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Social care costs for community-dwelling older people living with frailty

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Abstract

International evidence indicates that older people with frailty are more likely to access social care services, compared to nonfrail older people. There is, however, no robust evidence on costs of social care provided for community-dwelling older people living with frailty in their own homes. The main objective of this study was to examine the relationship between community-dwelling older people living with frailty, defined using the cumulative deficit model, and annual formal social care costs for the 2012–2018 period. A secondary objective was to estimate formal social care spending for every 1% reduction in the number of older people who develop frailty over 1 year. Secondary analysis of prospective cohort data from two large nationally representative community-based cohort studies in England was performed. Respondents aged ≥75 were used in the main analysis and respondents aged 65–74 in sensitivity testing. We used regression tree modelling for formal social care cost analysis including frailty, age, gender, age at completing education and living with partner as key covariates. We employed a minimum node size stopping criteria to limit tree complexity and overfitting and applied ‘bootstrap aggregating’ to improve robustness. We assessed the impact of an intervention for every 1% decrease in the number of individuals who become frail over 1 year in England. Results show that frailty is the strongest

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predictor of formal social care costs. Mean social care costs for people who are not frail are £321, compared with £2,895 for individuals with frailty. For every 1% of nonfrail people not transitioning to frailty savings of £4.4 million in annual expenditures on formal social care in England are expected, not including expenditure on care homes. Given considerably higher costs for individuals classed as frail compared to nonfrail, a successful intervention avoiding or postponing the onset of frailty has the potential to considerably reduce social care costs.

KEYWORDS

ageing, community, costs, frailty, health research, older people, social care

1 | INTRODUCTION

In England, government expenditure on formal adult social care is ~£16 billion, with most recipients of services aged ≥65 (Foster, 2020; Johnson et al., 2018). Spending on adult social care provides support to people with physical or mental disability or illness for routine daily activities, including washing, dressing, grooming and bathing. The 2014 Care Act introduced national eligibility criteria for adult social care in England, aiming to ensure that adults deemed sufficiently in need and unable to cover their own care receive the support they require. The Care Act specifies that an adult is considered in need of care if they are unable to achieve two or more outcomes (such as maintaining personal hygiene) without assistance, distress or danger to their health. If they have assets over £23,250, they automatically have to pay the full cost of their care. If their savings are less than this, they will receive a contribution to the cost of their care from the local authority, depending on their income and savings. Aligned with the means testing for social care in England, the majority of care is paid for privately or provided informally by carers, typically spouses, other family members, neighbours or friends (Luchinskaya et al., 2017). In addition to this expenditure and informal care, evidence indicates that ~1.5 million people in England have unmet care needs (Age UK, 2019). These expenditures are likely to continue increasing given the projected absolute increase in the size of the older population over coming decades (Luchinskaya et al., 2017; Wittenberg et al., 2018).

Older people living with frailty are core users of health and social care. In England around 6.5% of people aged 60–69 have frailty, rising to around 65% of people over 90 (Gale et al., 2015). Although not synonymous with disability, around 90% of older people living with frailty experience mobility problems, and over 50% have difficulties with washing, dressing or housework (Gale et al., 2015). International evidence indicates that older people living with frailty access social care services more than fit older people (Hoeck et al., 2012; Kehusmaa et al., 2012; Rochat et al., 2010; Roe et al., 2017). Increasing frailty is associated with substantial increases in healthcare costs, driven by increased hospital admissions, longer inpatient stay and increased general practice consultations (Dent et al., 2017; Han et al., 2019; Ilinca & Calciolari, 2015; Roe et al., 2017; Simpson et al., 2018).

What is known about this topic?

- Older people with frailty are more likely to access social care services.
- compared to nonfrail older people.
- There is no robust evidence on costs of social care for older people living with frailty.

What this paper adds?

- Frailty is the strongest predictor of formal social care costs.
- Mean social care costs for people living in their own homes who are not frail are £330, compared with £2,962 for individuals with frailty.
- A successful intervention targeting delay or prevention of frailty could considerably reduce social care costs.

1.1 | Background

Despite evidence linking frailty with loss of independence and use of health and social care services, there is no robust evidence on costs of social care for older people living with frailty in their own homes. This evidence is important to inform national social policy and resource allocation decisions.

1.2 | Objectives

Our main objective was to examine the relationship between older people living with frailty, defined using the cumulative deficit model, and annual formal social care costs. A secondary objective was to estimate formal social care spending for every 1% reduction in the number of older people who develop frailty over 1 year.

2 | METHODS

2.1 | Study design

We perform secondary analysis of prospective cohort data from two large nationally representative community-based cohort studies in England. The Community Ageing Research 75+ (CARE75+) recruits community-dwelling older people aged 75 and over, with wide geographical representation across urban and rural areas of the country. CARE75+ commenced in December 2014, with data collected to November 2018 used for this study. The English Longitudinal Study of Ageing (ELSA) is designed to be representative of adults aged 50 and over and a source of rich information to guide health and social policy. We worked with data from wave 6 of ELSA, conducted in 2012/2013.

2.2 | Setting

Community Ageing Research 75+ is a multisite, community-based cohort study, recruiting from English general practices, with wide sociodemographic representation (Heaven et al., 2019). ELSA is a nationally representative panel study in private households in England (Steptoe et al., 2013).

2.3 | Participants

People living in the community. Care home residents were excluded. CARE75+ data additionally exclude people living at home and bedbound and in the terminal stage of life.

English Longitudinal Study of Ageing study received ethical approval from the National Research Ethics Service (NRES), and CARE75+ was approved by the NRES Committee Yorkshire and Humber. All participants provided informed consent. Formal University of Leeds ethics approval was received prior to implementation of this study.

2.4 | Variables

2.4.1 | Frailty measure

Frailty was defined in both data sets using a research-standard frailty index (FI), based on the cumulative deficit model of frailty, and previously validated (Mitnitski et al., 2001). The FI score is calculated as an equally weighted proportion of the number of deficits present in an individual relative to the total possible. Owing to the comprehensive information on clinical conditions and diseases, the cumulative deficit model is sensitive to modifications in underlying health. Furthermore, and in comparison to most other frailty measures, the continuous nature of the FI score avoids a priori categorisation into risk categories. We used this continuous measure of frailty to let data categorise formal social care costs outcome into categories based on observed patterns.

2.4.2 | Other covariates

We included age, gender, age at completion of education and living with partner. These were selected based on previous studies using this FI (Rogers, Marshall, et al., 2017; Rogers, Steptoe, et al., 2017) and availability in both ELSA and CARE75+ data sets.

2.4.3 | Social care costs

Formal social care costs were defined as the sum of annual costs related to the utilisation of a range of social care services funded by the local authority, privately funded or paid for through a combination of these. We used total formal social care costs as the outcome variable.

2.5 | Data sources

English Longitudinal Study of Ageing and CARE75+ collect the FI score and all explanatory variables, but information about utilisation of formal social care services differs. This is because, unlike healthcare systems, social care systems lack structured data collection in aspects such as standardised coded data and established national data dictionaries. Examining the two data sets provides a more comprehensive and robust understanding of social care use in England.

English Longitudinal Study of Ageing respondents reported use of home care, housing manager, council handyman, other formal social care, lunch clubs, day centres, meals on wheels and frozen meals in the week preceding the survey. CARE75+ respondents reported receiving help from warden, home care, night sitter and day sitter in the 4 weeks prior to the survey. Count variables measured frequency of formal social care services. CARE75+ also collects additional information on home adaptations. A dichotomous variable captured availability of home adaptations by asking respondents whether they have the following adaptations: grab rails, bed risers, hoist, helping hand, key safe, pendant alarm, stair lift and outside step.

To obtain annual social care costs, individual service utilisation was multiplied by the unit costs for each service, inflated to 2018 values to ensure comparability and scaled to annual numbers. Home adaptations were costed once in the year when their availability was first reported. Unit costs were obtained from the Personal Social Services Research Unit costs for social care and Supporting Information (Appendix S1).

To improve comparability, we mapped age at completion of education and living with partner variables onto a unified measurement scheme. FI, age and gender variables were, by construction, the same.

2.6 | Bias

Aligned with the method of data collection in ELSA and to minimise bias due to no collection of social care use data, we assumed respondents who reported no difficulty with either a basic activity of daily living or instrumental activity of daily living (IADL) had no social care costs. We used regression tree modelling to accommodate mass points and right-skewness of the cost distribution.

2.7 | Study size

All available data in the CARE75+ data and Wave 6 of ELSA were used. In total, 5,685 individuals aged ≥65 were interviewed in Wave 6 of ELSA including 2,477 respondents aged ≥75. There were 2,472 assessments in the CARE75+ data.

2.8 | Sensitivity analysis

A sample of ELSA respondents aged 65–74 ($N = 3{,}200$) was used.

2.9 | Statistical methods

Social care costs have particular features that present challenges to modelling. A similar situation arises with healthcare costs. There are many individuals who report no use of social care services and therefore have zero costs. At the other extreme, there are a few individuals who have very high service use and consequently very high costs: the cost distribution is highly skewed. In order to employ traditional regression methods, a two-part model might be used, thus dealing with those with no social care. In addition, a transformation, such as a logarithm, would be needed to cope with skewness. This leads to a complex model which can be difficult to interpret, for example, with multiplicative effects rather than additive effects. Often with traditional regression, interaction terms are not considered due to the many possibilities and complexity of interpretation. There are also assumptions about residuals which may not always hold, and so there are concerns about robustness.

An alternative approach taken here is regression tree modelling. This has advantages, the most important of which are ability to effectively describe relationships in complex data sets and simplicity which greatly aids interpretation. With regression tree modelling, there is no need to assume any parametric relationship between social care costs and the main exposure, frailty. Neither is it necessary to break the model into two parts to model the case of no care usage nor are there difficulties in fitting and interpreting interactions. The regression tree method incorporates these features simply by the structure of the underlying tree, and so it can more effectively describe relationships in complex data sets than parametric models. Interpretation of the resulting tree model is also straightforward since the final fitted tree shows how predictors combine to yield expected social care costs. The model may be explained clearly to policy makers. We implemented modelling using the rpart (version 4.1-15) library in R (Therneau et al., 2019).

The regression tree procedure splits the dependent variable into similar-looking subsamples based on covariates. Similarity between subsamples can be assessed using mean-squared error among other metrics. The overall importance of a covariate is determined by how much it improves similarity within subsamples. The algorithm, in the absence of constraints, stops if the subsample similarity cannot be improved by further dividing using the set of explanatory variables. We employed a minimum node size stopping criterion to limit tree complexity.

We applied 'bootstrap aggregating' (bagging) to improve robustness with the ipred library (version 0.9.9) (Peters et al., 2019). As a result of bagging, we generated multiple responses for each observation in the original data set. We used these responses to predict each observation.

The scenario calculation assessed the impact of every 1% reduction in the number of people who develop frailty over 1 year on total social care spending for older people living in their own homes. We estimated the probability of becoming frail using ELSA data and applied to national statistics data on population by age category (Office for National Statistics, 2020) to calculate the total increase in the number of older people becoming frail. To obtain cost savings, we multiplied 0.01 of this number by the difference in estimated average costs for frail and nonfrail categories obtained from the bagging estimation.

3 | RESULTS

3.1 | Participants

A total of 2,408 individuals ≥75 years interviewed in ELSA, Wave 6, are included in the analysis. A total of 2,456 assessments of 1,038 individuals are included from CARE75+.

3.2 | Summary statistics

Table 1 shows descriptive statistics for participants. The FI groups individuals into four categories: very fit (FI score of 0–0.10); well (>0.10–0.14), vulnerable (>0.14–0.24) and frail (>0.24) (Hubbard et al., 2014). A third of included CARE75+ participants (mean age 81 years) and ELSA participants (mean age 82 years) have frailty. There are more women than men (56% and 52%, respectively). About 52% of ELSA respondents and 46% of CARE75+ respondents

TABLE 1 Descriptive statistics

	ELSA, 75+			CARE75+		
	M	*SD*	*N*	*M*	*SD*	*N* (%)
Age	80.6	4.6	2,408	81.5	4.9	2,456
Female	0.56	0.5	2,408	0.52	0.5	2,456
Frailty	0.21	0.13	2,408	0.19	0.11	2,456
Living w partner	0.52	0.5	2,408	0.46	0.5	2,456
Age at finishing education			2,408			2,456
1 (≤14)	31.31		754	17.75		436
2 (=15)	26.83		646	32.98		810
3 (=16)	16.53		398	20.07		493
4 (=17)	6.35		153	6.88		169
5 (=18)	4.94		119	4.53		111
6 (≥19)	10.8		260	11.03		271
Missing	3.24		78	6.76		166
Total SC costs						
Nonfrail	194.76	1,238.39	1,599 (66.4%)	800.48	5,231.44	1,739 (70.8%)
Frail	3,220.11	11,053.8	809 (33.6%)	4,336.28	1,2078.4	717 (29.2%)

Abbreviations: CARE75+, Community Ageing Research 75+; ELSA, English Longitudinal Study of Ageing.

live with a partner. Counts of respondents who used different types of formal social care services are provided in Appendix S2.

3.3 | Main results

Mean social care costs for those with frailty are higher than for the nonfrail group in both ELSA (£3,220 vs. £195) and CARE75+ (£4,336 vs. £800). Analysis showed a nonlinear relationship between social care costs and frailty (Figures A1 and A2 in Appendix S3). Social care costs increase rapidly at levels of frailty above the 0.24 cut-point of the frailty category.

Results from the analysis using ELSA respondents aged ≥75 are presented in Figure 1. The initial cut-point is at a FI score of 0.49 indicating respondents with FI score <0.49 differ from respondents with FI score ≥0.49 in their formal social care utilisation. This underscores the importance of frailty compared to age, gender, age at completion of education and living with partner in predicting social care costs. For individuals with FI score <0.49, the degree of frailty further impacts on total social care costs. For those whose FI score is <0.25, predicted average social care costs are £196. For individuals with frailty score 0.25–0.49, predicted average social care costs are £2,097. Similarly, results based on CARE75+ show the most important predictor of social care costs is frailty (Figure 2). The initial cut-point is at 0.39. In both ELSA and CARE75+, the initial cut-point is above the recognised 0.24 cut-off which conventionally differentiates frail from nonfrail individuals.

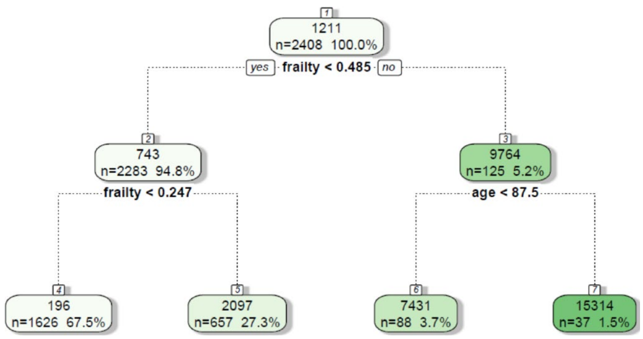

FIGURE 1 Regression tree results for English Longitudinal Study of Ageing respondents aged 75 and older

Age is an important predictor of social care use for ELSA individuals with FI score >0.49. In this group, respondents aged 75–87 have predicted social care costs of £7,431, while respondents aged ≥88 have, on average, predicted costs of £15,314. Age is also the next important predictor of costs for CARE75+ respondents with frailty scores above 0.39. In this group, respondents aged 75–83 have predicted social care costs of £4,748, whereas respondents with FI score >0.39 and aged 83–87 have £12,353 of predicted formal social care cost. Furthermore, respondents ≥88 years incur the highest costs of £22,571. For those with FI score <0.39, age is the next important predictor of social care costs. Respondents aged 75–88 have predicted social care costs of £827. For older respondents age at completing education further differentiates between clusters of individuals with similar social care use. Older, less educated and less frail individuals have predicted social care costs of £2,145. Respondents with >14 years of education have higher social care costs (£8,359).

Results from the sensitivity analysis (Appendix S3) demonstrate that frailty is the most important predictor of formal social care costs for people aged 65–74 years. About 95% confidence intervals for leaf sample means are provided in Appendix S4.

3.4 | Bagging

Bagging results based on ELSA indicate that the mean social care costs for people aged ≥75 who are not classified as frail are £321, compared with £2,895 for individuals with frailty. Bagging results based on CARE75+ regression tree model show that the mean costs for nonfrail individuals are £1,088 and for frail individuals £3,890 (Table 2). The difference in results might be explained by the fact that different formal social care services are costed and adaptations are also included for CARE75.

3.5 | Scenario calculations

We assessed the impact of an intervention for every 1% decrease in the number of individuals who become frail over a year in England. Our estimates suggest that 171,395 older people aged ≥75 will become frail. For every 1% of nonfrail people not transitioning to frailty, a successful intervention is predicted to save £4.4 million in annual expenditures on formal social care for older people living in their own homes based on ELSA data. Estimates based on CARE75+ data point to £4.8 million in annual savings.

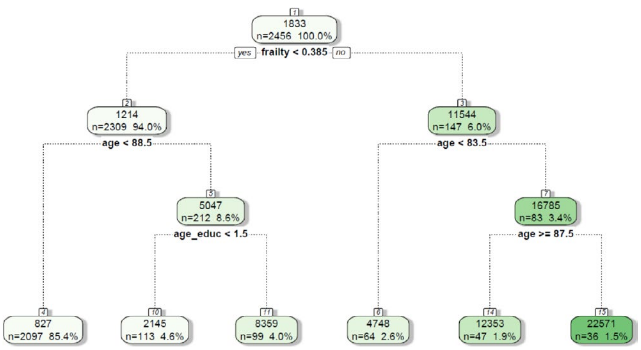

FIGURE 2 Regression tree results for Community Ageing Research 75+ respondents aged 75 and older

4 | DISCUSSION

4.1 | Key results

Frailty is the strongest predictor of total social care costs. Age and age at completing education have important but comparatively smaller association with social care spending. Our results identify a subgroup of people with frailty, typically with higher FI scores, who are likely to require significant social care support. A successful intervention targeting delay or prevention of frailty in individuals who are not yet frail is likely to reduce the impact on social care services.

4.2 | Limitations

While formal social care for community-dwelling older people is only a partial indicator of resource use, it is important to quantify as, although not all older people with frailty have social care needs, frailty identifies a group who are likely to be key users of social care services and who account for considerable social care expenditures with important implications for resource planning. Our estimates for community-dwelling older people living with frailty do not include the costs associated with providing long-term care home placements so are an underestimate of total social care costs in later life. Furthermore, the most heavily dependent older people and those with advancing dementia may be underrepresented in the samples, underestimating costs.

Different payment arrangements for formal social care are not accounted in our analysis. Although ELSA collects payment for care information, respondents may not always be aware how each service is funded. This could explain why 48 people aged ≥75 report using government-funded social care and so we did not analyse formal social care costs by payment. Similarly, only 138 ELSA respondents report paying for social care through their own income. Due to small sample size, we could not reliably attribute the observed

TABLE 2 Bagging results for people aged 75 and older

	Min	1st qu.	Median	Mean	3rd qu.	Max
ELSA						
Nonfrail	295.8	311.8	316.0	320.8	320.5	558.6
Frail	313.6	1,034.5	1,637.4	2,894.6	3,080.4	18,014.0
CARE75+						
Nonfrail	744.7	787.4	795.5	1,087.9	828.3	11,517.4
Frail	814.7	938.4	1,545.7	3,890.0	4,327.3	23,347.0

Abbreviations: CARE75+, Community Ageing Research 75+; ELSA, English Longitudinal Study of Ageing.

higher social care costs of more educated people to higher ability to pay for social care.

The formal social care modules in the two datasets differ. Albeit the difference in predicted total social care costs between nonfrail and frail individuals is close in magnitude, available variables from which to calculate total cost differed. Caution is therefore needed in generalising results.

Interviewing in ELSA Wave 6 took place in 2012–2013, but it is unlikely that this invalidates the main findings or messages of this study as the share of frail people aged ≥75 is relatively stable (35%–40%) for waves 1–7 in ELSA and therefore should be generalisable to current practice. We also evaluated our model using CARE75+ data where interviewing is contemporary, and the main message regarding the importance of frailty in predicting formal social care costs is consistent.

It is possible that funding cuts to social care over the period of our studies may have affected disproportionately some services and, as a result, access to services may be different in the two studies. We consider this unlikely as the group of older people with frailty, being core users of social care, are likely to continue to require access to services. Furthermore, local authorities decide independently on service provision and therefore the likelihood of all local authorities choosing to cut the same service is low.

Although regression tree modelling has many virtues, it has some limitations; it is prone to overfitting the data where it captures fine-grained idiosyncrasies in the observed data. This means that estimates are not necessarily stable in new samples. To address methodological concerns, we used a minimum node size stopping criteria to limit the complexity and overfitting and then applied bagging procedure to improve robustness.

4.3 | Interpretation

There are compelling economic reasons to avoid or postpone the onset of frailty in older people including increased dependency. The results presented here demonstrate considerable increase in formal social care costs for individuals identified as frail compared to non-frail even when they remain at home and not accounting for informal care. This suggests that there is a need to focus on frailty prevention, and successful interventions have the potential to reduce social care costs.

4.4 | Generalisability

This study provides contemporary estimates of costs of formal social care for community-dwelling older people with frailty based on nationally representative data for England. The cumulative deficit model of frailty used to estimate frailty prevalence has been operationalised in a number of analogous ageing studies (Hubbard et al., 2014; Mezuk et al., 2016; Roe et al., 2017; Romero-Ortuno & Kenny, 2012). Our prediction approach to assess intervention impact is based on English publicly available data on frailty prevalence and population numbers, but it can be usefully applied to generate cost predictions using estimates from real-life interventions to prevent or delay the onset of frailty in other countries as well. The estimates generated for impact of frailty on social care costs and scenario modelling are of value to policymakers across health and social care as it enables consideration of the impact of interventions for frailty that are wider than the traditional 'health' focus. We believe that our findings will therefore be extremely useful to policymakers in terms of resource allocation decisions, and commissioners in terms of commissioning services for this group, with greater knowledge of potential impact on social care costs as they demonstrate the potential benefits of funding more 'upstream' community-based interventions to help with the prevention of frailty.

AUTHOR CONTRIBUTIONS

Concept and design: SN, AH, CH, RW, NP, AC. Acquisition of data: SN, AH, RW, NP, AC. Analysis and interpretation of data: SN, AH, CH, RW, NP, BC, AC. Drafting of the manuscript: SN, CH, RW, NP, AC. Critical revision of the paper for important intellectual content: SN, AH, CH, RW, SH, BC, AC. Statistical analysis: SN, RW. Provision of study materials or patients: NP, AC. Obtaining funding: CH, RW, NP, SH, BC, AC. Supervision: RW, NP, AC.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the UK Data Service at https://www.elsa-project.ac.uk/accessing-elsa-data/ and from the Bradford Institute for Health Research (https://www.bradfordresearch.nhs.uk/care75/data-request/).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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