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Prevalence and correlates of frailty among community-dwelling older men and women: findings from the Hertfordshire Cohort Study

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Abstract

Background: frailty, a multi-dimensional geriatric syndrome, confers a high risk for falls, disability, hospitalisation and mortality. The prevalence and correlates of frailty in the UK are unknown.
Methods: frailty, defined by Fried, was examined among community-dwelling young-old (64–74 years) men (n = 320) and women (n = 318) who participated in the Hertfordshire Cohort Study, UK.
Results: the prevalence of frailty was 8.5% among women and 4.1% among men ($P = 0.02$). Among men, older age ($P = 0.009$), younger age of leaving education ($P = 0.05$), not owning/mortgaging one's home (odds ratio [OR] for frailty 3.45 [95% confidence interval {CI} 1.01–11.81], $P = 0.05$, in comparison with owner/mortgage occupiers) and reduced car availability (OR for frailty 3.57 per unit decrease in number of cars available [95% CI 1.32, 10.0], $P = 0.01$) were associated with increased odds of frailty. Among women, not owning/mortgaging one's home ($P = 0.02$) was associated with frailty. With the exception of car availability among men ($P = 0.03$), all associations were non-significant ($P > 0.05$) after adjustment for co-morbidity.
Conclusions: frailty is not uncommon even among community-dwelling young-old men and women in the UK. There are social inequalities in frailty which appear to be mediated by co-morbidity.

Keywords: *frailty, prevalence, older people, social inequalities, co-morbidity, elderly*

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Introduction

Frailty is a multi-dimensional geriatric syndrome [1]; it may be described as a state of increased vulnerability which results from decreased physiological reserves, multi-system dysregulation and limited capacity to maintain homeostasis [2]. Although overlapping, frailty is not synonymous with either co-morbidity or disability [3, 4]; rather, co-morbidity may be considered a risk factor for frailty and disability, a consequence of frailty [5]. Frailty confers high risk for falls, disability, hospitalisation and mortality [5].

However, frailty remains an evolving concept lacking unique diagnostic criteria for use in clinical practice and epidemiological research [6–10]. Approaches to the characterisation of frailty have included: an index based on the proportion of accumulated deficits [11]; presence of problems in at least two of the physical, nutritive, cognitive and sensory domains [12]; a 7-point Clinical frailty scale [13]; dependency, e.g. needing assistance from another person for bathing or taking medications [14]; and grip strength has been proposed as a useful single marker of frailty [15]. However, the Fried criteria [5] are the most widely implemented objective approach to the classification of frailty as a biological functional limitation or impairment [16], defining frailty as present if a person has at least three of the following criteria: weight loss, weakness, exhaustion, slowness and low activity [5]. Frailty defined by Fried has predictive validity for adverse health outcomes, including disability [5, 17].

Data on the prevalence and correlates of frailty (defined by Fried) are largely from US studies. The prevalence of frailty among 5,317 community-dwelling men and women aged 65 years and older who participated in the American Cardiovascular Health Study was 6.9% with a 4 year incidence of 7.2% [5]; frailty was associated with older age, male gender, being African American, having lower education and income, poorer health and higher rates of comorbid chronic disease and disability. In the Women's Health and Aging Study-I, the prevalence of frailty among 749 community-dwelling women aged 65 years and older who were moderately to severely disabled was 25%, and frailty was associated with incident difficulties in performing activities of daily living [18]. Ottenbacher [19] studied frailty among 621 Mexican Americans, average age 78 years: 22% of women and 17% of men were classified as frail and upper extremity strength, disability, co-morbidities, and mental status scores predicted frailty among men, and lower extremity strength, disability and body mass index predicted frailty among women. The prevalence of frailty in the Women's Health Initiative Observational Study [20] was 16.3%, and older age, co-morbidity, smoking, depressive symptoms, lower income, living alone and poorer self-reported health were associated with increased frailty. Cawthorn *et al.* [21] estimated a frailty prevalence of 4% among American men aged 65 years and older and the seven and a half year incidence of frailty among 420 community-dwelling women aged 70–79 years who participated in the Women's Health and Aging Study II and were not frail at baseline was 9% [22].

European studies on the prevalence and determinants of frailty are limited. The French Three-City Study demonstrated a frailty prevalence of 7% among 6,078 community-dwelling men and women aged 65 years and older [17]; frailty was associated with older age, female gender, lower education, lower income, poorer self-reported health status and more chronic diseases in addition to incident disability. The recent Survey of Health, Aging and Retirement in Europe (SHARE) [23], which did not include UK data, studied 16,584 men and women aged 50 years and older; the prevalence of frailty was 4.1% among participants aged 50–64 years and 17% among those aged 65 and older, with a higher prevalence of frailty among women. The SHARE study demonstrated higher prevalences of frailty in southern than northern Europe and concluded that education contributed to this geographical variation. We are not aware of any prevalence data on frailty defined by the Fried criteria from the United Kingdom.

The United Kingdom has an ageing population [24]. Within the context of this demographic change, the UK government's ageing strategy recognises the importance of building a society which enables individuals to live a healthy and independent old age [25]. The UK government also acknowledges the need for effective planning to enable health and social systems to have the capability to support and care for inevitably increasing numbers of frail older people over time [26]. Although social factors such as lower education and income are broadly acknowledged as playing an important role in frailty [27], research focused on the social patterning of frailty is limited [5, 17, 20, 23]. Understanding of the social context in which frailty occurs would (i) inform local and national public health policy and planning by identifying subgroups of the population in which the burden of frailty is focused and (ii) would provide clues to aetiology and give direction for where best to target initiatives and interventions which aim to reduce frailty.

The objective of the current study was to describe the prevalence of frailty and to examine its associations with lifestyle and social characteristics, among community-dwelling young-old men and women who participated in the Hertfordshire Cohort Study (HCS), UK [28].

Methods

Study participants comprised 322 men and 320 women aged 64–74 years who participated in home interviews and clinic visits for a musculoskeletal follow-up component of the HCS [28] in 2004–5. At the follow-up clinic visit, medical and social histories were updated. Information was collected on frailty status using the Fried criteria [5]. Self-assessed health-related quality of life was ascertained using the short-form 36 (SF-36) questionnaire, and SF-36 data were mapped to eight domain scores including physical function. Hand grip strength was measured three times on each side using a Jamar handgrip dynamometer, and participants completed a timed 3 metre walk. Please see Appendix 1 in the

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Table 1. Summary characteristics of study participants

n (%)		Men (*n* = 320)	Women (*n* = 318)
Age (years)[a]		69.2 (2.5)	69.5 (2.6)
Smoking status	Never	120 (37.5)	200 (63.5)
	Ex	173 (54.1)	98 (31.1)
	Current	27 (8.4)	17 (5.4)
Alcohol (units per week)	Non-drinker	17 (5.3)	78 (24.7)
	Very low (<1)	44 (13.8)	72 (22.8)
	Low (1–10 men, 1–7 women)	139 (43.4)	120 (38.0)
	Moderate (11–21 men, 8–14 women)	67 (20.9)	36 (11.4)
	Fairly high (22–35 men, 15–21 women)	36 (11.3)	5 (1.6)
	High (>35 men, >21 women)	17 (5.3)	5 (1.6)
Age left full-time education (years)[b]		15 (15,16)	15 (15,16)
Left full-time education aged ≤14 years		62 (19.4)	62 (19.5)
Social class in adulthood[c]	I Professional	16 (5.3)	21 (6.6)
	II Management and Technical	78 (25.7)	70 (22.0)
	III NM Skilled non-manual	37 (12.2)	45 (14.2)
	III M Skilled manual	115 (37.8)	129 (40.6)
	IV Partly skilled	52 (17.1)	41 (12.9)
	V Unskilled	6 (2.0)	12 (3.8)
Housing tenure	Owned/mortgaged	281 (87.8)	266 (83.7)
	Rented/other	39 (12.2)	52 (16.4)
Number of cars available	None	12 (3.8)	40 (12.6)
	1	168 (52.5)	192 (60.4)
	2	116 (36.3)	77 (24.2)
	3	24 (7.5)	9 (2.8)

[a]Mean and standard deviation.
[b]Median and interquartile range.
[c]Based on social class of the husband for ever married women.

supplementary data on the journal website (http://www.ageing.oxfordjournals.org/) for a full description of the study population and methodology.

The Fried frailty criteria define frailty as presence of three or more of the following items: unintentional weight loss (greater than 10lb over the past year), weakness, self-reported exhaustion, slow walking speed and low physical activity. In this study, these criteria were operationalised as follows: weakness was defined as a maximum grip strength of ≤30kg for men and ≤20kg for women [29]; exhaustion was identified if the participant felt that everything they did was an effort for either moderate amounts or most of the time in the past week; slow walking speed was defined as a 3 m walk time in the slowest fifth of the HCS sex-specific distribution (≥3.82 s for men and ≥3.98 s for women); and low physical activity was identified if the participant had an SF-36 physical functioning score in the bottom fifth of the HCS sex-specific distribution (≤75 for men and ≤60 for women). Four participants had missing data for the Fried frailty score and were excluded from all analyses.

Statistical methods

Cross-tabulations of frequencies and percentages and univariate and multiple logistic regression models were used to analyse the relationships between frailty and the characteristics of the study participants. Univariate analyses were conducted initially, followed by mutually adjusted, and comorbidity adjusted, analyses for lifestyle and social variables that were significantly associated with frailty ($P < 0.05$) in the univariate analyses. Categories of age, smoking status, alcohol intake, age left full-time education, social class and number of cars were used for presentational purposes, but P values for association were obtained from continuously distributed variables. All analyses were conducted for men and women separately using Stata, release 10.0 (Stata Corporation 2007).

Results

Table 1 shows the summary characteristics of the study participants who were aged 64–74 years at the time of the follow-up clinic visit. Table 2 shows the prevalence of each of the components of the Fried frailty criteria according to gender; the overall prevalence of frailty was 8.5% for women and 4.1% for men ($P = 0.02$ for gender difference).

Table 3 shows the univariate associations between the characteristics of the HCS participants and Fried frailty status. Among men, older age, younger age of leaving full-time education, not owning or mortgaging one's home and having fewer cars available for household use were all associated with increased odds of being frail. Among women, lower alcohol intake and not owning or mortgaging one's home were associated with increased odds of being frail.

Among men, a mutually adjusted logistic regression model for frailty versus all of the variables that were significant in univariate analyses showed that the associations between frailty and age of leaving education ($P = 0.58$)

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Table 2. Prevalence of Fried frailty and its component items

n (%)	Men (n = 320)	Women (n = 318)
Unintentional weight loss (>10lb over the past year)	17 (5.3)	11 (3.5)
Weakness[a]	22 (6.9)	68 (21.5)
Self-reported exhaustion[b]	18 (5.6)	32 (10.1)
Slow walking speed[c]	63 (19.8)	63 (19.9)
Low physical activity[d]	85 (26.6)	69 (21.7)
Frail on the Fried score (presence of three or more of above criteria)	13 (4.1)	27 (8.5)

[a]Maximum grip strength ≤30kg men and ≤20kg for women.
[b]The participant felt that everything they did was an effort for moderate amounts to most of the time in the past week.
[c]Timed up and go 3 metre walk ≥3.82 s for men and ≥3.98 s for women.
[d]SF-36 physical functioning score in the bottom fifth of the sex-specific distribution (≤75 for men and ≤60 for women).

Table 3. Univariate associations between frailty and the lifestyle and social characteristics of HCS participants

		Men		Women	
		n (%) frail on the Fried score	Univariate odds ratios (95% CI) for frailty	n (%) frail on the Fried score	Univariate odds ratios (95% CI) for frailty
Age (years)	≤67.7	1 (0.9)	1.39 (1.09, 1.78)	7 (6.6)	1.07 (0.92, 1.24)
	−70.8	5 (4.3)	P = 0.009, per year of age	12 (12.1)	P = 0.40, per year of age
	≥70.9	7 (7.4)		8 (7.1)	
Smoking status	Never	4 (3.3)		12 (6.0)	
	Ex	8 (4.6)	1.18 (0.48, 2.89)	14 (14.3)	1.62 (0.89, 2.96)
	Current	1 (3.7)	P = 0.72, per increased band of smoking	1 (5.9)	P = 0.12, per increased band of smoking
Alcohol intake (units per week)	Non-drinker	3 (17.7)		10 (12.8)	
	Very low (<1)	1 (2.3)		7 (9.7)	
	Low (1–10 men, 1–7 women)	5 (3.6)		9 (7.5)	
	Moderate (11–21 men, 8–14 women)	3 (4.5)	0.71 (0.42, 1.17)	1 (2.8)	0.66 (0.45, 0.97)
	Fairly high (22–35 men, 15–21 women)	0 (0.0)	P = 0.18, per increased band of intake	0 (0.0)	P = 0.04, per increased band of intake
	High (>35 men, >21 women)	1 (5.9)		0 (0.0)	
Age left full-time education (years)	≤14	6 (9.7)	0.50 (0.25, 1.01)	5 (8.1)	0.85 (0.59, 1.22)
	≥15	7 (2.7)	P = 0.05, per year older	22 (8.6)	P = 0.37, per year older
Social class in adulthood	I Professional	0 (0.0)		1 (4.8)	
	II Management and Technical	0 (0.0)		6 (8.6)	
	III NM Skilled non-manual	1 (2.7)	1.65 (0.99, 2.77)	3 (6.7)	1.19 (0.86, 1.64)
	III M Skilled manual	10 (8.7)	P = 0.06, per lower band of social class	9 (7.0)	P = 0.30, per lower band of social class
	IV Partly skilled	2 (3.9)		7 (17.1)	
	V Unskilled	0 (0.0)		1 (8.3)	
Housing tenure	Owned/mortgaged	9 (3.2)	Reference	18 (6.8)	Reference
	Rented/other	4 (10.3)	3.45(1.01, 11.81) P = 0.05	9 (17.3)	2.88 (1.22, 6.84) P = 0.02
Number of cars available	None	2 (16.7)		6 (15.0)	
	1	9 (5.4)	0.28 (0.10, 0.76)	15 (7.8)	0.64 (0.35, 1.19)
	2	2 (1.7)	P = 0.01, per extra car	6 (7.8)	P = 0.16, per extra car
	3	0 (0.0)		0 (0.0)	

95% CI, 95% confidence interval.

and home ownership (P = 0.23) were attenuated. The adjusted odds ratios for frailty in relation to age (odds ratio [95% confidence interval {CI}] per year older 1.27 [0.96, 1.69], P = 0.10) and car availability (odds ratio [95% CI] per extra car 0.35 [0.11, 1.04], P = 0.06) remained sizeable, but the associations were not significant at the 5% level.

Among women, a mutually adjusted logistic regression model for frailty versus alcohol intake and home ownership demonstrated that the association with home ownership remained significant (odds ratio for frailty for not owning or mortgaging one's home [95% CI] 2.47 [1.01, 6.03], P = 0.05), whilst the association with alcohol intake was attenuated (P = 0.10).

Finally, we analysed the associations between frailty and co-morbidities among men and women (ischaemic heart disease, stroke/TIA, high blood pressure, bronchitis, diabetes,

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minor trauma fracture, hand osteoarthritis and history of falling) to identify which co-morbidities should be included as adjustment factors in the analyses of frailty versus lifestyle and social factors. Ischaemic heart disease ($P < 0.001$), stroke/TIA ($P = 0.04$) and high blood pressure ($P = 0.02$) were associated with frailty among men, and ischaemic heart disease ($P < 0.001$), high blood pressure ($P = 0.01$) and diabetes ($P = 0.05$) were associated with frailty among women. The association between car availability and frailty among men was strengthened by adjustment for these significant co-morbidities ($P = 0.03$), but the associations between frailty and age ($P = 0.14$), education ($P = 0.72$) and home ownership ($P = 0.64$) were further attenuated. The association between frailty and home ownership among women was attenuated by adjustment for ischaemic heart disease, high blood pressure and diabetes ($P = 0.21$).

Discussion

We have shown that the prevalence of frailty, as defined by Fried, among community-dwelling young-old men and women aged 64–74 years who participated in the HCS, UK, was 8.5% for women and 4.1% for men. Among men, frailty was associated with older age, younger age of leaving full-time education, not owning or mortgaging one's home and having fewer cars available for household use. Among women, not owning or mortgaging one's home was associated with increased frailty. However, with the exception of reduced car availability and frailty among men, these associations were not significant ($P > 0.05$) after adjustment for co-morbidity. These findings, the first from a UK study, have two important implications. First, frailty is not uncommon even among young-old community-dwelling men and women in the UK. Second, there are social inequalities in frailty which appear to be largely mediated by the variety of chronic disorders and co-morbidities that occur with greater frequency among socially disadvantaged individuals. Our results identify subgroups of the population in which the burden of frailty is focused and could inform planning for the capability of health and social systems to care for increasing numbers of frail older people over time. Our results also provide some direction for where best to target initiatives and interventions which aim to reduce frailty.

Our prevalence statistics, the first to be published from a UK study, are broadly comparable with published US and European prevalence data for frailty defined by the Fried criteria (4–25% [5, 17–23]), although the relatively young age of the HCS participants has perhaps lead to a relatively low prevalence of frailty in the current study. However, our results highlight the need for increased planning of geriatric medicine services if frailty, even in this relatively young cohort, is already approaching 10% prevalence in at least one gender group. The wide variation in published frailty prevalence estimates is unsurprising owing to different: study designs and geographical locations; inclusion and exclusion criteria; gender, age and ethnicity of study participants; and variations in the implementation of the Fried criteria. However, it is perhaps of note that the prevalence found in this study was more similar to that reported by the French Three-City Study [17] and the European-wide SHARE study [23] than to that reported by the US studies.

Home ownership and car availability are useful markers of social and material advantage [30] which reflect the amount and stability of household income [31]. Our univariate findings support the argument that social factors play a role in frailty [27] and are consistent with the limited literature on social influences on frailty [5, 17, 23]. Further, our adjusted results suggest that social inequalities in frailty may be largely attributable to the variety of chronic disorders and co-morbidities that occur with greater frequency among socially disadvantaged individuals [32]. Our results identify subgroups of the population in which the burden of frailty is focused and could inform planning for the capability of health and social systems to care for increasing numbers of frail older people over time.

The observed gender difference in frailty (8.5% among women, 4.1% among men) in this study is consistent with available literature [17, 19, 23, 33] and is not unexpected given that women have lower average lean mass and strength than men [5, 34] and that older women are more likely than men to live alone with consequence for poorer nutrition, sarcopenia and frailty [34]. Other explanations for the gender difference in frailty prevalence include: differences in patterns of physical activity and physical performance, the fact that men of a given age have higher mortality rates but women have more morbidity and disability and women having lower baseline levels of muscle mass and lower levels of neuroendocrine and hormonal factors such as testosterone which may predispose them to reaching frailty [33].

This study had some limitations. Firstly, we have only considered cross-sectional relationships between lifestyle and social factors and frailty. However, follow-up of the HCS cohort is ongoing (e.g. postal and clinical follow-ups are planned and the cohort are flagged with the National Health Services Central Registry for ongoing notification of deaths) and will yield valuable longitudinal information on frailty incidence and progression. Secondly, additional information on social factors such as household income or receipt of benefits would have been useful. Thirdly, Hertfordshire is in the relatively less deprived South Eastern area of England, and we studied community-dwelling young-old men and women who might reasonably be expected to be at the less frail end of the spectrum among older people. Finally, response bias analyses (data not shown) demonstrated that baseline age, health behaviours such as smoking and social factors such as not owning one's home or lower social class influenced likelihood of taking part in the follow-up study, although co-morbidity and frailty components such as grip strength did not. However, our analyses were internal; unless the association between e.g. home ownership and frailty is systematically different among subgroups of the population defined by health behaviours, social factors and frailty level, no major bias should have been introduced.

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Our study also had many strengths. Firstly, the data were rigorously collected according to strict protocols by trained research nurses and doctors [28]. Secondly, we operationalised frailty using the accepted and objective Fried criteria [16]. Finally, we are confident that our results are generalisable to the wider population of older people in England, because the cohort have been shown to be broadly comparable with participants in the nationally representative Health Survey for England [28].

In conclusion, we have shown that frailty (operationalised by the Fried criteria) is not uncommon even among young-old community-dwelling men and women in the United Kingdom and that there are social inequalities in frailty which appear to be largely mediated by co-morbidity.

Key points

- Frailty confers a high risk for falls, disability, hospitalisation and mortality. However, research in to the prevalence of frailty and its correlates, particularly social influences, is limited.
- Using data from the HCS, we have shown that frailty, defined by the Fried criteria, is not uncommon even among young-old community-dwelling men and women, aged 64–74 years, in the UK (prevalences: 8.5% women; 4.1% men).
- We have demonstrated social inequalities in frailty (across levels of education, home ownership and car availability) which are largely mediated by co-morbidity.

Conflicts of interest

None declared.

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Supplementary data

Supplementary data mentioned in the text is available to subscribers at the journal website http://ageing.oxfordjournals.org.

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Excess mortality in men compared with women following a hip fracture. National analysis of comedications, comorbidity and survival

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Abstract

Introduction: osteoporosis is a common disease, and the incidence of osteoporotic fractures is expected to rise with the growing elderly population. Immediately following, and probably several years after a hip fracture, patients, both men and women, have a higher risk of dying compared to the general population regardless of age. The aim of this study was to assess excess mortality following hip fracture and, if possible, identify reasons for the difference between mortality for the two genders.
Methods: this is a nationwide register-based cohort study presenting data from the National Hospital Discharge Register on mortality, comorbidity and medication for all Danish patients (more than 41,000 persons) experiencing a hip fracture between 1 January 1999 and 31 December 2002. Follow-up period was until 31 December 2005.
Results: we found a substantially higher mortality among male hip fracture patients than female hip fracture patients despite men being 4 years younger at the time of fracture. Both male and female hip fracture patients were found to have an excess mortality rate compared to the general population. The cumulative mortality at 12 months among hip fracture patients compared to the general population was 37.1% (9.9%) in men and 26.4% (9.3%) in women. In the first year, the risk of death significantly increased for women with increasing age (hazard ratio, HR: 1.06, 95% confidence interval, CI: 1.06–1.07), the number of comedications (HR 1.04, 95% CI 1.03–1.05) and the presence of specific Charlson index components and medications described below. For men, age (HR 1.07, 95% CI 1.07–1.08), number of comedications (HR 1.06, 95% CI 1.04–1.07) and presence of different specific Charlson index components and medications increased the risk. Long-term survival analyses revealed that excess mortality for men compared with women remained strongly significant (HR 1.70, 95% CI 1.65–1.75, $P < 0.001$), even when controlled for age, fracture site, the number of medications, exposure to drug classes A, C, D, G, J, M, N, P, S and for chronic comorbidities.

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