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Projected costs of long-term care for older people in England: The impacts of housing quality improvements

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ABSTRACT

Good quality housing is vitally important to public health. However, its economic consequences for the long-term care sector and implications for health policy have not been thoroughly examined. This study investigates the impacts of housing improvements on future costs of long-term care in England. Using data from two national surveys, the English Longitudinal Study of Ageing (ELSA) and the Health Survey for England (HSE), we combined a Markov model with a macrosimulation model to make projections of long-term care costs under a series of housing intervention scenarios. We project that, without housing interventions, formal care costs will increase from £22.4 billion to £40.8 billion and unpaid/informal care costs will increase from £55.2 billion to £90.8 billion between 2022 and 2042. In a scenario where all housing problems are remedied, formal and unpaid care costs in 2042 are projected to be £2.8 billion and £7.1 billion lower than the no intervention scenario, respectively. There are substantial synergies between health and housing policies. Well-designed housing improvement programmes delay the progression of long-term care needs, resulting in lower long-term care costs. The cumulative savings of long-term care costs over time can pay back the investment needed for housing improvements.

1. Background

Long-term care is crucial to people who experience a loss of, or a decline in, functional capability to perform daily activities such as dressing, eating, and shopping in later life. High-quality care improves people's quality of life and promotes independence in life. People with long-term care needs may receive care from formal caregivers with professional training or unpaid caregivers who are often family members, neighbours, or friends [1]. Formal long-term care in England is financed by a mixture of government funding and service users' self-funding. The provision of formal care may take place in a care home or in the care recipient's home. In England, the formal adult social care sector employs 1.52 million people, accounting for 5.3 % of the economically active population, and contributing £55.7 billion to the gross value added (GVA) per annum [2]. Unpaid care is also known as informal care. There are 4.7 million unpaid caregivers in England, among whom 1.4 million people provide >50 h of care per week [3].

Demand for long-term care in England is expected to continue to rise in the following decades in the context of population ageing. A better understanding of the future costs of long-term care informs care planning and resource allocation, which is the key to mitigating unmet care needs and reducing care inequality in the population [4–6]. It is equally important for policymakers to identify policy measures that can prevent the onset and delay the progression of long-term care needs because potentially this has the double benefit of elevating individual well-being and containing care costs.

The quality of housing is a major determinant of population health. At present, 15 % of the residential dwellings in England do not meet the Decent Home Standard: they either have serious housing problems, fail to provide a reasonable level of thermal comfort, or are not in a reasonable state of repair [7]. People spend a substantial amount of their time at home. Sustained exposure to housing problems such as damp, mould, excess cold, or overcrowding can lead to a myriad of illnesses including cardiovascular diseases, respiratory diseases, and mental health problems [8–11]. Poor housing conditions are also strongly associated with functional disabilities in the older population, which points to the potential of housing improvements to reduce long-term care needs and costs [12]. Although a large body of literature has demonstrated the health benefits of housing improvements and interventions, little is known about their economic benefits. The synergies between health policy and housing policy are not fully understood.

This study makes projections of long-term care costs for older people

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in England between 2022 and 2042 under different housing intervention scenarios. Focusing on the impacts of housing improvements, the study aims to elucidate the interactions between the long-term care and housing sectors and to contribute to the ongoing debate about cost-effective strategies for disease prevention and health promotion.

2. Methods

2.1. Data

This study drew on data from two national surveys: The English Longitudinal Study of Ageing (ELSA) and the Health Survey for England (HSE). The ELSA is a biennial survey following a sample of older people aged 50 and over in England [13]. We used the data collected between 2012 and 2018 (waves 6–9, N = 35,425). ELSA contains information about housing quality. Its longitudinal design is essential to the construction of a Markov model. The HSE is a repeated cross-sectional survey [14]. A different sample is surveyed each year. We used HSE data collected between 2011 and 2019 (N = 19,546).

Our analyses also drew on official statistics from three sources: (a) 2018-based population projections, 2018-based mortality rates projections, and 2011-based marital status projections published by the Office for National Statistics [15,16], (b) the total number of care home residents and home care users according to data published by the NHS England [17] the ONS [18], and (c) the forecast of the GDP deflators and labour productivity by the Office for Budget Responsibility [19].

2.2. Markov model

We made projections of the prevalence of care needs in the older population by constructing a Markov model where individuals with certain shared characteristics repeatedly make transitions between different states in terms of long-term care needs each year. Our modelling approach consisted of two steps. In the first step, drawing on the ELSA data, we built multinomial logistic regression models with time-lagged predictors to estimate the probabilities of transitions between different levels of long-term care needs. The outcome variable was the level of care needs in wave $T + 1$ ($T = 6$–8), and the key predictor was the number of housing problems in wave T. Such a dynamic model was designed to rule out the reverse causation of exposure to housing problems on developing long-term care needs. We controlled for care needs, age, gender, equivalised income per week, total net wealth, housing tenure and educational qualifications in wave T to reduce confounding bias. Time dummy variables were also included in the model.

Long-term care needs were measured by the number of difficulties in performing daily activities. We investigated five activities of daily living (ADLs, getting out of bed, bathing, dressing, using the toilet, and eating) and three instrumental activities of daily living (IADLs, taking medication, shopping, and managing money). We created a variable with four categories: no functional difficulties (no care needs), IADL difficulties only (mild care needs), one or two ADL difficulties (medium care needs), and three or more ADL difficulties (high care needs). The ELSA collected information about 12 types of housing problems: rising damp, excess cold, bad condensation, rats/insects, too dark, electrical wiring/plumbing issues, noisy neighbours, pollution, overcrowding, water getting in, rot/decay, and structural problems. We summed the number of housing problems and created a count variable. Housing tenure was dichotomised: 0=owner occupied housing and 1=rented housing. The education variable had three categories: no qualifications, NVQ1–3/GCE/CSE or equivalent qualifications, and degree/below degree qualifications.

In the second step, we constructed the transition matrices of care needs from the regression analyses. A person may stay at the same level or transition to any other level of care needs (Figure A1 in the appendix). Mortality was represented as an absorbing state: individuals who are dead do not transition to other states. Mortality rates by age and gender came from the 2018-based mortality projections [15]. Mortality rates according to the level of care needs were derived from survival analyses using the ELSA end-of-life survey [20].

We multiplied the annualised transition probabilities by the number of people in a particular year, which gave us the projected number of people by single year of age, gender, and level of care needs in the next year. We started with the population aged 45 and over in the base year of 2022 and made projections until 2042 when everyone would be aged 65 and over. Since we are only interested in the long-term care needs of older people aged 65 and over, the Markov model represents a dynamic system: each year there are people who turn 65 years old (i.e., inflow) and who reach mortality (i.e., outflow).

We derived the transition probabilities for a base case scenario where there are no interventions to improve housing quality and for a range of intervention scenarios where the total number of housing problems in the population is reduced by housing improvement programmes. We also looked into a housing scenario where bad condensation, damp, and excess cold are remedied (i.e., CDC scenario). We included these three housing problems as an indicator variable in the regression analyses and controlled for the number of other housing problems. These three housing problems often appear together and are among the most common problems reported in the ELSA data (Table A1 in the appendix). Standardised approaches such as wall/roof insulation or double glazing of windows have been used in practice to remedy them. Applying those sets of transition probabilities to the Markov model gave us the projected prevalence rates of disability (i.e., levels of long-term care needs) among people aged 65 and over under different housing scenarios. These outputs were then fed into the macrosimulation model.

2.3. Macrosimulation model

The macrosimulation model consisted of four parts (Figure A2 in the appendix). First, drawing on the HSE data, we divided the older population in the base year of 2022 into small groups according to the key drivers of long-term care use. The HSE questionnaire covered similar ADL/IADL tasks to ELSA, but the respondents in the HSE were asked to choose from four options: 'I can do it myself', 'I have difficulties but can manage', 'I can only do it with help', and 'I cannot do it'. Our analyses show that the prevalence rates of functional difficulties reported in the HSE are comparable with those in the ELSA. This enabled us to map the prevalence rates of care needs derived from the Markov model onto those in the macrosimulation model. Following previous studies [21], we assumed that people living in care homes are those with the highest level of functional limitations (i.e., 3+ ADL limitations). Combining the HSE data and care home data published by the NHS Digital [17] and ONS [18], we estimated the probabilities of older people living in a care home according to personal characteristics.

Second, using the HSE data, we conducted regression analyses to estimate the predicted probability of receiving formal care and unpaid care, which were multiplied by the number of people in each small group. We built bivariate probit regression models to account for the two-way causation between formal and unpaid care [22,23]. This step gave us the number of people living in care homes, receiving formal home care, or receiving unpaid care in each small group. The numbers of people receiving formal home care and unpaid care were multiplied by the average hours of care per week and 52.14 weeks, resulting in the total annualised hours of home care and unpaid care, respectively.

Third, we attached the unit costs to care use to calculate the total costs at the national level in the base year. Taking a societal perspective, we estimated the costs of both formal and unpaid care. The unit costs of care homes and formal home care were estimated using data published by the NHS England [17] and in the Laing & Buisson report [24]. A variety of methods can be used to value unpaid care including the replacement costs approach, opportunity costs approach, contingent valuation, and discrete choice experiment [25]. To make sure formal and unpaid care costs are directly comparable, the replacement costs approach was adopted to estimate the unit costs of unpaid care. We treated home care as the closest substitute for unpaid care and used the hourly cost of home care, which is £23 as indicated by the NHS England data, to value unpaid care.

Finally, we applied the future trends in the drivers of care demand and care costs to the macrosimulation model. The future trends in demographic and socioeconomic drivers are described in the appendix (Table A2). Given the complexity of care needs among people with 3+ ADL limitations, it is reasonable to assume that the probabilities of living in a care home among people with 3+ ADL limitations will remain constant according to personal characteristics in the projection years. The future trends in care needs came from the output of the Markov model. The projected prevalence rates of care needs under different housing scenarios were run through the macrosimulation model, which gave us the projected demand for and costs of long-term care in those scenarios. The projected care costs were expressed in 2022 prices.

We took a Bayesian approach to account for the parameter uncertainty in our projections [26, p.82]. We derived the distributions of two groups of key parameters: the prevalence rates of care needs and average hours of home care and unpaid care per week. Conjugate priors were selected to simplify the computation. The level of care needs came from a multinomial distribution, which had the Dirichlet distribution as its conjugate prior. Meanwhile, we assumed that the number of care hours per week came from an exponential distribution, which had the Gamma distribution as its conjugate prior [27]. We derived the posterior distributions of projected care needs, number of care users, and costs of long-term care by running the Markov model and macrosimulation model together with 2000 repetitions. We report the 95 % Bayesian credible intervals. They indicate the ranges which contain the true values with 95 % probability. The regression analyses were conducted using Stata version 18. The Markov and macrosimulation models were constructed using MS Excel.

3. Results

Table 1 shows the characteristics of the ELSA 2012–2018 sample (aged 50 and over). Eighty per cent of the sample had no functional difficulties (Column 2). The proportions of people with IADL difficulties (mild care needs), 1–2 ADL difficulties (medium care needs), and 3+ ADL difficulties (severe care needs) were 2.9 %, 12.5 %, and 4.8 % respectively. Seventy-two per cent of the sample did not report any housing problems, 17.5 % had only one housing problem, 6.4 % had two problems, and 4 % had three or more housing problems. On average, individuals across the entire sample had 0.45 housing problems. Among those with housing problems, the average number of housing problems was 1.61. The prevalence of each type of housing problem is reported in Table A1 in the Appendix. Fifty-six per cent of the sample were females, and 16 % lived in rented housing. One-third of the sample (34 %) had no educational qualifications. Housing conditions were strongly associated with functional disabilities. People living in a house with more problems in wave T ($T = 6–8$) were significantly more likely to have ADL or IADL difficulties rather than having no functional difficulties in wave $T + 1$ (Columns 3–5, Table 1).

We estimated that 65.6 % of older people aged 65 and over in England did not have long-term care needs in 2022. This is projected to increase to 68.1 % in 2032 before declining to 66.6 % in 2042 in the base case scenario of no interventions (Table 2). The prevalence rate of mild care needs will decrease from 18.3 % in 2022 to 17.3 % in 2032 before rising to 18.0 % in 2042 in the base case scenario. The prevalence rate of medium care needs is projected to decrease from 9.2 % in 2022 to 8.4 % in 2032 and then increase to 8.9 % in 2042, and the prevalence rate of high care needs is projected to decrease from 6.8 % in 2022 to 6.2 % in 2032, and then rise to 6.5 % in 2042.

We project that the number of unpaid care users will increase from 2.22 million in 2022 to 2.85 million in 2042 in the no intervention scenario (Table 2). The number of care home residents is projected to rise from 297,000 in 2022 to 390,000, and that of home care users is projected to rise from 348,000 in 2022 to 547,000 in 2042. The costs of unpaid care, expressed in 2022 prices, are projected to rise by 64 %, from £55.2 billion in 2022 to £90.8 billion in 2042. Expenditure on formal care, expressed in 2022 prices, is projected to rise by 82 %, from £22.4 billion in 2022 to £40.8 billion in 2042.

The above costs of unpaid care were derived using the replacement cost approach. Such an approach ensures that unpaid care and formal

Table 1
Sample characteristics of ELSA 2012–2018 and results of time-lagged multinomial logistic regression analyses.

	Sample characteristics, ELSA 2012–2018	Time-lagged multinomial logistic regression model		
		IADL difficulties	1–2 ADL difficulties	3+ ADL difficulties
	Percentage (number) or means	Relative risk ratio (standard error)		
Functional difficulties				
No difficulties	79.8 (29,892)	Ref.	Ref.	Ref.
IADL difficulties only	2.9 (1091)	20.52*** (2.71)	7.68*** (0.88)	18.53*** (3.23)
1–2 ADL difficulties	12.5 (4686)	4.60*** (0.51)	12.15*** (0.65)	25.82*** (2.62)
3+ ADL difficulties	4.8 (1774)	16.9*** (3.71)	31.71*** (4.42)	428.83*** (64.59)
No. of housing problems	0.45	1.14** (0.05)	1.12*** (0.03)	1.16*** (0.04)
Age				
50–59 years old	39.8 (14,591)	Ref.	Ref.	Ref.
60–69 years old	19.0 (6947)	1.36 (0.26)	1.20* (0.11)	1.10 (0.17)
70–74 years old	15.3 (5617)	1.45 (0.31)	1.72*** (0.17)	1.44* (0.25)
75–79 years old	12.0 (4378)	2.31*** (0.48)	2.1*** (0.21)	1.61** (0.29)
80–84 years old	8.2 (2998)	4.43*** (0.90)	2.61*** (0.28)	2.48*** (0.44)
85–89 years old	4.1 (1488)	8.19*** (1.75)	4.11*** (0.49)	4.00*** (0.78)
90+ years old	1.7 (625)	15.25*** (3.93)	7.5*** (1.26)	11.64*** (2.74)
Gender				
Male	44.5 (16,644)	Ref.	Ref.	Ref.
Female	55.6 (20,799)	1.22* (0.11)	0.90* (0.04)	1.07 (0.09)
Weekly equivalised income (£)	412.3	0.49** (0.13)	0.66*** (0.08)	0.89 (0.17)
Wealth (£k)	427.2	0.92 (0.11)	0.74*** (0.05)	0.39*** (0.07)
Housing tenure				
Owner occupied housing	84.4 (31,308)	Ref.	Ref.	Ref.
Rented housing	15.7 (5809)	1.87*** (0.2)	1.56*** (0.10)	1.32** (0.14)
Educational qualifications				
No qualifications	34.3 (12,528)	Ref.	Ref.	Ref.
NVQ1–3/ GCE/CSE or equivalent	33.0 (12,018)	0.70*** (0.07)	0.95 (0.05)	0.98 (0.09)
Degree/ below degree qualifications	32.7 (11,931)	0.67*** (0.08)	0.85** (0.05)	0.82 (0.09)

Notes: The outcome variable of the regression model is functional difficulties at time $T + 1$; the base outcome category is no functional difficulties; independent variables are personal characteristics at time T; ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; Ref: reference category.

Table 2
Projected prevalence of long-term care needs, number of care users, and costs of long-term care in the scenario of no housing interventions.

	2022	2027	2032	2037	2042
Prevalence of long-term care needs					
No care needs	0.656	0.678	0.681	0.676	0.666
Mild care needs	0.183	0.174	0.173	0.175	0.180
Moderate care needs	0.092	0.085	0.084	0.086	0.089
High care needs	0.068	0.063	0.062	0.063	0.065
Long-term care users (thousand persons)					
Unpaid care users	2221	2279	2485	2690	2849
Care home residents	297	288	314	352	390
Home care users	348	375	429	491	547
Long-term care costs (£billion)					
Unpaid care	55.2	61.9	71.0	81.1	90.8
Formal care	22.4	24.6	28.8	34.5	40.8

Notes: Mild care needs: IADL limitations only or ADL difficulties; Moderate care needs: one or two ADL limitations; High care needs: three or more ADL limitations.

care are directly comparable in economic terms, but it is only one of the several commonly used approaches to value unpaid care. Switching to other approaches, such as the opportunity cost approach or the stated preference approach, would lead to different projected costs of unpaid care. It has been reported that the opportunity cost of unpaid care was £9.05 per hour in 2000 prices [4]. This is equivalent to £14.8 per hour in 2022 prices [28]. The projected unpaid care costs based on the opportunity costs approach will be approximately 36 % lower than those based on the replacement costs approach.

A reduction in the number of housing problems will lead to a downward shift in the future trajectories of long-term care needs (Fig. 1). In the scenario of no housing problems, the proportion of people without care needs is projected to be 68.7 % in 2042, which is two percentage points higher than in the no intervention scenario (66.6 %, Panel 1). The prevalence rates of mild, moderate, and severe care needs will be 17.2 %, 8.2 % 5.8 %, respectively, in 2042, which stand in contrast to the prevalence rates of 18.0 %, 8.9 %, and 6.5 %, respectively, in the base case scenario (Panels 2–4).

We project that, in the scenario where no houses have more than two problems, the number of unpaid care users will increase to 2.80 million in 2042 as opposed to 2.85 million in the base case scenario of no interventions (Figure A3 in the appendix). It can be noted that this scenario has a similar impact to the scenario where condensation, damp and excess cold are remedied (i.e., the CDC scenario). In the scenario of no housing problems, the projected number of unpaid care users will be 2.68 million in 2042, which is 0.17 million lower than in the base case scenario. The numbers of care home residents and home care users are projected to be 361,000 and 519,000 in 2042, respectively, as opposed to 390,000 and 547,000, respectively, in the base case.

In the scenario of no housing problems, the costs of unpaid care and formal care are projected to be £65.6 billion and £26.9 billion, respectively, in 2032 (Fig. 2). These figures are 7.6 % and 6.5 % lower, respectively, than the base case estimates. The costs of unpaid care and formal care are projected to be £83.7 billion and £38.0 billion, respectively, in 2042. These figures are 7.8 % and 6.8 % lower, respectively, than the base case estimates. The projected costs in the scenario of fewer than two housing problems are close to those in the no CDC scenario. The 95 % Bayesian credible intervals of the projected prevalence of care needs, number of care users, and costs of care in different projection years under various housing intervention scenarios are reported in Table A3 in the Appendix.

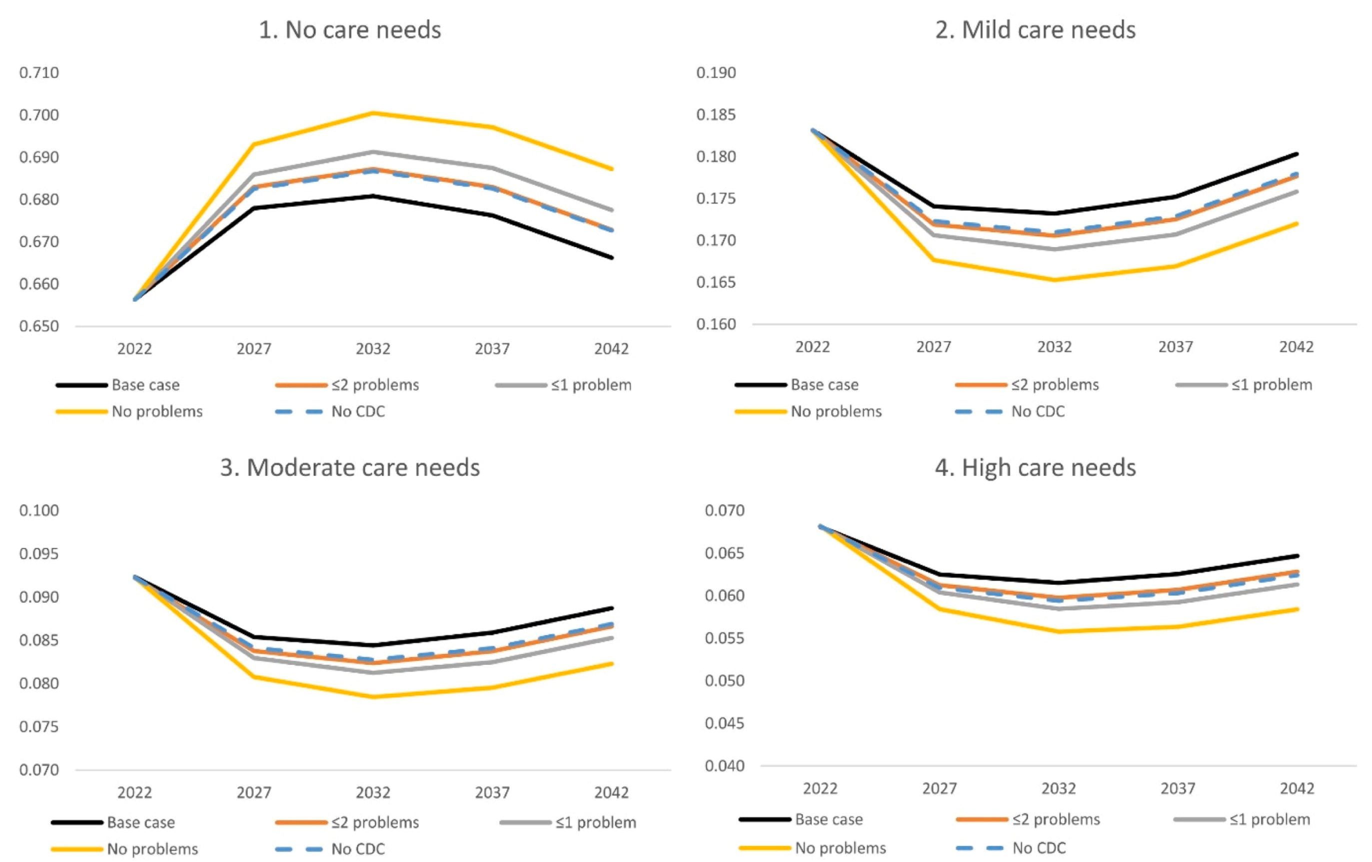

Fig. 1. Projected long-term care needs under the base case and housing intervention scenarios, 2022–2042
Notes: CDC: condensation, damp, or excess cold.

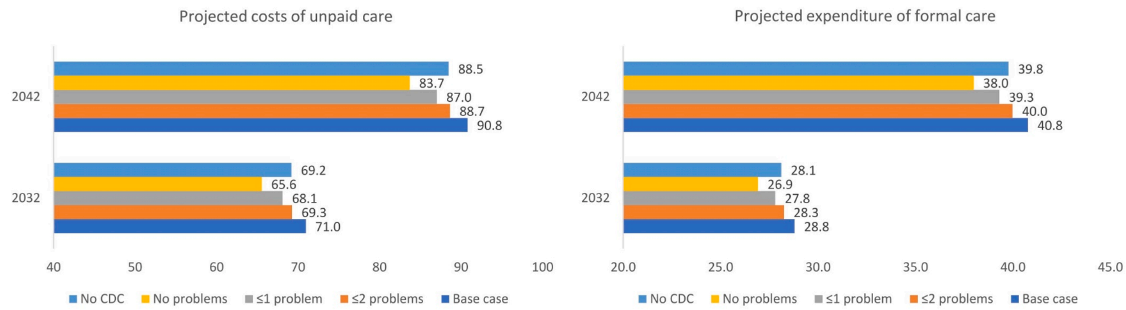

Fig. 2. Projected costs of unpaid care and expenditure of formal care under the base case and housing intervention scenarios in 2032 and 2042, in £billion
Notes: CDC: condensation, damp, or excess cold.

4. Discussion

This study investigated the impacts of housing improvements on the costs of long-term care for older people in England. We found that people living in better housing conditions are less likely to progress to more severe functional limitations and more likely to recover to a lower level of functional limitations. These findings are consistent with the evidence reported in the broader literature that housing problems are a serious threat to public health, whereas good quality housing protects people from health declines [8,12,29–32].

We extend the existing literature by demonstrating that the protective effects of housing can turn into a lower overall demand for long-term care in the older population, which has important consequences for care costs. Taking a multi-model multi-dataset approach, we showed that addressing housing problems can alter the future trajectories of long-term care needs in the older population, resulting in cost savings to the long-term care sector on an annual basis. If housing interventions are in place to reduce the number of housing problems to no more than two specific issues, the prevalence of long-term care needs in 2042 will be 0.6 percentage points lower, which will translate into a reduction in unpaid care costs of £2.1 billion and in formal care costs of £0.8 billion in 2022 prices in the projection year of 2042 in comparison to the no intervention scenario. The CDC scenario is projected to have a similar impact on long-term care costs. Only 4 % of the individuals in our sample reported three or more housing problems, and 9.4 % of older people lived in a house with bad condensation, damp, or excess cold (Table A1 in the Appendix). This suggests that even a relatively modest reduction in the number of housing problems can lead to notable savings in long-term care costs on an annual basis.

In the scenario where no houses have more than one problem, the prevalence of long-term care needs will be 1.2 percentage points lower than in the no intervention scenario in 2042, which will translate into a reduction in unpaid care costs of £3.8 billion and in formal care costs of £1.5 billion in 2022 prices. If all housing problems are remedied, the prevalence of care needs will reduce by 2.2 percentage points by 2042 in comparison to the no intervention scenario, leading to a reduction in unpaid care costs of £7.1 billion and in formal care costs of £2.8 billion in a year. To put those savings into context, government spending on care home services and formal home care for older people in England was £5.7 billion and £3.7 billion, respectively, in 2022.

Arguably, the saved government expenditure could be used to achieve other important policy goals in the long-term care sector such as personalisation of care services, improvements in care quality, and strengthening support for unpaid caregivers, to name just a few. The reduction in private expenditure means less economic burden for self-funders. In addition, as the overall older population becomes healthier, less labour input from unpaid caregivers would be needed. Unpaid caregivers would have more freedom to follow their employment aspirations or pursue leisurely activities according to their preferences.

When interpreting the cost savings to the long-term care sector, one should not forget to consider the costs to the housing sector. Garrett et al. reported that it would cost £9.8 billion in 2018 prices to remedy all houses in England with Category 1 housing problems [33]. This includes investment in houses which have the problems of excess cold (£6.0 billion), overcrowding (£0.7 billion), dampness (£0.3 billion), falls on stairs and between levels (£1.5 billion), pests (£70 million), noise (£6.9 million) and so on. In the Warm at Home (WAH) study, it was found that the total cost of implementing 2647 housing interventions amounted to £1.8 million, which was equivalent to £689 per intervention [30, p.56].

It is challenging to estimate the exact housing costs associated with the housing improvements in our study given the limited amount of evidence available. It is worth noting, however, that the cost savings to the long-term care sector are recurring in each projection year, whereas housing interventions normally require one-off investment and the consequent improvements in housing quality may last for a number of years. Even if we only focus on formal long-term care, based on the results in Table A3 and a discount rate of 0 % per annum, our calculation is that the cumulative cost savings will reach approximately £34.5 billion in 2022 prices by 2042 in the no housing problem scenario, which is well above the costs of removing all Category 1 problems (£9.8 billion in 2018 prices, see above). This conclusion still holds even if we hold a fairly conservative assumption that the impacts of housing improvements on housing conditions only last for ten years and new investments are required after that [34,35]. If the assumed discount rates are 3.5 % and 5 %, the cumulative cost savings will be £23.0 billion and £18.5 billion, respectively. The cumulative cost savings will be much larger if we take a societal perspective and also consider unpaid care costs because the majority of caregiving responsibilities are assumed by unpaid caregivers. In sum, although the implementation of housing interventions may involve substantial initial financial investment, the cost reductions in the long-term care sector could pay back the investment in the longer term.

Our research findings have important policy implications. While the health benefits of housing improvements have been repeatedly confirmed by previous studies, limited research has looked into their economic benefits. Garrett et al. estimated that mitigating the category 1 housing problems in England would save the NHS £1.4 billion per annum and that the full cost to society of leaving those hazards unmitigated would reach £15.8 billion per annum in 2018 prices [33]. We show that housing improvements can bring cost savings to the long-term care sector in England as well. From the housing policy perspective, remedying housing problems is an intervention initiative. But from the health policy perspective, it represents an important prevention strategy. Governments across the world have been implementing policies to address the rising demand for healthcare and long-term care and contain the costs of care. Based on the findings of this study, we argue that policymakers do not have to confine their policy measures within the health system. Instead, it is equally important to identify the synergies between health and other social policies. Carefully and cleverly designed housing improvement programmes can contribute substantially to illness prevention and health promotion, which will reap both health and economic benefits for many years to come.

The limitations of the study should be duly acknowledged. First, when building the Markov model, we followed the classic Markov memoryless property assumption and the homogeneous Markov chain assumption. The former assumes that the transition probabilities depend entirely on characteristics in the current state but not in the preceding states, whereas the latter assumes that the transition probabilities are constant over time. Dedicated studies will be needed in the future to scrutinise the plausibility of these assumptions in the case of long-term care needs. Second, in this study, we have focussed on projected costs associated with demand for care. We assumed that the supply of unpaid care and formal care could keep up with care demand. However, if there is a shortage of unpaid and formal care providers in the coming decades, the projected costs of care will be lower than what we have reported here in both the base case and housing intervention scenarios. Third, this study has focused on the impacts of housing problems on care recipients. Since the provision of unpaid and home care takes place in care recipients' homes, poor housing conditions also pose health threats to caregivers and create barriers to caregiving. However, we did not investigate the costs associated with those issues. As such, our study may have underestimated the full economic benefits of housing improvement programmes to the long-term care sector. Finally, CDC is the only indicator variable included in the analyses and projections. It would be useful for future analyses to understand better how other housing problems are clustered and interact with each other. This would enable us to look at scenarios where housing interventions are directly targeted at specific housing problems.

5. Conclusion

The quality of housing is an important determinant of health and has profound implications for the long-term care sector. Good quality housing delays the progression of long-term care needs, resulting in lower care costs in the long run. Our study underscores the economic connections and interactions between two important social policy areas that have been largely ignored in the public debate so far. In the context of continued population ageing and mounting care demand, well-designed housing improvement programmes have the double benefit of elevating personal well-being and saving long-term care costs.

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Data availability statements

This study draws on data collected in two national surveys: English Longitudinal Study of Ageing and Health for England. Those data are publicly available on the UK Data Service website (https://ukdataservice.ac.uk). The study also uses national statistics published by the NHS Digital, Office for National Statistics, and Office for Budget Responsibility in the UK. The data are publicly available on their respective websites. Links to those websites are cited in the references.

CRediT authorship contribution statement

Bo Hu: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Nicola Brimblecombe:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Investigation, Funding acquisition, Conceptualization. **Javiera Cartagena-Farias:** Writing – review & editing, Software, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Wagner Silva-Ribeiro:** Writing – review & editing, Software, Methodology, Investigation, Formal analysis, Data curation.

Declaration of competing interest

None

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.healthpol.2025.105246.

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