Social frailty increases the risk of all-cause mortality: A longitudinal analysis of the English Longitudinal Study of Ageing

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ABSTRACT

Objectives: Social frailty is a common condition in older people, but its consequences are largely unknown. Therefore, in this longitudinal analysis, we aimed to investigate the association between social frailty and risk of all-cause mortality in a large sample of older people.
Design: Longitudinal, cohort.
Settings and participants: Older people participating to the English Longitudinal Study of Ageing (ELSA).
Methods: Social frailty was defined based on financial difficulty, household status, social activity, and contacts with other people: social frailty was defined as ≥ 2 points, social pre-frailty (1 point), and robustness (0 points). Survival status during ten years of follow-up was assessed using administrative data. Cox proportional hazard models were used to estimate adjusted hazard ratios (HR) and 95 % confidence intervals (95 % CI) of the association between social frailty status and all-cause mortality.
Results: At baseline, compared to social robust participants, social frail subjects reported a significant higher presence of potential risk factors for all-cause mortality. During the ten years of follow-up, after adjusting for 10 potential confounders, social frailty at baseline (vs. robustness) was associated with a significantly higher risk of death (HR = 1.31; 95 % CI: 1.04–1.64; p = 0.02), whilst social pre-frail was not. Among the single factors contributing to social frailty, poverty increased the risk of all-cause mortality by approximately 60 % (HR = 1.60; 95 % CI: 1.33–1.93; p < 0.0001) as well as living alone (HR = 1.46; 95 % CI: 1.10–1.94; p = 0.009).
Conclusions and implications: Social frailty was significantly associated with all-cause mortality in a large cohort of older people, highlighting the importance of identifying this phenomenon in older adults to inform targeted intervention efforts.

1. Introduction

With an ever increasing population aging, in which the gap between social classes is becoming more evident, it is important to underline a possible association between social problems and health outcomes, including all-cause mortality. In this context, frailty is widely regarded as a multidimensional construct with physical, cognitive, psychological and social components (Pek et al., 2020).

Social frailty, usually defined as the absence of social resources, social activities, and self-management abilities that are important for

fulfilling basic social needs, is common and sometimes present as domain of frailty (Ma et al., 2018). Social frailty could be considered in a continuum of being at risk of losing, or having lost, resources that are important for fulfilling one or more basic social needs during the life span (Bunt et al., 2017).

During the last two years, the levels of isolation and loneliness have increased due to the COVID-19 pandemic. Moreover, multiple studies have shown that older adults, who were socially isolated during the COVID-19 pandemic had a significantly higher likelihood of cognitive decline compared to those who were not (Noguchi et al., 2021). Indeed,

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insights from these finding are supported by research relating to the potential protective role of commensality against social frailty, as well as against depressive mood and feelings of loneliness (Kimura et al., 2012). Social frailty is an important risk factor for physical deficits and disability that may lead to the subsequent development of physical frailty in non-frail older adults (Pek et al., 2020; Bunt et al., 2017); both, social isolation and loneliness, are associated with cardiovascular disease (CVD) risk factors such as increased blood pressure, higher cholesterol levels, obesity, and smoking (Sherman et al., 2009).

There is a growing body of evidence that underlines the relationship between the presence of social frailty and negative outcomes, in particular cognitive issues. A previous study in 1697 community-dwelling Chinese older adults reported a high prevalence of social frailty among participants who had dementia, subjective memory decline, and cognitive impairment (Ong et al., 2021). Other studies have been carried out to analyze the theme of social frailty that have attempted to evaluate this issue (Ma et al., 2018; Ko and Jung, 2021). However, to date, studies on this topic have not utilized a long-term follow-up, have not included a large population of older people and in particular, have not considered participants living in the community. Finally, the concepts of mortality and social frailty had always been analyzed as two separate entities potentially precluding a "real" association.

Given this background, the aim of the present study was to investigate the possible association between social frailty and its components at baseline and all-cause mortality over ten years of follow-up in a large representative sample of the older English adult population.

2. Materials and methods

2.1. Study population

This study is based on data from the English Longitudinal Study of Ageing (ELSA) between wave 2 (2004–2005) and wave 7 (2014–2015). The ELSA is a prospective and nationally representative cohort of people living in the UK (Steptoe et al., 2013). The ELSA was approved by the London Multicenter Research Ethics Committee (MREC/01/2/91). Informed consent was obtained from all participants. For the aims of this research, we included only older people, i.e., men and women older than 60 years.

2.2. Social frailty

For defining social frailty in the ELSA study, we used the definition proposed by Bunt et al. (2017), adapted to the information available in this dataset. Financial difficulty was defined using the threshold for poverty of the UK population, considering the total family level income below £20,346 (Smith and Middleton, 2007), household status (living alone vs. not living alone), social activity (non-participation in social activities vs. participation in social activities), and contacts with other people, defined as weekly contact with friends in person/phone/email. For each component, two values (0 less severe and 1 more severe) were attributed, resulting in a final score from zero to four. The total score was then divided into social frailty (≥ 2 points), social pre-frailty (1 point), and robustness (0 points) (Yamada and Arai, 2018; Huang et al., 2021).

2.3. Outcomes: mortality

Mortality was assessed during the ten years of follow-up period using administrative data (Steptoe et al., 2013).

2.4. Participants characteristics

The following variables were considered as potentially important covariates for the association between frailty status and all-cause mortality: educational level, as years of schooling (continuous); marital status, categorized as married vs. other options; body mass index, categorized using the World Health Organization criteria (World Health Organization, 2000), i.e., <18.5 (underweight), 18.5–25 (normal weight), 25–30 (overweight), or ≥ 30 kg/m^2 (obese); smoking status (ever vs. never); disability in one or more of five activities of daily living; physical activity level (Veronese et al., 2017), categorized as sedentary, low, moderate or high level; the presence of comorbidities, categorized as ≥ 2 vs. less, as commonly used in geriatric medicine (Salive, 2013; Veronese et al., 2021); ethnicity, categorized as whites vs. others; the presence of depressive symptoms assessed using the Center for Epidemiologic Studies Depression Scale (CESD), considered as continuous variable (Eaton et al., 2004); the activities of daily living (ADL) in which the participant was independent.

2.5. Statistical analyses

The data were weighted using the person-level longitudinal weight, core sample, wave 2 (http://www.ifs.org.uk/ELSA). Means and standard deviations (SD) were used to describe quantitative measures, whilst percentages and counts were used for categorical variables. Characteristics of the study participants at baseline (wave 2) were compared according to social frailty status (robustness, pre-frailty, frailty) using the Chi-square/Fisher exact tests for categorical variables, and a generalized linear model, after testing for homoscedasticity of the variances with the Levene test, for continuous variables.

The association between social frailty status at baseline and all-cause mortality during the follow-up was explored by survival curves using Kaplan-Meier analyses and the log-rank test. Cox proportional hazard models were used to estimate hazard ratios (HR) and 95 % confidence intervals (95 % CI) for the association between social frailty status at baseline and all-cause mortality. We included all the covariates significantly different across social frailty status at baseline (p < 0.05) or associated with all-cause mortality during follow-up (p < 0.10). The collinearity among covariates was assessed using the variance inflation factor, taking a value over two as exclusion criterion. However, no parameter was excluded for this reason.

The single factors constituting social frailty score at the baseline (poverty, limited social activities, limited contacts with other people, living alone) were used as exposure variables, adjusting, other than the variables mentioned before, also for the other social factors.

All statistical tests were two-tailed, and a p-value < 0.05 was considered to be statistically significant. All analyses were performed using SPPS 26.0.

3. Results

Of the 9432 participants who took part in wave 2 (baseline) of the ELSA study, 3186 were excluded for being younger than 60 years, and 2097 had no data regarding survival status or social frailty, leaving 4149 subjects eligible for this study (Fig. 1, not weighted data).

Overall, 1785 (=43.0 %) were affected by social frailty, compared to 1615 (=38.9 %) and only 749 participants (=18.1 %) were categorized as robust social status. The most frequent social issue was poverty that affected 64.5 % of the population included, whilst the less frequent was living alone that affected 15.4 % of the sample. Table 1 shows the data according to social frailty status at baseline. Compared to socially robust, socially frail subjects were significantly older, more frequently females, whites, and less educated. Moreover, socially frail people were more frequently smokers and disabled, also reporting a higher presence of multimorbidity and depressive symptoms (Table 1). Finally, socially frail subjects were more sedentary and obese (BMI >30) than their counterparts without social frailty.

Fig. 2 graphically shows the association between social frailty and all-cause mortality, during the ten years of follow-up. Socially frail participants experienced a higher risk of all-cause mortality (log rank p-value: <0.0001). After adjusting for ten potential confounders and
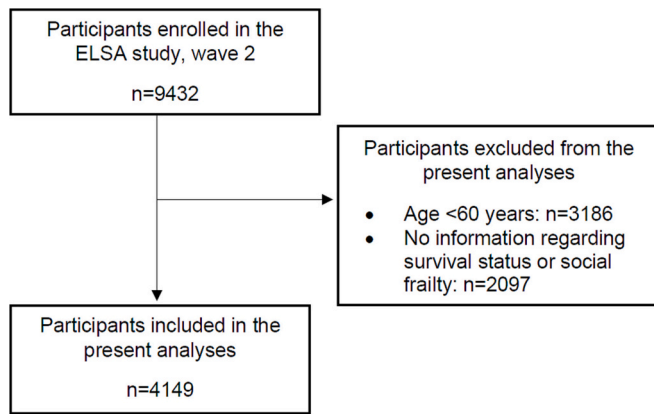
Fig. 1. Flow-chart of the study (not weighted data).

Table 1

Participants' characteristics according to presence of social frailty at baseline in the ELSA Study (weighted data).

	Social robustness (n = 749)	Social pre-frailty (n = 1615)	Social frailty (n = 1785)	p-Value
Age, years, mean (SD)	68.8 (7.2)	70.2 (7.4)	73.1 (8.6)	<0.0001
Sex, male, n (%)	425 (56.7)	847 (52.4)	861 (48.2)	<0.0001
Whites (n, %)	734 (98.0)	1581 (97.9)	1773 (99.3)	0.001
Years of education, mean (SD)	10.3 (6.6)	6.4 (6.8)	4.6 (6.3)	<0.0001
Ever smoker, n (%)	463 (61.9)	1028 (63.7)	1207 (67.7)	0.002
Independent in ADL, n (%)	642 (85.8)	1229 (76.1)	1245 (69.8)	<0.0001
CESD, mean (SD)	1.0 (1.5)	1.4 (1.8)	1.7 (1.8)	<0.0001
Multimorbidity (n, %)	405 (54.1)	1070 (66.3)	1255 (70.3)	<0.0001
Physical activity level, n (%)				
High	161 (21.5)	271 (16.8)	205 (11.5)	<0.0001
Moderate	396 (52.9)	789 (48.9)	779 (43.6)	
Low	151 (20.2)	388 (24.0)	563 (31.5)	
Sedentary	30 (4.0)	129 (8.0)	206 (11.5)	
BMI, n (%)				
18.5–24.9 kg/m^2	184 (27.5)	342 (24.8)	364 (23.6)	0.005
25.0–29.9 kg/m^2	307 (46.0)	605 (43.9)	588 (38.1)	
30–34.9 kg/m^2	106 (15.9)	284 (20.6)	321 (20.8)	

Abbreviations: SD (standard deviation); ADL (activities of daily living); CESD (Center for Epidemiologic Studies Depression Scale); BMI (body mass index).

taking socially robust people as reference, social frailty was associated with a significantly higher risk of death (HR = 1.31; 95 % CI: 1.04–1.64; p = 0.02), whilst socially pre-frailty was associated with a higher all-cause mortality risk in unadjusted models, but not in adjusted models (Table 2).

Among the single factors contributing to social frailty, poverty increased the risk of all-cause mortality by approximately 60 % (HR = 1.60; 95 % CI: 1.33–1.93; p < 0.0001) as well as living alone (HR = 1.46; 95 % CI: 1.10–1.94; p = 0.009), whilst limited social activities and contacts with other people did not increase the risk of all-cause mortality (Table 2).

4. Discussion

The present study including 4149 older people is one of the first to analyze the relationship between the presence of social frailty and all-cause mortality. Previous studies have focused their interest on social frailty and other negative consequences omitting the importance of
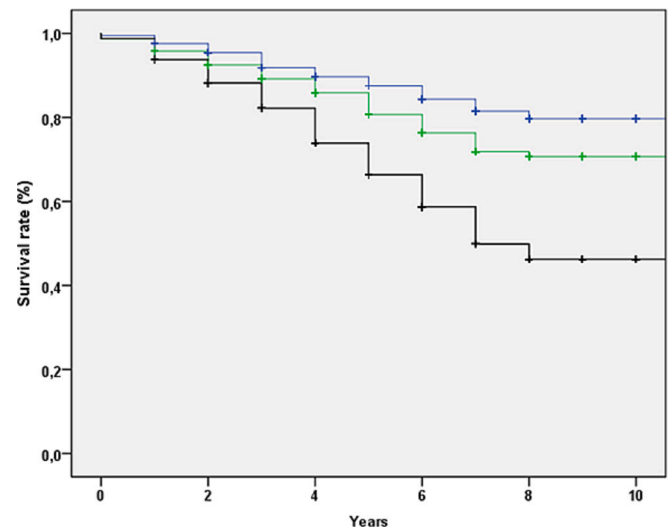

Fig. 2. Survival curves in the ELSA Study according to social frailty status at the baseline.

Legend: Black line = social frailty; green line: social pre-frailty; blue line: social robustness.

Table 2

Survival analysis for the ELSA Study. Mortality according to the presence of social frailty.

Factor	Unadjusted			Fully-adjusted[a]		
	HR	95 % CI	p-Value	HR	95 % CI	p-Value
Social robustness	1	Reference	–	1	Reference	–
Social pre-frailty	1.46	1.17–1.82	0.001	1.22	0.97–1.53	0.09
Social frailty	3.22	2.62–3.95	<0.0001	1.31	1.04–1.64	0.02
Poverty	3.42	2.90–4.03	<0.0001	1.60	1.33–1.93	<0.0001
Limited social activities	2.02	1.72–2.36	<0.0001	1.05	0.88–1.25	0.62
Limited contacts with other people	2.14	1.79–2.57	<0.0001	1.06	0.87–1.28	0.59
Living alone	7.13	6.29–8.08	<0.0001	1.46	1.10–1.94	0.009

Abbreviations: HR (hazard ratio); 95 % CI (95 % confidence interval).

When considered single factors, the others were included as covariates.

[a] Adjusted for: age, sex, race, years of education, smoking status, number of difficulties in the activities of daily living, Center for Epidemiologic Studies Depression scale, presence of multimorbidity, physical activity level, body mass index (in categories).

social frailty as possible risk factor for all-cause mortality. In our study, we reported that some factors indicating the presence of social frailty, such as poverty and living alone, are among the most important contributors to all-cause mortality in older persons.

One important epidemiological point is that social frailty is common among UK older people, affecting approximately one in every two people. In the ELSA study, subjects affected by social frailty were significantly older, more frequently females, whites and less educated than their counterparts. However, even if all these are relevant risk factors for all-cause mortality, our research shows that social frailty was significantly associated with a higher risk of death. To be able to identify older people who are part of this category could be an important step for geriatricians to better frame them and prevent the onset of medical conditions (such as cardiovascular diseases) or death that can be associated with social frailty, according to an increasing literature (Bunt et al., 2017).

An Italian study including 2171 older individuals has found a new

approach to frailty, i.e., biopsychosocial frailty that combines both physical and psychosocial domains, finally expanding the construct of frailty toward social sciences. Biopsychosocial frailty model was a short- and long-term predictor of overall dementia, particularly vascular forms. Even if of importance, this work explored only the association with dementia and not all-cause mortality (Solfrizzi et al., 2019). Findings from the present study support pervious literature that has investigated social frailty with negative outcomes. For example, one previous study reported that social frailty was significantly associated with poor physical functioning, cognition, depression, and mortality (Ma et al., 2018). However, this study suffers from limitations, such as the failure to adjust for some potentially important confounding variables, in fact they included only age and sex, whilst our study has 10 different confounding variables (Ma et al., 2018). Another study based on 6603 community-dwelling adults showed how social pre-frailty and social frailty significantly increased the risk for incident disability and mortality (Yamada and Arai, 2018). A Japanese study including 1240 hospitalized patients with heart failure reported that during the 1-year observation period after discharge, the rates of all-cause mortality were significantly higher in patients with social frailty than in those without it, even after adjusting for key clinical risk factors (Jujo et al., 2021). However, the results of this study are influenced by a possible selection bias, since only hospitalized patients were included (Jujo et al., 2021).

Many factors have been considered important in raising all-cause mortality risk in older people, such as age itself, male sex, education, the presence and severity of medical conditions, low physical activity, all of which increase the risk of frailty and consequently of mortality (Hao et al., 2019). We observed that social frailty is significantly associated with all-cause mortality. A systematic review showed significant links between several serum inflammatory markers, and social frailty status (Pothier et al., 2022), further justifying our findings since a pro-inflammatory phenotype is commonly associated with a higher mortality risk in older people (Franceschi et al., 2000). Moreover, several potential biological mechanisms may underline the association between social frailty and the risk of adverse outcomes in older people, since persons with social frailty may have less physical activity, higher burden of coexisting depression, or less social support for disease management (Keshvani and Pandey, 2021). All these factors, which we cannot include in our statistical analyses, may further justify our clinical findings.

Moreover, our research indicates that poverty and living alone may significantly increase the risk of all-cause mortality in older people. We are living in a period of economic problems and financial crisis, in which COVID-19 further increased family's poverty in the UK especially those without a steady job (Whitehead et al., 2021). Several studies in recent years have investigated the relationship between living alone and mortality. A repeated cross-sectional, nationally representative study carried out among older adults demonstrated that older adults living alone are more vulnerable than those living with others, and their mortality risk increased over these years. However, this study only included people aging >77 years and thus it is not representative of the entire old population (Shaw et al., 2020). A Japanese study including 5534 individuals showed how relative poverty and lack of social engagement may be related to a higher mortality risk in retired men, but their results indicated non-significant associations in women (Tanaka et al., 2018). A meta-analytic review reported that social isolation, loneliness and living alone increased the likelihood of mortality, respectively, with no differences between measures of objective and subjective social isolation (Holt-Lunstad et al., 2015). Our study shows how several factors such as poverty, limited social activities, limited contacts with other people, and living alone are connected with mortality, but after adjusting for potential confounders only poverty and living alone increased the risk of all-cause mortality for these people, finally showing the importance of these two factors for older people and how a real welfare state should invest in prevention.

The findings of this study must be interpreted within its limitations.

First, data regarding medical conditions were self-reported, potentially introducing a recall bias. Second, data on the cause of death was not available, and this could be an important information to allow for a better understanding about which causes may be prevented. Finally, the ELSA study includes Caucasians in large majority, avoiding the part of population that could be, paradoxically, more exposed to social frailty.

5. Conclusions

Our study shows the importance of the issue of social frailty for geriatrics and general practitioners. Research on social frailty could be useful to prevent the onset of pathologies that can cause death in older people. We may suggest that as measures to early detect and prevent social frailty, the implementation of easy accessibility and limited costs by the national health systems may be of help also allowing better use of resources. Therefore, every government should have in its welfare program a scheme to avoid social frailty, and in particular, poverty and living alone for older people.

Declaration of competing interest

None.

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