Research paper

The frailty instrument of the survey of health, ageing and retirement in Europe (SHARE-FI) predicts mortality beyond age, comorbidities, disability, self-rated health, education and depression

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ABSTRACT

Purpose: To investigate the robustness of the recently created Frailty Instrument for primary care of the Survey of Health, Ageing and Retirement in Europe (SHARE-FI, http://www.biomedcentral.com/1471-2318/10/57) to predict mortality in the face of age, comorbidities, disability, self-rated health, education and depression.
Subjects: Eleven thousand, three hundred and eighty-four females and 9163 males from Wave 1 of SHARE (2004–2006) who had known information on mortality by Wave 2 (2006–2007). The mean individual follow up period was 2.4 years.
Methods: A binary logistic regression model was computed to assess how the SHARE-FI classes (i.e. non-frail, pre-frail and frail) predicted mortality in the presence of age, number of chronic diseases, number of limitations with activities of daily living, self-rated health, years of education, and EURO-D depression score.
Results: After a mean follow up of 2.4 years, the crude mortality rate in females was 0.7% (non-frail), 2.6% (pre-frail) and 9.2% (frail). In males, the mortality was 2.0% (non-frail), 8.8% (pre-frail) and 22.6% (frail). In the binary logistic regression model (females), significant predictors of mortality were age (OR: 1.1, $P < 0.001$) and frail class (OR: 2.9, 95% CI: 1.3–6.2, $P = 0.006$). In males, significant predictors were age (OR: 1.1, $P < 0.001$), self-rated health (OR: 2.0, 95% CI: 1.5–2.5, $P < 0.001$) and frail class (OR: 2.5, 95% CI: 1.3–4.9, $P = 0.007$).
Conclusion: The SHARE-FI frail class is a robust predictor of mortality even after adjusting for age, comorbidity, disability, self-rated health, education and depression.

1. Introduction

Frailty in older adults is a key clinical concept characterised by dysregulation of multiple biological systems, accumulation of deficits, vulnerability to stressors and increased risk of adverse outcomes such as falls, disability, hospitalisation, institutionalisation and death [1–3]. Although there is no international consensus on the definition of frailty [4], one of the most accepted operationalisations is that of Fried et al., who defined it as a clinical syndrome in which three or more of the following are present: unintentional weight loss, exhaustion, weakness, slow walking speed, and low physical activity [5].

Frailty is an emerging concept in General Practice and has the potential to provide commissioners of health care with a clinical focus for targeting resources at an ageing population [6,7]. However, operationalising Fried's frailty phenotype on an individual patient requires complex calculations on a reference sample,

which is not practical in the context of primary care. Indeed, family physicians and community practitioners are in need of easy instruments for frailty [8].

To provide European community practitioners with an easy frailty metric, we created and validated a frailty instrument for primary care (SHARE-FI) based on the survey of health, ageing and retirement in Europe [9]. The SHARE-FI calculators (one for each gender) are freely accessible on *BMC Geriatrics* (http://www.bio-medcentral.com/1471-2318/10/57) and their use is intended for community-dwelling adults aged 50 and over. In our main study, we demonstrated that SHARE-FI was a powerful predictor of mortality over a mean follow-up of 2.4 years, even after adjusting for baseline age [9].

Ageing, comorbidity, disability and frailty are distinct (albeit causally related) clinical entities [10–14]. Our main study [9] did not report how SHARE-FI predicts mortality after adjusting for those and other potential confounders such as self-rated health [15,16], education level [17,18] and depression [19]. The present study investigates the robustness SHARE-FI to predict mortality in the face of those important covariates.

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2. Methods

2.1. Subjects

Seventeen thousand, three hundred and four females and 13,811 males included in the first wave of the survey of health, ageing and retirement in Europe (SHARE, release 2.3.0 of November 13th, 2009), corresponding to nationally representative samples of 12 European countries (Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium and Israel).

2.2. Creation of SHARE-FI

As detailed in our main study [9], SHARE-FI was created via estimation of a discrete factor (DFactor) model based on five SHARE frailty items (Appendix), using LatentGOLD® (version 4.5.0). The five frailty items were proposed by Santos-Eggimann et al. [20]. A single DFactor with three ordered levels or latent classes (non-frail, pre-frail and frail) was obtained for each gender. Fig. 1 summarises the original development and validation of SHARE-FI [9].

2.3. Mortality prediction

Wave 2 established whether Wave 1 participants had died, were still alive, or had been lost to follow-up. For those who had died, the exact time to death since the initial interview was not collected. Wave 1 data were collected between 2004–2006 and Wave 2 between 2006–2007. The mean individual follow up period between Wave 1 and Wave 2 was 2.4 years.

2.4. Covariates

The covariates are:

- age (years);
- number of years of education. Based on respondents' self-report of their highest level of education achieved, years of education were derived from the 1997 International Standard Classification of Education (ISCED-97) [21];
- self-rated health on the following scale: 1: excellent; 2: very good; 3: good; 4: fair; or 5: poor;
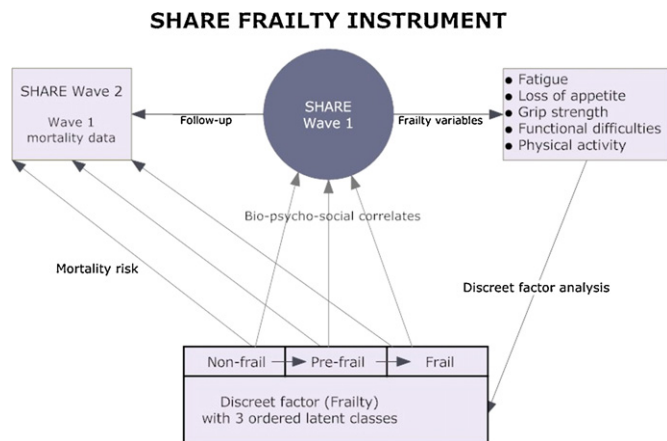
SHARE FRAILTY INSTRUMENT

Fig. 1. Development and validation of SHARE-FI (separately for each gender). The illustration has been reproduced with permission of the authors (copyright holders) from the original SHARE-FI study (http://www.biomedcentral.com/1471-2318/10/57). The latter is an open access article distributed under the terms of the creative commons attribution license (http://creativecommons.org/licenses/by/2.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

- number of chronic diseases (active or in the past) diagnosed by a doctor, from the following list:
  ○ heart attack or myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure,
  ○ high blood pressure or hypertension,
  ○ high blood cholesterol,
  ○ stroke or cerebral vascular disease,
  ○ diabetes or high blood sugar,
  ○ chronic lung disease such as chronic bronchitis or emphysema,
  ○ asthma,
  ○ arthritis, including osteoarthritis, or rheumatism,
  ○ osteoporosis,
  ○ cancer or malignant tumour, including leukaemia or lymphoma, but excluding minor skin cancers,
  ○ stomach or duodenal ulcer, peptic ulcer,
  ○ Parkinson's disease,
  ○ cataracts,
  ○ hip fracture or femoral fracture,
  ○ other fractures,
  ○ Alzheimer's disease, dementia or senility,
  ○ and other conditions;
- number of limitations with activities of daily living (ADL), from the following list (one point per each limitation):
  ○ dressing, including putting on shoes and socks,
  ○ walking across a room,
  ○ bathing or showering,
  ○ eating, such as cutting up the food,
  ○ getting in and out of bed,
  ○ and using the toilet, including getting up or down;
- EURO-D depression scale [22].

2.5. Statistical analyses

Binary logistic regressions were conducted with SPSS 16.0 to assess whether the frailty classes at Wave 1 significantly predicted whether or not a subject was dead by Wave 2. In the models, the frailty class variable was entered as a categorical predictor, using the non-frail class as reference category, and simple contrasts were requested. The dependent variable (i.e. dead at Wave 2, coded 0 = no and 1 = yes) included non-missing data only. The odds ratio (OR) for mortality was indicated by the Exp(B) statistic in the binary logistic regression model. Ninety-five percent confidence intervals for ORs were requested.

Four logistic regression models were computed: unadjusted (model 1) and age-adjusted (model 2), as previously reported [9]; model 3 was adjusted by age, number of chronic diseases and number of ADL limitations; and model 4 was adjusted by age, number of chronic diseases, number of ADL limitations, self-rated health, years of education, and EURO-D score.

The logistic regression assumption of independent variables being linearly related to the logit was checked, and the fit of the models was checked with the Hosmer and Lemeshow test. Given the large sample size and consistent with our main publication [9], the level of significance was set at 0.01.

3. Results

The mean age (standard deviation) of females was 63.6 (11.1), and that of males was 64.1 (9.9). Complete data for assessing frailty according to the approach by Santos-Eggimann et al. [20] were available for 15,578 females and 12,783 males.

Of the females with data available (n = 15,578), 66.9% were non-frail (n = 10,420), 25.8% were pre-frail (n = 4,025) and 7.3% were frail (n = 1,133). Of the males (n = 12,783), 82.3% were non-frail (n = 10,517), 14.6% were pre-frail (n = 1,871) and 3.1% were frail (n = 395).