 (9.68%)	78 (19.6%)	25 (21.4%)	0.99[0.50;1.99]	99 (21.3%)	4 (8.00%)	0.31[0.09;1.11]
Secondary		29 (4.77%)	3 (3.23%)	24 (6.03%)	2 (1.71%)	0.27[0.06;1.29]	23 (4.95%)	3 (6.00%)	0.82[0.20;3.30]
University		11 (1.81%)	1 (1.08%)	7 (1.76%)	3 (2.56%)	1.15[0.36;3.72]	9 (1.94%)	1 (2.00%)	0.72[0.09;6.02]
Living arrangements, n (%):	613								
Family		167 (27.2%)	30 (31.9%)	106(26.4%)	31 (26.5%)	Ref.	126(26.9%)	11 (21.6%)	Ref.
Partner		311 (50.7%)	44 (46.8%)	206(51.2%)	61 (52.1%)	1.05[0.68;1.62]	251(53.6%)	16 (31.4%)	0.78[0.36;1.69]
Living alone		135 (22.0%)	20 (21.3%)	90 (22.4%)	25 (21.4%)	1.04[0.62;1.77]	91 (19.4%)	24 (47.1%)	2.83[1.38;5.80]
Physical activity, n (%):	610								
Active (≥30 minutes/day)		352 (57.7%)	37 (39.4%)	262(65.8%)	53 (44.9%)	Ref.	292(62.8%)	23 (45.1%)	Ref.
<30 minutes/day		171 (28.0%)	42 (44.7%)	91 (22.9%)	38 (32.2%)	1.47[0.97;2.21]	110(23.7%)	19 (37.3%)	1.69[0.92;3.10]
Sedentary		87 (14.3%)	15 (16.0%)	45 (11.3%)	27 (22.9%)	2.38[1.48;3.83]	63 (13.5%)	9 (17.6%)	1.82[0.85;3.89]
Perceived health[1], n (%):	616								
Good or +		259 (42%)	31 (32.6%)	191 (47,4%)	37 (31.4%)	Ref.	211(44.9%)	17 (33%)	Ref.
Fair		305 (49.5%)	54 (56.8%)	185 (45.9%)	66 (55.9%)	1.61[1.08;2.41]	226(48.1%)	25 (49.0%)	1.33 [0.72;2.46]
Bad		52 (8.44%)	10 (10.5%)	27 (6.70%)	15 (12.7%)	2.30[1.27;4.17]	33(37.02%)	9 (17.6%)	2.95[1.30;6.71]
Number of morbidities[2], mean (SD)	616	0.78 (0.93)	0.93 (1.12)	0.73 (0.91)	0.86 (0.80)	1.13[0.96;1.32]	0.73 (0.83)	1.04(1.25)	1.31[1.05;1.63]
Number of drugs, mean (SD)	582	4.98 (3.06)	6.12 (3.31)	4.61 (2.93)	5.39 (3.07)	1.05[0.99;1.11]	4.58 (2.89)	6.62(3.17)	1.15[1.08;1.24]
Psychoactive drugs, n (%), ≥1	563	180 (32.0%)	27 (32.5%)	115 (30.7%)	38 (36.2%)	1.22[0.83;1.81]	130(30.0%)	23 (50.0%)	2.14[1.20;3.81]
Hospitalization/previous year, n (%), ≥1	616	78 (12.7%)	19 (20.0%)	46 (11.4%)	13 (11.0%)	0.81[0.45;1.45]	53 (11.3%)	6 (11.8%)	0.88 [0.37;2.07]
Falls / previous year, n (%) ≥1	615	149 (24.2%)	25 (26.3%)	101 (25.1%)	23 (19.5%)	0.78[0.49;1.23]	108 (23%)	16 (31.4%)	1.46[0.81;2.64]
BADL (Barthel[3]), mean (SD)	616	96.5 (7.03)	95.5 (9.82)	97.5 (5.73)	94.1 (7.70)	0.97[0.96;0.99]	97.1 (5.30)	93.1(12.1)	0.97[0.96;0.98]
IADL (Lawton & Brody[4]), n (%)	615								
Independent		472 (76.7%)	63 (66.3%)	336(83.4%)	73 (62.4%)	Ref.	373(79.5%)	36 (70.6%)	Ref.
Mild Dependence		103 (16.7%)	23 (24.2%)	54 (13.4%)	26 (22.2%)	1.70[1.10;2.64]	73 (15.6%)	7 (13.7%)	0.94[0.42;2.10]
Moderate + Severe Dependence		40 (6.50%)	9 (9.47%)	13 (3.23%)	18 (15.4%)	4.82[2.81;8.27]	23 (4.90%)	8 (15.7%)	4.48[2.03;9.87]
Cognitive status (MEC[5]), mean (SD)	614	27.0 (3.67)	26.6 (3.61)	27.4 (3.57)	26.2 (3.90)	0.94[0.90;0.98]	27.3 (3.64)	25.6(3.78)	0.91[0.86;0.96]
Affective status (GDS[6]) mean (SD)	607	3.79 (3.27)	4.15 (3.22)	3.55 (3.31)	4.31 (3.09)	1.05[1.00;1.10]	3.58 (3.18)	5.10(3.82)	1.11[1.04;1.20]
Body mass index (BMI), mean (SD), n (%)	592	28.5 (4.15)	28.3 (4.74)	28.2 (3.88)	29.6 (4.40)	1.06[1.02;1.11]	28.5 (3.92)	28.9(5.08)	1.02[0.94;1.10]
< 22 Low weight		36 (6.08%)	8 (8.79%)	22 (5.71%)	6 (5.17%)	Ref.	22 (4.88%)	6 (12.0%)	Ref.

22-26.9 Norm weight		144 (24.3%)	26 (28.6%)	98 (25.5%)	**20 (17.2%)**	0.78[0.31;1.97]	111(24.6%)	**7 (14.0%)**	0.27[0.09;0.81]
27-29.9 Over weight		169 (28.5%)	26 (28.6%)	96 (24.9%)	**47 (40.5%)**	1.53[0.64;3.62]	123(27.3%)	**20 (40.0%)**	0.67[0.26;1.61]
≥ 30 Obesity		243 (41.0%)	31 (34.1%)	169 (43.9%)	**43 (37.1%)**	0.94[0.39;2.24]	195(43.2%)	**17 (34.0%)**	0.37[0.14;0.94]
Nutritional assessment (MNA-SF[7]), mean (SD)	604	12.9 (1.64)	12.6 (1.80)	13.0 (1.60)	**12.8 (1.61)**	0.94[0.85;1.04]	13.0 (1.58)	**12.6(1.76)**	0.87[0.76;1.00]
Visual impairment (Jaeger Card[8]), n (%)	611	195 (31.9%)	34 (35.8%)	112(28.0%)	**49 (42.2%)**	1.67[1.16;2.42]	143(30.6%)	**18 (36.7%)**	1.32[0.74;2.36]
Hearing impairment (HHIE-S[9]), n (%)	612	121 (19.8%)	21 (22.1%)	71 (17.7%)	**29 (25.0%)**	1.38[0.90;2.09]	89 (19.1%)	**11 (21.6%)**	1.17[0.60;2.27]
Urinary incontinence (ICIQ-SF[10]), n (%)	615	277 (45.0%)	44 (46.3%)	163 (40.5%)	**70 (59.3%)**	1.83[1.27; 2.65]	199(42.4%)	**34 (66.7%)**	2.51[1.40;4.48]
Mobility assessment (Timed-up-and-go test[11]), mean (SD)	599	13.0 (6.80)	14.6 (7.36)	11.8 (5.45)	**16.2 (9.02)**	1.06[1.03;1.08]	12.4 (6.38)	**15.5(8.36)**	1.05[1.02;1.08]
Social risk (Social-familial evaluation scale[12]), mean (SD)	614	8.83 (2.72)	8.66 (2.82)	8.70 (2.70)	**9.44 (2.66)**	1.09[1.03;1.15]	8.66 (2.57)	**10.7(3.16)**	1.23[1.14;1.33]

SD: Standard deviation

[1]**Perceived health**, question: "In general, would you say that your health is excellent, very good, good, fair, or bad? [2]**Morbidities related to frailty**, including: cerebrovascular accident with sequelae, Parkinson's disease, osteoarticular diseases, severe visual deficit, dementia, acute myocardial infarction or heart failure, chronic obstructive pulmonary disease, recurrent falls, severe deafness and chronic depression. [3] **Basic Activities of the Daily Living** (BADL) Barthel Index (from 0 to 100 points), below 60 represents moderate/ severe dependence. [4] **Instrumental Activities of the Daily Living** (IADL) Lawton and Brody Index, with dependence cut-off points for women <8 points (from 0 to 8 points) and men <5 points (from 0 to 5 points). [5]**Mini Cognitive Examination** (MEC), (from 0 to 30 points), cut-off point for cognitive deterioration ≤ 23. [6] **Geriatric Depression Scale** (GDS) Yesavage Scale (from 0 to 15 points), cut-off point for probable depression> 5. [7]**Mini Nutritional Assessment Short Form** (MNA-SF) (from 0 to 14 points), cut-off point ≤ 11 for risk of malnutrition. [8]**Jaeger Card**, point > 20/40 visual acuity deficit. [9]**Handicap Hearing Impairment in the Elderly Screening Version** (HHIE-S) (from 0 to 40 points) (ref). The cut-off point ≥10 was considered an auditory limitation. [10]**International Consultation on Incontinence Questionnaire Short Form** (ICIQ-SF) (from 0 to 21 points) with a cut-off point ≥ 1 for the diagnosis of urinary incontinence. [11]**Timed-up-and-go test** (TUGT) The score of> 10 seconds was considered altered. [12]**Socio-Family Rating Scale of the Elderly** (SFRSE) (from 0 to 25 points) which assesses family, economic situation, housing, social relations, and social support, with a cut-off point ≥10 for social risk.

Table 2: Multivariate Competitive Risk Models for Home Care and Nursing Home admission, prognostic index functions and risk classification.

HOME CARE (HC)			NURSING HOME (NH)		
	Sub Hazard Ratio	p-value		Sub Hazard Ratio	p-value
Age (years)	1.11 [1.07-1.16]	<0.001	*Age (years)*	1.11 [1.04-1.19]	0.002
IADL: *Independent*	1		*IADL: Independent*	1	
IADL: *Mild Dependence*	1.51 [0.95-2.40]	0.083	*IADL: MIld Dependence*	0.58 [0.23-1.46]	0.250
IADL: *Moderate Dependence or +*	2.75 [1.35-5.61]	0.005	*IADL: Moderate Dependence or +*	2.64 [1.02-6.82]	0.045
TUGT *(seconds)*	1.03 [1.00-1.06]	0.024	-	-	-
-	-	-	*Number of drugs*	1.10 [1.02-1.19]	0.019
			SFRSE (points)	1.18 [1.07-1.29]	<0.001
PROGNOSTIC INDEX FUNCTION (PI)					
HC PI			NH PI		
PI: 0,107*Age (years)+0.412* Mild instrumental dependence (IADL) +1,013* Moderate instrumental dependence (includes severe and total) (IADL) + 0,0331*TUGT (seconds)			PI: 0,106*Age (years)-0.551* Mild instrumental dependence (IADL) +0.971* Moderate instrumental dependence (includes severe and total) (IADL) + 0.097* Number of drugs + 0.165 *SFRSE (points)		
Risk group			Risk group		
· Lower risk group: PI 7.5 - 8.3 · Medium risk group: PI 8.4 - 8.9 · Higher risk: PI ≥ 9.0			· Lower risk group: PI 7.9 - 9.5 · Medium risk group: PI 9.6 - 10.2 · Higher risk: PI ≥ 10.3		

IADL: Instrumental Activities of Daily Living; TUGT: Timed Get Up and Go Test; SFRSE: Socio-Family Rating Scale of the Elderly

Figures

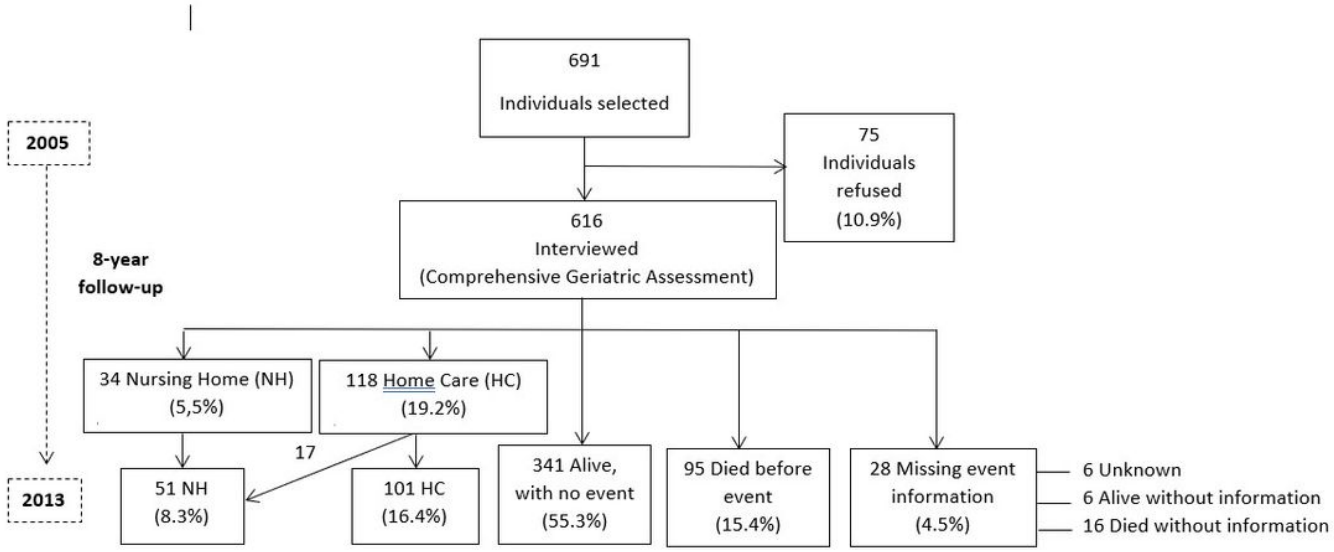

Figure 1

Flow diagram showing the study follow-up.

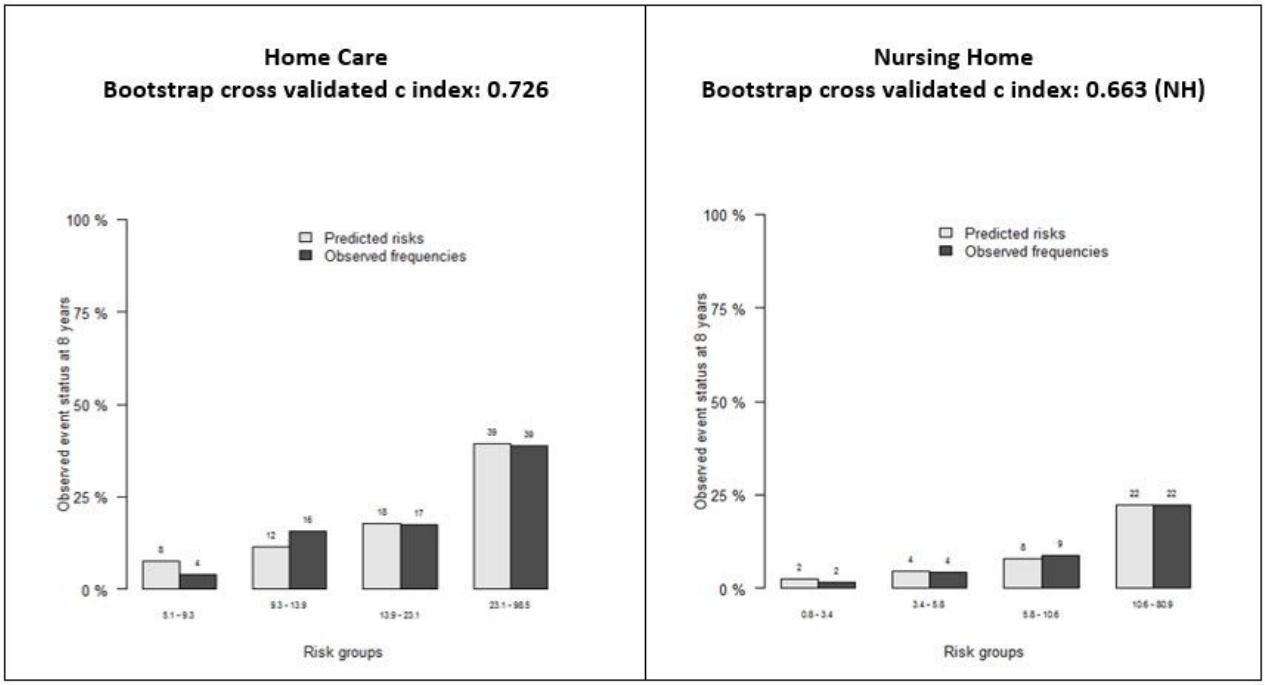

Figure 2

Calibration plots for risk outcomes prediction and discrimination index (8 years).

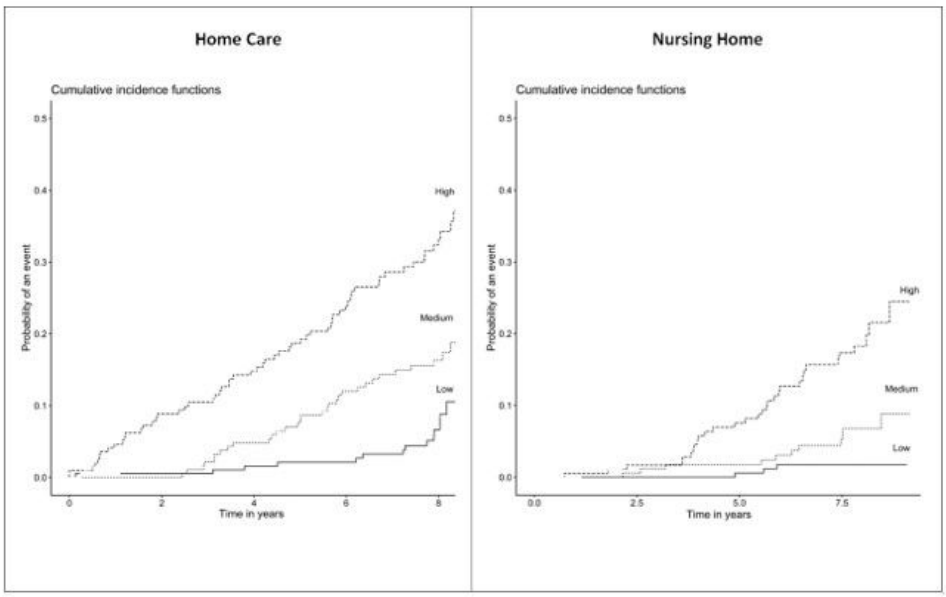

Figure 3

Cumulative incidence for the prediction groups of Home Care and Nursing Home events.