The social cost of cold homes in an English city: developing a transferable policy tool

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ABSTRACT

Background Although there is substantial epidemiological evidence implicating cold homes in death and morbidity, evidence for the UK on the nature and scale of the costs involved is fragmentary. Policy making in this area is thus not well-informed of the benefit of interventions which arises in the form of costs averted.

Methods This pilot study presents estimates of the social cost of harms to health caused by cold homes in the City of Sheffield. All costs are monetized and are for 1 year. Different elements of social cost are distinguished as are different types of harms to health. Because all estimates are derived from readily available secondary data the estimating framework is readily transferable to any other English local authority area.

Results The social cost arising from losses of well-being are shown to dominate other elements of social cost including National Health Service and Social Care costs, and the social cost arising from mental illness is shown to dominate that arising from other harms to health including death.

Discussion The implications of the results for the application of fiscal rate-of-return and social cost–benefit tests are discussed. Several areas are identified in which research reported in this pilot study could be improved on and expanded.

Keywords public health, morbidity and mortality, economics

Introduction and background

Although a large body of epidemiological evidence associates cold homes with a wide range of adverse health outcomes, evidence on the costs that such outcomes impose on those afflicted and on other members of society is limited and fragmentary, and officially acknowledged to be so—‘the annual cost to the NHS of treating winter-related disease due to cold private housing is over £850 million. This does not include additional spending by social services, or economic losses through missed work. The total costs to the NHS and the country are unknown’.1 And as Fenwick et al.2 report there is a near total absence of evaluations of housing improvements which incorporate estimates of the social cost of cold homes.

This paper reports a pilot case study designed to estimate the monetized 1 year social cost of cold homes in the City of Sheffield, with total social cost disaggregated by type of harm to health and by key components of social cost. The aim is to develop a baseline estimate of the scale and nature of the social cost burden of cold homes in order to assist local policy-makers in prioritizing and targeting policies to avert the deaths and illnesses suffered by those living in cold homes. As the estimates are entirely derived from readily available secondary data, the estimating framework is transferable to any other English local authority area.

Sheffield, the third largest city in England, is less prosperous than the region to which it belongs and the national UK economy, largely due to a steep and prolonged decline in employment in its traditional industrial base of steel making and the manufacture of metal products. Its recent economic history is fairly typical of many European cities whose rapid development in the second half of the nineteenth century was based on heavy industry.

Section 2 gives an overview of the estimation methods (which are described in detail in a separate technical appendix). Section 3 contains a brief note about the transferability of the estimates. Section 4 presents details of the social cost estimates.
Section 5 identifies the main findings and indicates how the results of this pilot study could be expanded on and improved by further research.

An outline of methods

Types of illness and categories of social cost

Social cost estimates are derived for those harms to health for which there is reasonably well-established evidence implicating cold homes, which include death, cardio-vascular disease, respiratory illness and falls in the home. For surveys of this evidence see. In addition a smaller number of recent studies have identified a link between cold homes and common mental disorders (anxiety and milder forms of depression). Although the causal pathways involved in this link have not yet to be fully identified they seem likely to involve stressors including thermal discomfort and persistent worries about fuel costs and the adverse effect of living in a cold home on physical health. For a review of this evidence and an interpretation of the causal links involved, see Liddell and Guiney.

Following the precepts of cost–benefit analysis and the example of Layard et al., a distinction is observed between two broad components of social cost: the monetary value of the direct loss of well-being suffered by those whose health is harmed; and the cost falling on others as a concomitant of the loss of well-being, which consists of National Health Service (NHS) and Social Care expenditures and the loss of economic output (GDP) where those afflicted are of working age.

Estimating social costs

For each type of harm to health total social cost is the product of an estimate of case numbers and a specified set of money costs per case which cover the different elements of social cost identified above. All costs are thus monetized, and are for 2011–12.

All deaths are assumed to occur at the beginning of the year in question and all cases of morbidity are assumed to extend over the full year. Issues relating to the incidence of cases across multiple time periods and to the impact of policy interventions on case numbers are not analysed.

Following Gilbertson et al. cases of morbidity involving cardio-vascular and respiratory disorders and falls in the home are derived from harm-to-health likelihood coefficients provided by the national Housing Health and Safety Rating System (HHSRS) which set the number of persons affected per household at one. Those involving mental illness are derived from data provided by Harris et al. using adjustments to ensure consistency with the estimates of cases derived from the HHSRS. And in three instances—death, falls in the home and common mental disorders—the estimates of case numbers are adjusted to take account of the fact that it cannot be plausibly assumed that harm to health is uniquely associated with cold homes.

Because official data on care costs do not distinguish morbidities related to cold homes from the same or similar conditions arising from other causes, it is difficult to identify appropriate and reasonably precise unit NHS and Social Care costs. The unit care costs specified below should thus be thought of as plausible broad approximations rather than precise estimates.

The estimates of well-being costs per case do not assume that those whose health is harmed by cold homes would otherwise be free of illness and disability, but rather that they would otherwise enjoy the average level of health of the general (national) population in the age group to which they belong.

Although local data are used to derive estimates of case numbers and unit costs, the use of several additional items of national data means that the estimates are subject to potential bias. We evaluate this bias and identify other causes of a difference between the estimates and true social cost. As all such causes work in the same direction to reduce estimated cost below true cost, our estimates of social cost are conservative.

Case numbers

Estimates of 1 year case numbers are derived as follows

- **Death**—annual average excess winter deaths for the Sheffield Local Authority area for the period 2008–11 from West Midlands Public Health Observatory, modified by a national ‘Marmot Adjustment Coefficient’ of 0.215 (see Appendix section 1).
- **Cardio-Vascular Disease**—the HHSRS national harm-to-health likelihood coefficient for the hazard of excess cold (1/380) multiplied by the number of local households in which at least 1 person aged 65 or above resides (see Appendix section 2).
- **Respiratory Illness**—the HHSRS national harm-to-health likelihood coefficient for the hazard of damp and mould (1/464) multiplied by the number of local households in which at least 1 person aged 16 or below resides (see Appendix section 2).
- **Falls in the Home**—the number of local households in which at least 1 person aged 65 or above resides multiplied by the HHSRS national harm-to-health likelihood coefficient for the hazard of falls on stairs (1/245), with the sum modified by the national ‘Marmot Adjustment Coefficient’ of 0.215 to
account for falls in the home not attributable to low indoor temperatures (see Appendix section 2).

- **Common mental disorders**—the total number of local households multiplied by the national proportion of adults using less domestic fuel than needed to heat the home due to cost worries who also suffer from a common mental disorder with the proportion adjusted to account for those using less fuel due to cost worries who suffer from a common mental disorder due to other causes, and with the product reduced to cover only those affected who receive treatment (see Appendix section 3).

It is important to bear in mind that the set of HHSRS harm-to-health likelihood coefficients and the proportions estimated by Harris et al.\(^9\) from which all cases of morbidity are estimated are national averages—defined for national values of those factors which expose individuals to harms to health associated with cold homes. The most immediate of which are the thermal efficiency of dwellings and the disposable income of household residents coupled with the price of domestic fuel. Thus, the estimates of local cases will be biased to the extent that there are differences between local and national profiles in respect of these factors. This can be assessed from official data on fuel poverty, which is determined by the interaction of these three factors. On the official, low-income high cost measure local and national rates of fuel poverty for 2011 are virtually identical—11% of Sheffield households versus 10.9% of national households.\(^11\) Although local household incomes are below the national average, the effect of this on the ability of local residents to keep warm at home is more-or-less exactly offset by the higher local proportion of dwellings in the social rented sector, the thermal efficiency of which higher than that of other tenures. Thus, the estimates of local cases of morbidity are unlikely to be subject to significant estimation bias on account of the use of the above national coefficients and proportions.

### Social costs per case

Social costs per case are specified as follows.

- **Loss of Well-Being**—£40,000 for the value of 1 year of healthy and disability-free life, combined with World Health Organization Disability Adjusted Life Year weights of 1 for death, 0.4 for cardio-vascular disease, 0.25 for respiratory illness, 0.3 for falls in the home and 0.2 for common mental disorders, with morbidity weights taken from World Health Organization.\(^12\) These weights are adjusted for the probability that those afflicted would not otherwise enjoy full health (see Appendix section 4).

- **National Health Service and Social Care Cost**—for cardio-vascular disease £3,124 per case for NHS Primary, Secondary and Tertiary Care and non-NHS Social Care; for respiratory illness £4,359 per case for NHS Primary, Secondary and Tertiary Care and non-NHS Social Care; for falls in the home £2,453 per case for NHS Primary, Secondary and Tertiary Care and £390 per case for Social Care and for common mental disorders £1,543 per case for NHS Primary, Secondary and Tertiary Care and non-NHS Social Care (see Appendix section 5).

- **GDP loss**—£682 per case of common mental disorders for those of working age, derived from the estimates of Layard et al.\(^6\) (see Appendix section 6).

In the case of common mental disorders, the specified care costs per case are significantly less than true unit care costs on account of two factors the effects of which we have not estimated. The first relates to the well-documented NHS treatment deficit for anxiety and depression disorders which is at least partly compensated for by informal care provided by family and friends, which should be counted in along with NHS and Social Care costs in any estimate of social cost. The second relates to equally well-recognized mental ill health co-morbidities. As Naylor et al.\(^14\) report mental ill health is associated with worse outcomes for a range of physical illnesses and thus with increased NHS and Social Care costs for such illnesses. These costs should also be counted in along with direct NHS and Social Care costs.

### Transferability

Because the official secondary data used to derive the case and unit cost estimates for Sheffield is routinely published for all other English local authority areas, the estimating framework is readily transferable to any other English local authority area, provided that any estimating bias resulting from the use of additional items of national data is corrected for. The computational effort involved in any such transfer is relatively modest.

### Results

Table 1 shows the result of applying the methods outlined in the Methods section, with the estimated total 1 year social cost of just under £20 million distributed by harm to health category (the row third from bottom) and by cost category (the final column). It should be recalled that the social cost estimates for all morbidities are conservative because of the one-person-per-household property of the estimation methods used, and that those for common mental disorders are subject to an additional downwards bias on account of the exclusion of the cost of informal care and of co-morbidities.
Discussion

Main findings
The estimated social cost of cold homes is dominated by losses in the quality of life—by the loss of well-being suffered by those who die or become ill because they live in cold homes. By comparison the cost of cold homes which fall on others—the cost of Health and Social Care services for those who suffer such illnesses and the resulting loss of economic output—is relatively small. Mental illness associated with cold homes imposes a social cost which is 75% greater than the combined social cost of all other harms to health associated with cold homes including death, and almost seven times greater than that of death alone. The dominance of social cost arising from mental illness reflects the relatively large number of estimated cases rather than a high social cost per case.

These findings carry an important implication for the application of conventional rules of public policy appraisal. Under a fiscal rate-of-return test, the public expenditure cost of a policy intervention is compared with the induced down-the-line savings in public expenditure, whereas under a cost–benefit test the comparison is between the public expenditure cost of the policy and the induced public expenditure savings plus the value of non-fiscal social gains—in the present context the value of well-being gains which result from better health plus the induced gain in economic output. Any policy on cold homes which passes a fiscal rate-of-return test will automatically pass a cost–benefit test (because reduced public expenditures on care services are generated by health gains which in turn generate a GDP gain), but the reverse is not necessarily the case. Consider a policy for which the public expenditure cost exceeds the induced public expenditure savings, but for which the value of the gain in well-being plus that in GDP is greater than this excess. This policy would fail a fiscal rate-of-return test but pass a more encompassing and arguably more satisfying cost–benefit test. Such a policy will be typically one which generates significant health-related gains in well-being and GDP but only modest savings in public expenditure.

Table 1 indicates that policies on cold homes which reduce mental illness are more likely to fall into this category—for each case averted the gain in well-being plus GDP per pound of public expenditure saved is greater for common mental disorders than for all other morbidities. Although fiscal rate-of-return tests have appeared more attractive during the recent period of fiscal austerity, from a social point of view policies on cold homes and fuel poverty which reduce mental illness may need protection from such a test.

Existing knowledge in the area
Although there is substantial existing evidence implicating cold homes in a wide range of adverse health outcomes, knowledge of the cost which such outcomes impose on the individuals afflicted and on other members of society is very limited and fragmentary.

What this study adds
This study uses existing secondary data to provide an estimate of the monetized 1 year social cost of cold homes in the City of Sheffield. The estimate is based on a concept of social cost which is coherent and reasonably comprehensive, and which is relevant for the evaluation of public policy interventions. The estimating framework is readily transferable to any other English local authority area at a modest computational cost.

Limitations and areas for further research
There are several areas in which the results of this pilot feasibility study could be expanded on and improved by further research. Firstly, the estimates of NHS and Social Care unit costs—which are presented as plausible approximations only—would be made more precise by a detailed professional scrutiny, and also by the inclusion of an estimate of the unit NHS and Social Care cost of mental ill health co-morbidities.

| Table 1 | The social cost of death and illness related to cold homes, Sheffield, 2011–12, £ million |
|---------|---------------------------------|---|---|---|---|---|
|         | Death                          | Cardio-vascular illness | Respiratory illness | Falls at home | Common mental disorders | Total cost |
| Loss of well-being | £1.856 | £1.600 | £1.311 | £1.123 | £9.638 | £15.528 |
| NHS primary and secondary cost plus social care | — | £0.391 | £0.602 | £0.333 | £2.112 | £3.438 |
| GDP loss | — | — | — | — | £0.934 | £0.934 |
| Total social cost | £1.856 | £1.991 | £1.913 | £1.456 | £12.684 | £19.900 |
| Number of cases | 58 | 125 | 138 | 117 | 1369 | — |
| Total social cost per case | £0.032 | £0.016 | £0.014 | £0.012 | £0.009 | — |
Secondly, the estimates of total care costs would be significantly improved by the inclusion of estimates of the unit cost of informal care for all cold-home-related morbidities, especially so for mental illness. And third, at the level of analytical structure rather than empirical detail, modelling the evolution of harms to health due to cold homes over a sequence of future time periods would remove the limitation in the present estimates of the single year time frame. In such a projection, the translation of case numbers of morbidity and mortality into life years lost is less straightforward than in the single year case due to the persistence and probable increasing severity over time of existing cases of morbidity; the emergence of new cases of morbidity and the eventual termination of cases of morbidity by death. The advantage of modelling this evolution under a no change policy assumption would be to allow the beneficial impact of any new policy intervention to be estimated from a sequence of life years saved over the projected length of life of the intervention.

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References

Appendix: Sources and methods in detail

Section 1: Estimating deaths

Excess winter deaths are those recorded in the four winter months December–March minus the average of recorded deaths in the two non-winter four month periods (August–November and April–July). Calculations by the Marmot Review Team⁴ indicate that only 21.5% of national excess winter deaths are attributable to houses being cold rather than to other winter conditions.

Section 2: Estimating cases of cardio-vascular disease, respiratory illness and falls in the home

See Housing Health and Safety Rating System⁸ for a brief description of the HHSRS and Annex D paragraphs 1.04, 2.20, 20.02 and 21.04 for the HHSRS likelihood coefficients for the hazards of excess cold, damp and mould and falls in the home. Each coefficient measures the probability that an occupier of a dwelling will suffer a harm to health caused by a specified hazard over a period of 12 months. The coefficients relate to harms to health that fall across four categories of severity and which are deemed to need medical care. It is an implication of the construction of HHSRS that the number of persons per dwelling affected by any hazard to health is set to one.


The adjusted proportion is applied to the number of local households rather than the number of local adults in order to ensure consistency with the estimates of cases derived from the HHSRS.

An alternative method would be to use the data in table 7.1 on the prevalence of common mental disorders together with that on the proportion who report being unable to keep the home warm in winter—which is lower than the proportion using less fuel than necessary due to cost worries. But the authors report that the reported cold-in-winter proportion is subject to recall effects—varying according to the month in which the survey question is asked. The reported ‘(proportion) . . . . would have been higher had interviewing taken place only in the winter’.⁹

The London School of Economics Centre for Economic Performance Mental Health Policy Group¹⁶ reports that only 25% of those suffering mental illness receive treatment. This adjustment also ensures that estimated cases of mental illness are computed on the same basis as those of other morbidities derived via the HHSRS likelihood coefficients.

Section 3: Estimating cases of common mental disorders

The data in Harris et al.⁹ table 7.1 can be used to identify the proportion of the adult population who report having used less fuel than necessary to heat the home due to cost worries over the past 12 months, and the proportion of this sub-group who suffer from a common mental disorder. This latter proportion is adjusted by subtracting the lesser rate of common mental disorders among those who do not use less fuel due to cost worries, in order to isolate the effect attributable to worries about fuel costs rather than to other factors. The adjusted proportion is applied to the number of local households rather than the number of local adults in order to ensure consistency with the estimates of cases derived from the HHSRS.

A counterfactual is assumed under which those suffering harm to health because of cold homes would otherwise enjoy the average level of health of the general population in the age group to which they belong, rather than an illness and disability free level of health—which is a commonly assumed counterfactual. Claxton et al.¹⁹ figure 4.1 report health-related quality of life scores from the Health Survey for England by age and gender which show that for both males and females aged between 65 and 70 this score is ~ 80% of the maximum score, ~ 95% of the maximum for those aged 16 years and below and ~ 88% of the maximum for those of the mean age of all UK adults (47.5 years in 2011). Thus the adjusted money value of the 1 year losses of well-being are £40 000 × 1 × 0.80 = £32 000 (for death), £40 000 × 0.4 × 0.8 = £12 800

Section 4: Estimating unit social costs: loss of well-being

A value of £40 000 for a disability free year of life is within the range of willingness-to-pay values for the UK proposed in EuroVaq¹⁷ Appendix table 2.3, and is also within the range used within 12 UK government departments. See Wolff et al.¹⁸

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(for cardio-vascular disease), \(£40\,000 \times 0.3 \times 0.8 = £9\,600\)
(for falls in the home), \(£40\,000 \times 0.25 \times 0.95 = £9\,500\)
(for respiratory disease) and \(£40\,000 \times 0.2 \times 0.88 = £7\,040\) (for common mental disorders).

**Section 5: Estimating unit social costs: NHS and Social Care expenditures**

The NHS and Social Care costs per case specified below are averages across all classes of severity.

The per case NHS and Social Care cost for cardio-vascular disease is total expenditure in category 10 'problems of circulation' for Sheffield PCT in NHS Programme Budgeting Tool divided by cases of 'coronary heart disease' for Sheffield PCT recorded in NHS Quality and Outcomes Framework.

The per case NHS and Social Care cost for respiratory disease is total expenditure in category 11 'respiratory illness' for Sheffield PCT recorded in NHS divided by cases of 'chronic pulmonary obstructive disease' for Sheffield PCT recorded in NHS Quality and Outcomes Framework.

The per case cost for falls in the home for NHS Primary, Secondary and Tertiary Care for is that shown for Sheffield PCT under code HB14C in NHS National Schedule for Reference Costs and for non-NHS Social care is derived via an inflation adjustment on 2007 data for the Sheffield Local Authority in the Capgemini Supporting People Cost Model for the ‘Older Floating and Other’ client group—an older age group receiving housing-related social care services not resident in any form of sheltered accommodation. See Department of Communities and Local Government.

The per case NHS and Social Care cost for common mental disorders is total expenditure in category 5 'other mental health disorders' for Sheffield PCT recorded in NHS Programme Budgeting Tool divided by cases of 'depression 18 years + ' for Sheffield PCT recorded in NHS Quality Outcomes Framework.

**Section 6: Estimating unit social costs—loss of GDP**

The data in Layard et al. tables 2, 3 and 4 indicate that taking into account other barriers to continuous employment a person suffering 'general anxiety' rather than enjoying good health can expect to lose 0.96 months of work per year due to unemployment or 0.25 months of work per year due to being absent from work. Appropriately weighted these losses convert to an average of 0.7 months per year, which in turn converts into an annual GDP loss per of £682 per case of general anxiety assuming that the person would have been employed at the 2011–12 adult UK National Minimum Wage Rate. This figure applies only to those suffering cold-home-related Common Mental Disorders who are of working age.