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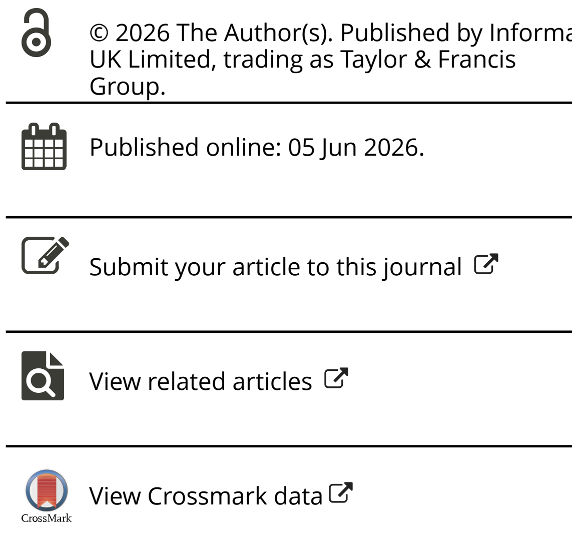

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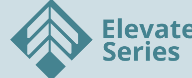

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SOCIAL AND BEHAVIORAL DETERMINANTS OF HEALTH | ARTICLE COMMENTARY

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Improving population health through better social housing: a critical commentary

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ABSTRACT

Introduction: With many homes failing to meet minimum housing standards, concerns have been raised about the effects on peoples' physical and mental health. Cold and damp homes are a particular hazard. The effects of growing austerity and poverty have increased the impact on individuals and the wider society. Given that those affected by poor housing tend to be the most socially deprived, any harms and health inequalities are accentuated. Recognising the health, social and economic consequences of poor housing, governments have implemented policies and provided funding to improve the standards of homes. Retrofitting homes with warmth-related improvements is thought to improve peoples' health and wellbeing, promote social cohesion and benefit economic growth. It is less certain if the costs of retrofitting homes are a good use of scarce funds.
Methods: Using recognised guidance, this commentary critically appraises an economic evaluation of the costs and benefits of improving social housing, assessing the implications for future practice.
Results: Despite uncertainties that remain in terms of the cost-effectiveness of retrofitting homes, benefits to people's health and wellbeing, as well as cost-savings to households and the NHS are evident.
Discussion: Such initiatives should be continued, accompanied by high quality research into their costs and benefits.

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Retrofitting; housing; health; wellbeing; cost-effectiveness; inequality

Introduction

Despite guidance and regulations intended to ensure that homes are safe, warm and functional for residents, concerns remain that too many homes are unhealthy and unsafe (Department for Communities and Local Government, 2006a, 2006b; Marmot et al., 2024; Ministry of Housing Communities and Local Government, 2024a; Secretary of State for Levelling Up, 2022). In England some 3.5 million households live in homes that do not meet the minimum housing standards set out in the Decent Homes Standard (Department for Communities and Local Government, 2006a), placing their residents' physical and mental health at direct and indirect risk of harm (Marmot et al., 2024; Ministry of Housing Communities and Local Government, 2024a). Cold, damp and poorly ventilated homes present a particular hazard (Clark et al., 2023; Ministry of Housing Communities and Local Government, 2024b). They are associated with cardiovascular (e.g. myocardial infarction, stroke) and respiratory (e.g. asthma, COPD) conditions, as well as increased deaths (e.g. 4,950 excess winter deaths in the UK in 2022–2023) (Marmot et al., 2024). It is recognised that a lack of affordable rental housing, insecure tenancy and unsafe deprived neighbourhoods may exacerbate the physical and mental health of the population (Gibson et al., 2011; Rana et al., 2022). The consequences of poor housing are felt throughout society. Treating those affected by poor housing is thought to cost the National Health Service (NHS) in England £1.4 billion per year, with the effects on the wider society through providing care, poorer educational achievement, lost productivity

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and limited career prospects costing £18.5 billion per year (Marmot et al., 2024). With an ageing housing stock and increasing poverty in the UK (Marmot et al., 2024; Waters & Wernham, 2023), it is thought that further deterioration in the housing conditions is likely (Balogun et al., 2023.). Given that those people impacted by poor housing tend to be the most vulnerable to social and economic deprivation (e.g. unemployed, fuel poor, elderly, people with long-term conditions), any harms to health may be amplified by the health inequalities they experience (Marmot et al., 2024; Waters & Wernham, 2023). As renewing the entire housing stock is not feasible, initiatives to improve the quality of existing homes provides a practical compromise (Marmot et al., 2024). Retrofitting insulation and heating to existing homes is thought to be effective in improving health and wellbeing (Ige et al., 2019; Long & Cullum, 2024; Long et al., 2015; Thomson et al., 2009, 2013), however uncertainty remains as to whether it is a good use of funding. With concerns about the opportunity costs for private landlords, local authorities and governments of investing in such schemes and a lack of clarity concerning how long it takes to recover the costs, it is important to evaluate the cost-effectiveness of such interventions (Bray et al., 2017; Energy Security and Net Zero Committee, 2025; Eurofound, 2016; Galvin & Galvin, 2025; Higney & Gibb, 2024). Despite several studies assessing costs, far fewer have undertaken economic evaluations of the costs and health benefits of retrofitting schemes, particularly in the UK or similar jurisdictions (Chapman et al., 2009; Dymond et al., 2021; Fenwick et al., 2013; Pega & Wilson, 2016). An economic evaluation by Bray et al (2017), which aims to assess the costs and benefits of improving social housing through retrofitting double-glazed windows and new energy efficient combi-boilers, provides a more recent UK-based evaluation within a general population (i.e. not limited to a specific health condition) (Bray et al., 2017). In this commentary we critically appraise the methods used within the economic evaluation by Bray et al (2017) (Bray et al., 2017) and expand upon the findings in the context of implementing them within practice.

Materials and methods

The costs and benefits of warmth-related housing improvements (i.e. intervention) for families living in social housing were evaluated by Bray et al (2017) through a cost-consequences analysis (Bray et al., 2017). Improvements were made through the installation of double-glazed windows and new energy efficient combi-boilers. Benefits focused on measures of health (using a self-rated visual analogue scale from 0 (worst imaginable) to 100 (best imaginable)), wellbeing and quality of life, reported by families as part of a historical (before and after) cohort study (EuroQoL Group, 1990; Office for National Statistics, 2013; Stewart-Brown & Janmohamed, 2008). Costs incurred were the mean costs to the housing provider for the improvements per household. Health service use represented the estimated number of occasions members of households reported they had accessed primary and secondary (i.e. outpatient, inpatient and accident/emergency (A&E)) care in the previous 6 months, which were costed using reference costs (Curtis, 2014; Department of Health, 2014). Households recruited were a purposive sample of 389 households (228 households completed follow-up) from the North-East of England, who were identified by their social housing provider for part of their retrofit scheme. Demographic/socioeconomic (e.g. age, gender, marital status, employment, income, fuel poverty), health (e.g. chronic illness: respiratory, cardiovascular, arthritis) and outcome data were collected at baseline and/or 12 months follow-up. Outcomes and health service use (i.e. costs) were presented as mean change from before to 12 months after the housing improvements using paired *T* tests. Sub-group analyses examined the effects of gender, age, smoking status, fuel poverty, and seasonality.

Results

Bray et al (2017) report that at 12 months following the intervention, statistically significant improvements were reported in mean change in health (household: 4.8%, $p = 0.009$; main tenant: 7.5%, $p < 0.001$) and financial status (main tenant: 6.8%, $p = 0.020$)(Bray et al., 2017). Improvements in health status and anxiety by 12-month follow-up were statistically significant in people aged ≥65 years (main tenant: 13.1%, $p < 0.005$) compared to non-significant changes for those aged <65 years (main tenant: 2.1%). Similarly, Bray et al (2017) found significant benefits in health status were evident for women (main tenant: 7.7%,

$p < 0.005$) and people at low risk of fuel poverty (main tenant: 8.2%, $p < 0.005$) at 12-month follow-up (Bray et al., 2017). On other measures of quality of life and wellbeing any changes at 12-month follow-up were not statistically significant. Households reported that the number of rooms unheated declined (−0.73 rooms per household, $p < 0.001$), equating to 23% of households being able to heat at least one additional room. Household use of all health services in the previous 6-months decreased by the 12-month follow-up. Statistically significant reductions were reported for attendance at outpatients (−0.30 visits per household (−68.7%), $p = 0.001$) and at A&E (−0.18 visits per household (−45.5%), $p = 0.012$). Visits to general practitioners (−0.65 visits per household (9.7%), $p = 0.276$) and inpatient stays (−0.01 episodes per household (−4%), $p = 0.878$) also declined, although not statistically significant. The changes in health service use resulted in a reduction in costs per household over 6-months by 15.8% (−£94.79; 95% confidence interval (CI) −£273.01 to £85.14), from £598.59 (Standard deviation (SD) = £927.51) at baseline to £503.80 (SD = 951.31) at 12-month follow-up, with no significant seasonal differences (warm versus cold months).

Discussion

The detrimental effects of poor housing on peoples' health and wellbeing have been recognised for many years (Ige et al., 2019; Long & Cullum, 2024; Long et al., 2015; Thomson et al., 2009, 2013). Costs to health services for treating conditions and illnesses related to poor housing, and to the economy in lost productivity and social cohesion, continue to grow (Ballesteros-Arjona et al., 2022; Long et al., 2015; Marmot Review Team, 2011). Government funded initiatives have endeavoured to address issues associated with the physical attributes of housing, particularly with cold and damp (ECO Scheme Heating and Insulation Grants, 2017; GOV.UK, 2021, 2022a, 2022b, 2023, 2024, 2025). Increasing austerity and fuel poverty emphasize the need for urgent action (Ballesteros-Arjona et al., 2022). Although different initiatives to improve the condition of housing through retrofitting have been shown to be effective, the extent of the benefit varies depending on the specific initiative implemented, the characteristics of the residents, the outcomes assessed, and the quality of the evaluation undertaken (Long & Cullum, 2024; Long et al., 2015; Rodgers et al., 2018; Thomson et al., 2009, 2013). Less consideration has been given to the cost-effectiveness of interventions to improve housing conditions, with some uncertainty remaining due to the different studies' risk of bias and equivocal findings (Chapman et al., 2009; Fenwick et al., 2013; S. Long et al., 2015). The cost consequences analysis undertaken by Bray et al (2017) (Bray et al., 2017) found statistically significant benefits, specifically for peoples' health status, their use of health services (i.e. reduction in outpatient and A&E appointments) and financial situation (including indicators of fuel poverty). Despite these benefits, their analysis suggested that it would take approximately 20 years to recoup the costs through health service savings. This differed from other analyses that indicated costs would be recovered in 18 months (Eurofound, 2016). This uncertainty highlights the differences in the studies in terms of the characteristics of participants, interventions, comparators, and outcomes considered, as well as the design and rigour of the studies. Although the evidence suggests that interventions to improve housing are beneficial to health and wellbeing, which leads to cost savings to the health service, the extent of the costs and benefits remain unclear. Importantly, evaluations may neglect to consider the opportunity costs faced by those investing in retrofitting homes (e.g. private landlords, local authorities or national governments), balancing the immediate financial outlay for retrofitting compared to funding alternative investments (e.g. additional housing, health and social care, education) and long-term benefits (e.g. reduced energy costs, decreased carbon emissions, increased property values) that may be realised (Fox-Rushby & Cairns, 2005; Morris et al., 2010). These should be considered in future analyses. Further evidence is needed to support action to improve both housing and health.

Assessment of the quality of the economic evaluation

Using a checklist for assessing the methodological quality of economic evaluations (Critical Appraisal Skills Programme, 2018; Drummond et al., 2015; Philips et al., 2004), we found that Bray et al (2017) (Bray et al., 2017) had clearly specified the decision problem they were addressing, stating the population, intervention, comparator, and outcomes assessed. Results were interpreted appropriately taking account

of socioeconomic and demographic factors and were relevant to the UK. There were inadequacies that may affect the evaluation. Estimates of effectiveness were established through a historical cohort study that assessed outcomes before and after the intervention. With no separate control group receiving a relevant alternative and limited information about the households prior to the intervention, uncertainty surrounded any benefits that were reported. The perspective used was not clearly stated and the time horizon was too limited to adequately account for the effects and costs that may result. Given that mean costs were used for the intervention and health service resource use was estimated by the tenant, not all relevant costs may have been captured and may not have been measured appropriately. There are concerns as to whether all relevant outcomes were included, valued appropriately and assessed, given that many were estimated by the main tenant on behalf of the household. In particular, the evaluation did not appear to consider the adverse effects that retrofitting can have on air quality and damp resulting from poor ventilation (Roberts et al., 2025). Although quality of life was measured, uncertainties remain about its use economic evaluations of public health programmes. As a cost consequence analysis was used, no modelling was undertaken and, consequently, uncertainty was not assessed. Limited discussion was provided around the generalisability of findings, particularly in relation to health inequalities and issues around intersectionality (Lancaster University, 2026; Routen et al., 2023).

Application to practice

It is evident that improvements through retrofitting social housing have benefits to tenants in their health, wellbeing and financial situation, which also have positive implications for the health service, economy and wider society. Given these benefits, a policy of household improvements should be pursued, despite the uncertainties that remain due to the limited evidence concerning cost-effectiveness. With restrictions on local and national government funding, financial pressures on social housing organisations and some private landlords, any investment should be informed by the health inequalities/social gradient (i.e. health outcomes tend to deteriorate as socioeconomic position worsens), providing equitable benefit to reflect need. It is often those affected by increasing austerity and fuel poverty (e.g. households with low incomes, older people, children, lone parents, or people from minority ethnic backgrounds) who live in housing below recognised standards and are at greater risk of ill health associated with cold and damp (Waters & Wernham, 2023). Inevitably any health inequalities they experience maybe accentuated (Waters & Wernham, 2023). Implementation in the private rented sector may prove more challenging, given that tenancy and rents are currently less regulated than in the social housing sector (Soaita et al., 2020). Although the UK government is reviewing regulation for the private sector, the cost of retrofitting private rented homes may have consequences for the tenant through increased rent or landlords ending tenancies to withdraw from the rental sector (Ministry of Housing Communities and Local Government, 2025; National Retrofit Hub, 2025). Acceptability of implementation within the private rental sector will need further consideration, depending on government guidance and regulation. Given that different forms of home improvements have shown benefit (Barton et al., 2007; Bray et al., 2017; Chapman et al., 2009; Rodgers et al., 2018; Thomson et al., 2001; 2009), the specific form used will depend on the issues associated with the housing and the extent of the funding available. Irrespective of the improvements undertaken, it is important that further research evaluates both their long-term benefits and cost-effectiveness.

Further research

Although the economic evaluation followed recognised guidance on economic evaluations of public health interventions (National Institute for Health and Care Excellence, 2012), the approach taken was acknowledged to be affected by certain limitations that cause some uncertainty in the findings. In using a historic cohort design with no separate control group there may have been an overestimation of the benefits. Also, uncertainty around the perspective, placing reliance on the main tenant to provide data on costs and effects for the household and a short time horizon, all result in some concern about the study. A stepped wedge randomised controlled cluster trial may provide an appropriate design to assess the benefits of a housing intervention. If not practical, a quasi-experimental study using a

difference-in-difference approach might be more appropriate. Despite benefits on outcomes measuring health and financial status, the effects on quality of life were less clear (Bray et al., 2017). It was thought that this may reflect a lack of sensitivity of the health-related quality of life measure used (EQ-5D-3L) (EuroQoL Group, 1990) in assessing the effects of interventions to improve housing conditions (i.e. focuses on health and efficiency, not equity) and the inadequacy of the time horizon to realise any benefits (Bray et al., 2017). Developments in assessing quality of life for public health interventions, particularly in terms of quality adjust life years would be beneficial. Consideration should be given in future research to outcomes that reflect the conditions that often affect people living in cold and damp housing, particularly around respiratory and cardiovascular conditions, as well as their use of a range of health services. Issues concerning the possible unintended consequences of improving housing standards through retrofitting, including housing conditions (e.g. condensation, damp, mould, indoor air pollution) and increase of health inequalities (e.g. through differential access for social and private residents, or displacement of residents) should be evaluated. A wider perspective would also encompass changes in productivity/economic benefits (e.g. work and or school days lost), wider environmental consequences (e.g. carbon emissions) and a broad range of economic and societal costs (e.g. healthcare, changes to social circumstances). Although the influence of seasonality appeared limited (Bray et al., 2017; Chapman et al., 2009), this may reflect that study recruitment excluded the period from January to March and warrant further evaluation. Peoples' age was shown to affect health outcomes and should be included in future studies, with consideration given to the various mechanisms that may underpin its effects. Importantly, any study should extend its time horizon beyond 12 months to ensure it captures relevant costs and outcomes. A cost consequences analysis was undertaken. Although an appropriate approach as it allows a wider consideration of welfare and quality of life, it may be beneficial to be able to undertake a cost-effectiveness or a cost-benefit analysis with long-term modelling, even if a cost-utility analysis is considered not to be appropriate. Any future study should consider different regions and populations to ensure the diversity of the population is incorporated and the findings are equitable and generalisable.

Conclusion

With increasing poverty, the effects of poor housing on peoples' health and wellbeing continues to grow. Several initiatives have been implemented to retrofit houses to overcome damp and cold conditions, providing beneficial impacts on health and some cost savings to households and the health service. Although limitations in the evidence mean there is uncertainty as to when any investment will be recouped through savings, the impacts on health indicate such initiatives should continue to be pursued. Further good quality research is needed to clarify the most effective and cost-effective approach to improving the housing stock.

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Author contributions

CRediT: **Lucy Astle**: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing; **Reuben Larbi**: Formal analysis, Writing – original draft; **Katerina Panagaki**: Formal analysis, Methodology, Writing – original draft, Writing – review & editing; **Catherine Harris**: Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing; **Lisa Knight**: Writing – review & editing; **Andrew Clegg**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Data availability statement

Data available within the article or its supplementary materials.

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