Health Impact Assessment of Housing Improvements: A Guide

Scottish Health and Inequalities Impact Assessment Network (SHIIAN)

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Contents **Page**

ABOUT THIS GUIDE

This guide updates the previous guide published in 2003. It has been written to help those doing a health impact assessment of a housing proposal. The document:

- Provides background information on housing conditions and housing policy in Scotland
- Contains a review of research evidence on housing and health
- Gives guidance on applying this evidence in the context of a health impact assessment
- Summarises some HIA case studies and sources of evidence

The document is not a blue-print for HIA of housing proposals. It summarises information that should help with an assessment and highlights where further evidence and data might be required. We hope it is useful for housing interventions such as building projects or housing improvement or regeneration schemes and even to help with assessments of housing policies or strategies. But there will be other health and well-being impacts associated with such projects that ought to be assessed as well. We hope this guide is flexible enough to support different approaches to HIA.

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CHAPTER 1: HOUSING IN SCOTLAND

Martin Higgins

This chapter provides a summary of available data on housing in Scotland and current national housing policy, for non-housing professionals. It aims to help public health professionals understand the constraints and policy context within which housing proposals are developed.

SCOTTISH HOUSING POLICY

Housing is one of the policy areas devolved from the United Kingdom Parliament in London to the Scottish Parliament in Edinburgh. The current Scottish Government housing document is *Homes Fit for the 21st Century*. The strategy aims to increase housing supply to meet the demand for an additional 200,000 homes by 2020. It acknowledges that the recession in the UK and Scottish economies since 2008 will continue to have a significant effect on the housing market. The main recession-related problems are the lack of construction activity, the restrictions on mortgage lending, and pressures on household budgets due to rising food and energy prices. Reductions in public spending levels are likely to have a significant impact on the housing market until at least 2015. *Homes Fit for the 21st Century* notes that fiscal measures such as mortgage relief and housing benefit remain controlled by the UK government. There is a desire expressed in the strategy to see local authorities use their housing subsidy in more creative and flexible ways. Low cost ownership, shared equity schemes and self-build are mentioned as ways to increase supply. There is also a commitment to an Innovation and Investment Fund to allow more affordable housing to be built. The 'right-to-buy' for council tenants has been revised as, 'excessive discounts still available to tenants with the pre-2002 'preserved' right-to-buy are unjustifiable'.[1]

Aside from increasing housing supply, *Homes Fit for the 21st Century* also makes a commitment to ensure that the quality of the overall housing stock in Scotland is continuously improved. By 2015, all social landlords will need to meet the Scottish Housing Quality Standard and a new standard for energy efficiency will be developed. The government is also committed to providing housing that is sustainable. It is notable that housing policy is aligned with recent spatial planning policies. There is a commitment to ensuring a plentiful supply of land for housing – on both greenbelt and brownfield sites. The design guides, *Designing Places* and *Designing Streets*, are referenced in the document and the importance of constructing neighbourhoods and places is stressed throughout. The links between housing, urban regeneration, health and wellbeing are also acknowledged. Another key theme in the document is the need to supply housing for an ageing population. A national strategy on housing for older people was published in 2011. *Age, Home and Community* focuses on enabling older people to live independently in their own homes. A key part of this work will be ensuring preventative support services are in place to achieve this objective.[2]

Government policy reflects and is enabled by legislation. The key legislation is summarised below in Table 1.

The extent to which housing policy is effective is, to some degree, recorded as part of the government's performance recording system, Scotland Performs.[a] There is a national indicator to 'Increase the rate of new house building'. Other targets relate to residential satisfaction with neighbourhood, provision of housing for people who are unintentionally homeless and reducing ecological footprint.

The Scottish National Party (SNP) won an overall majority in the Scottish election in May 2011. Its manifesto commitments included the following:

[a] http://www.scotland.gov.uk/About/scotPerforms (accessed 19 September 2012)

- Deliver 5,000 new council homes over the new parliamentary term
- Provide £16 million to expand schemes for first time buyers
- Build over 6,000 new affordable houses annually
- Expand the National Housing Trust model
- Develop a Scottish Housing Bond and access pension funds to secure additional investment
- Work with housing associations to explore funding mechanisms for renewable heat schemes
- Introduce a levy on long-term empty homes
- Adopt a tenure neutral approach to housing[b3]
- Retain secure tenancies at affordable rents
- Make the case for determining own rules in relation to Housing Benefit
- Offer housing health checks to people in social rented accommodation
- Toughen up tenancy rules in relation to antisocial behaviour
- Create a development strategy for growing and improving the private rented sector
- Publish a national strategy on housing for older people
- Develop 'pay as you save' energy efficiency schemes and a single national Universal Home Insulation scheme
- Improve the planning system and unlock developments currently stalled due to infrastructure needs.[4]

Table 1: Housing legislation applicable in Scotland

Housing (Scotland) Act 1987	
	• Provides the framework for the management and allocation of social rented housing • Gives local authorities duties with respect to homelessness • Sets out the provisions regarding the operation of the right to buy • Provides local authorities with powers to tackle sub-standard housing in their areas • Sets the framework for local authority assistance to owner occupiers to help them improve the condition of their house • Provides that local authorities must maintain a housing revenue account for income and expenditure relating to its own housing stock
	Housing (Scotland) Act 1988
	This Act deregulated the private rental market in Scotland. It introduced two new forms of tenancy in the private sector from 2 January 1989 – the assured tenancy and the short assured tenancy, with less security of tenure.
	Housing (Scotland) Act 2001
	The focus of this Act is on the social rented sector. It introduced the Scottish Secure Tenancy (SST) for tenants of registered social landlords and local authorities and made reforms to the right to buy and homelessness legislation. It also created a single regulatory framework covering housing across the social rented sector and enhanced the strategic role of local authorities in assessing and tackling local housing needs.
	Homelessness (Scotland) Act 2003
	The policy intention of this Act was to improve the rights of homeless people. The Act provides the framework for the eventual abolition of the priority need test by 31 December 2012 This means that all unintentionally homeless people will be

[b] 'This approach means that the Scottish Government will be seeking housing choices that are able to be maintained (sustainable) for all rather than encouraging one particular form of housing. By promoting housing with a mix, for example of social and private rented, shared equity and owner occupation housing within communities'

	entitled to settled accommodation. It also provides that when a landlord raises proceedings for possession, that landlord must inform the relevant local authority. The aim is to give local authorities the opportunity to intervene early in order to prevent homelessness occurring.
	Anti-Social Behaviour (Scotland) Act 2004
	This Act established the framework for the private landlord registration scheme and the system for serving anti-social behaviour notices on private landlords.
	Tenements Act (Scotland) 2004
	This Act provides a structure for the maintenance and management of tenements if this is not provided for in the owner's title deeds. A key innovation is that it provides for decision making by majority.
	Housing (Scotland) Act 2006
	The main purpose of this Act was to address problems of condition and quality in private sector housing. It reformed local authority powers to deal with disrepair in their areas and the system of supporting owners to undertake repairs. It also contained provisions governing the “Home Report” (the set of documents that sellers must provide to potential buyers) and re-enacted, with changes, the system of licensing of houses in multiple occupation which is now contained in secondary legislation.
	Home Owner and Debtor Protection (Scotland) Act 2010
	The policy intention of this Act was to strengthen protection for home owners facing repossession. It requires all repossession cases to call in court, lenders to demonstrate to the court that they have considered reasonable alternatives to repossession and enable home owners to be represented in court by approved lay representatives.
	Housing (Scotland) Act 2010
	This Act modernises the system of regulation of social housing and ends the right to buy for new tenants and new supply social housing. It also contains a number of miscellaneous provisions which include increasing the protection for ‘unauthorised tenants’ who are at risk of losing their home following repossession action against their landlord and placing a duty on local authorities to assess the housing support needs of, and provide support services to, persons who are homeless or threatened with homelessness (and anyone residing with them), where the local authorities believes that the applicant might need housing support services.
	Property Factors (Scotland) Act 2011
	This Act provides that Scottish Ministers must prepare and maintain a register of property factors and makes it an offence to act as a property factor without being on the register. The Act also makes provision in relation to the resolution of disputes between homeowners and property factors.
	Private Rented (Housing) Scotland Act 2011
	This Act amends the private landlord registration system with the aim of improving enforcement of the scheme and introduces a power for local authorities to serve a statutory overcrowding notice that local authorities can use to address overcrowding in the private rented sector. It also makes relatively minor changes to the system of HMO licensing in the 2006 Act and other miscellaneous provisions such as the duty on private landlords to provide a document (a tenant information pack) at the start of a tenancy.
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HOUSING IN SCOTLAND

Dwellings

There are an estimated 2.377 million dwellings in Scotland and 2.368 million households.[5] 15,150 new dwellings were added to the housing stock in 2010/11, a fall from 16,845 in 2009/10 and 40% less than the 25,288 new homes built in 2005. Between 2005 and 2011, there were 148,089 new homes built in Scotland.

Table 2: Number of dwellings in Scotland, 2001-2011[5]

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Estimated stock of dwellings (000s) [1]	2,314	2,331	2,349	2,368	2,389	2,408	2,430	2,452	2,469	2,483	2,377
Privately owned dwellings (%)	70.2	71.1	72.1	72.9	73.8	74.5	75.1	75.6	75.9	76.0	76.2
Socially rented dwellings (%)	29.9	28.9	27.9	27.0	26.2	25.4	25.0	24.4	24.1	24.0	23.8

Figure 1: New housing supply in Scotland 2001 to 2011[5]

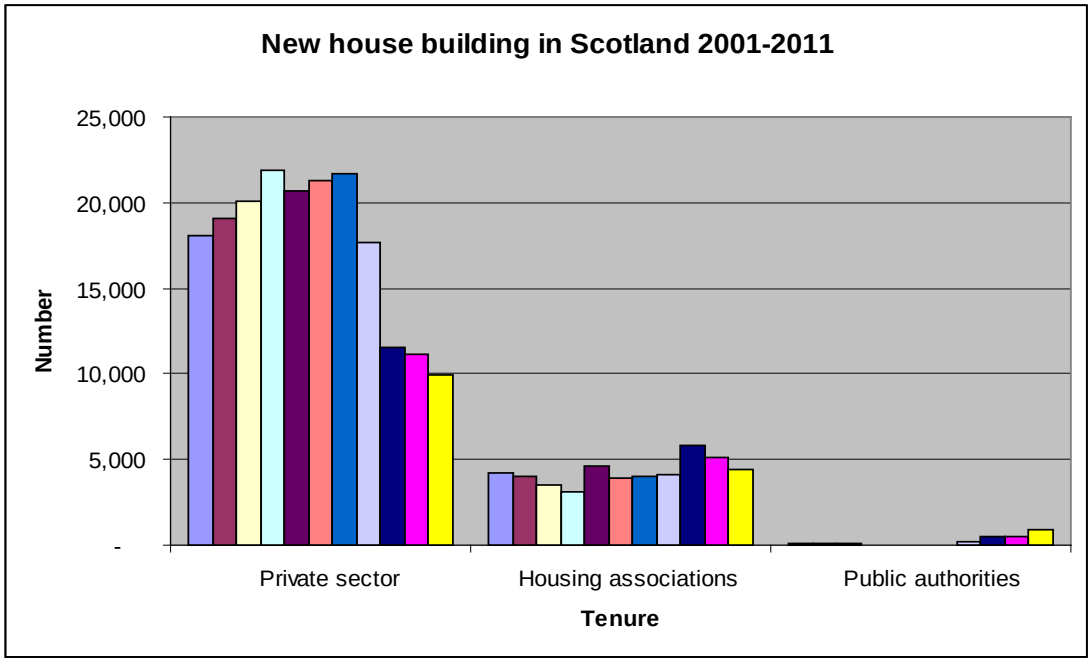


Figure 1 shows that most new dwellings are constructed by the private sector. There has been a marked slowdown in the number of private housebuilding completions since 2008 and a small increase in public authority housebuilding. Local councils started building homes again in 2008 after a number of years when they constructed very few new homes. Over the period, there has been a reduction in social rented stock from 30% of the total in 2001 to 24% in 2011. Privately rented housing accounts for almost 12% of the housing stock in 2011 compared with 6% in 2001.

Types of household

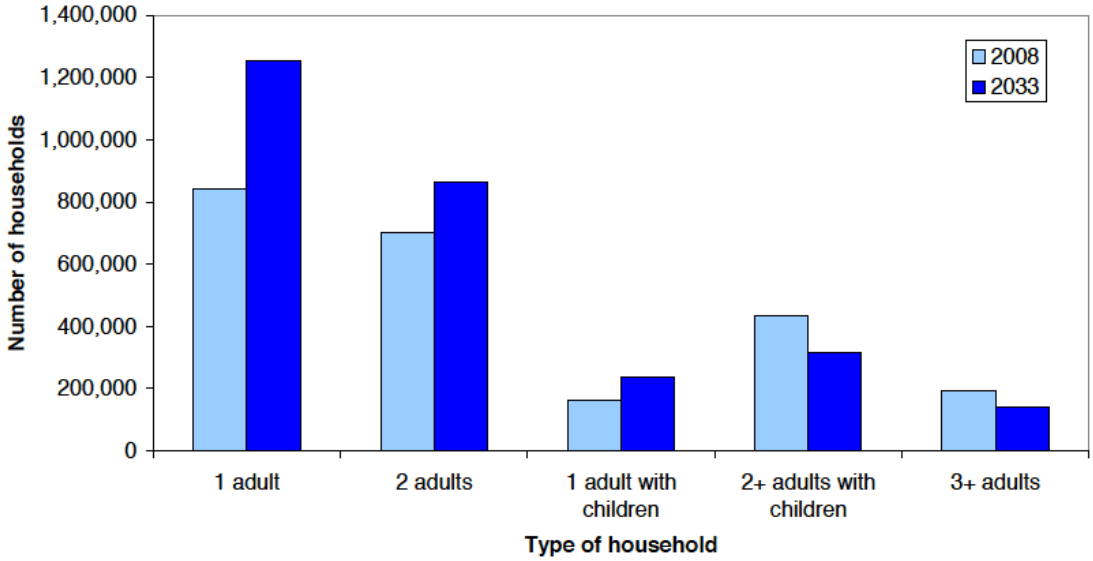
There were an estimated 2.377 million households in Scotland in 2011, around 7.9% more than there were in 2001.[6] As shown in Table 3, over the last thirty years there has been a shift from larger to smaller households. In 1981, three plus person households accounted for 48% of all households whereas in 2009 they accounted for 32% of households. In contrast, one person households accounted for 22% of households in 1981 and 33% of households in 2009. The most pronounced changes are an increase in single male households and a decrease in two adult plus children households.

Table 3: Household sizes and types in Scotland, 1981, 1991, 2001 and 2009[7]

Household Size	Household Type	1981	1991	2001	2009
1 person households	1 adult: male	7%	11%	14%	15%
	1 adult: female	15%	18%	19%	18%
2 person households	2 adults	28%	30%	30%	31%
	1 adult, 1 child	1%	3%	3%	4%
3+ persons households	1 adult, 2+ children	1%	2%	3%	2%
	2+ adults, 1+ children	33%	25%	22%	20%
	3+ adults	14%	11%	9%	10%

Projections predict that household numbers will continue to increase at a greater rate than population numbers. Research commissioned by the Scottish Government suggests that the increased number of smaller households, reflects social changes such as delayed marriage as well as changes in the age structure of the population.[8] Figure 2 suggests that the increase in small adult households will continue for the foreseeable future.

Figure 2: Projected number of households in Scotland by household type, 2008 and 2033[8]



The increase in smaller households and consequent demand for additional housing means there is demand for new homes required across the country. Figures 3 and 4 shows that demand is predicted to be greatest around Edinburgh and Aberdeen with some other rural areas such as Perth and Kinross and the Highlands and Islands showing demand above Scotland average. Demand for new housing in parts of the west of Scotland is not quite so great. By 2031 it is estimated that over 50% of households in the cities of Aberdeen and Glasgow will comprise a single adult with no children.

Figure 3: Projected number of households by local authority area, 2008 and 2033[8]

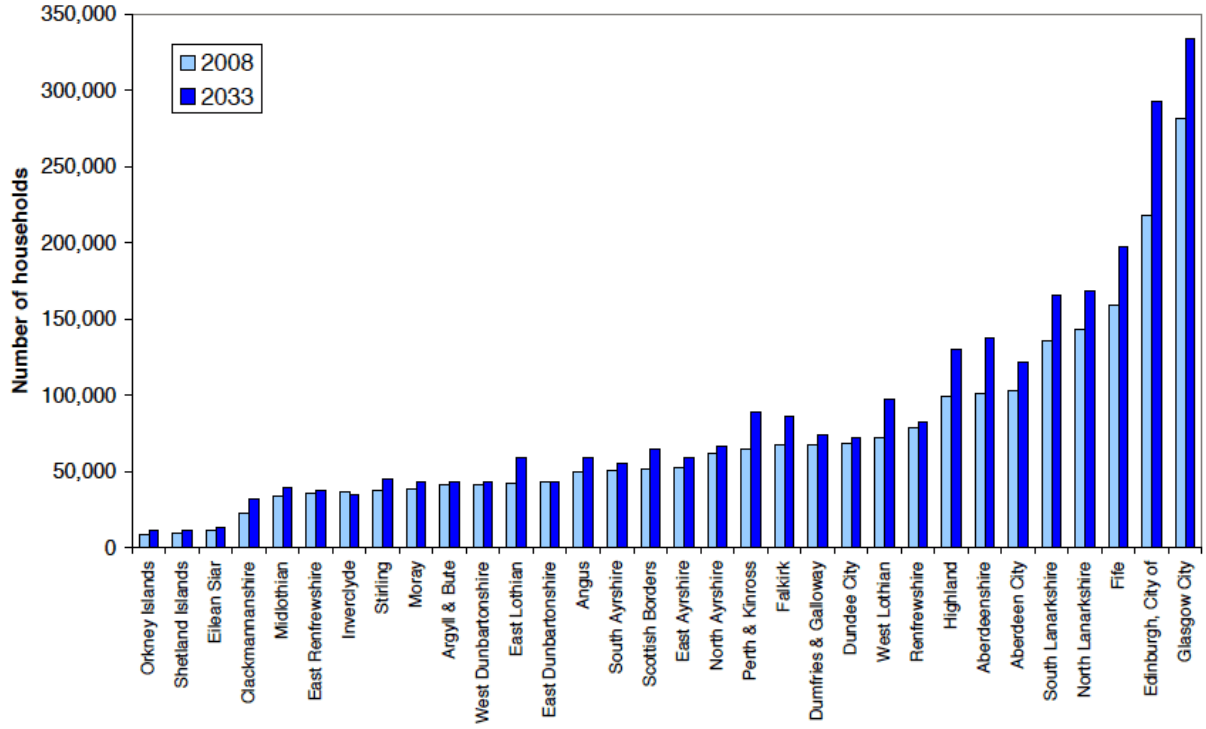
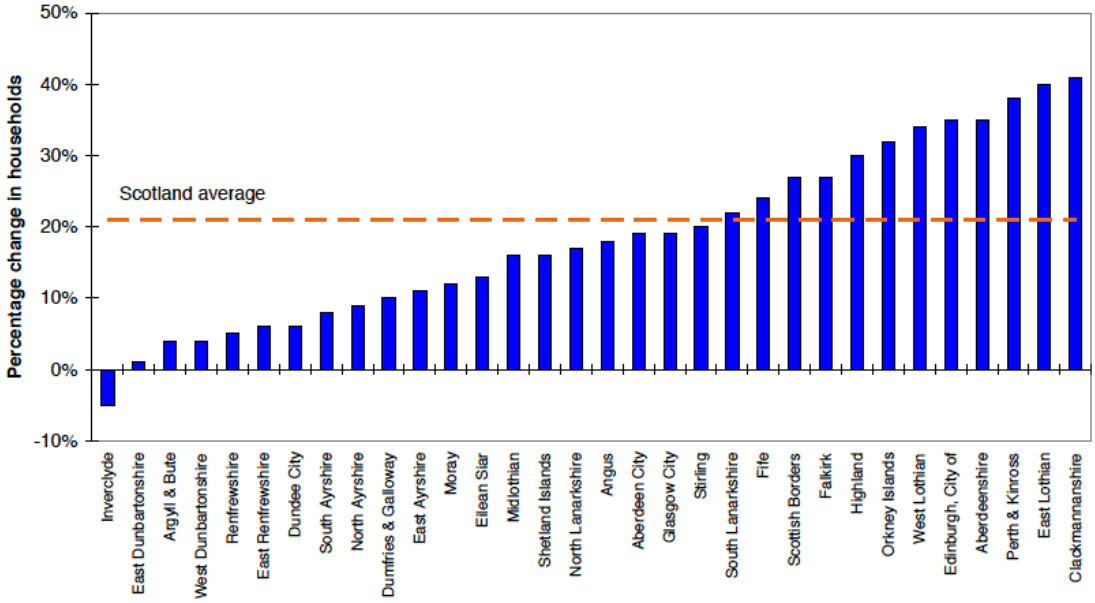


Figure 4: Projected percentage change in the number of households by local authority area, 2008 to 2033[8]



It should be noted that future projections of household size are prone to error. The authors of the government report note that any change to the pattern of high levels of in-migration in recent years and the current economic recession have the potential to affect future household sizes and types.

Housing conditions

The Scottish House Condition Survey (SHCS) is a national survey that looks at the physical condition of homes, and interviews the people who live in them. It reports on fuel and energy efficiency of homes as well as the proportion of households that meet the Scottish Housing Quality Standard (SHQS), which was introduced in 2004. Data available from the 2010 SHCS show that:

- 68% of dwellings were built after 1945, 22% since 1982. The most common new builds since 1982 have been detached houses.
- Most homes (62%) meet the National Home Energy Rating (NHER) for 'good' energy efficiency. Only 3% are 'poor'.
- Privately owned properties overall had lower NHER scores than social housing. Older properties (pre 1919) and properties in rural areas also had poor NHER scores.
- 28% of households had full central heating and 36% had partial central heating.
- 10% of dwellings were reported to have condensation and 4% some rising or penetrating dampness.
- In 2010, 28% of households were deemed fuel poor (compared to 33% in 2009)[c]. The proportion has risen since 2002 when only 13% of households were classified as fuel poor. Incomes, energy efficiency and fuel costs are reported to be the most important determinants of fuel poverty with a change ion any of these affecting fuel poverty levels.
- Households most likely to be classified as fuel poor are: NHER poor, older smaller households, pensioners, household income below £200 per week.[9]

The Scottish Housing Quality Standard (SHQS) is an aggregation of results derived from 5 higher-level categories. Properties are graded as pass or fail and need to pass thresholds in all of the following to meet the SHQS:

- Above the statutory Tolerable Standard;
- Free from serious disrepair;
- Energy efficient;
- With modern facilities and services;
- Healthy, safe and secure.

In 2010, 39% of the homes surveyed met the SHQS. The highest pass rate, 47%, was for housing association/co-operative properties while local authority/other public housing had the lowest pass rate at 31%. The most common reason for failure was poor energy efficiency. Homes without central heating automatically fail.

[c] The Scottish Fuel Poverty Statement states that, 'A household is in fuel poverty if it would be required to spend more than 10% of its income (including Housing Benefit or Income Support for Mortgage Interest) on all household fuel use.'

Housing Type

Data collected as part of the Scottish House Conditions Survey shows that there is a relatively even share of housing types. Detached, semi-detached, terraced and tenement dwellings form the majority of housing types. The predominant recent trend has been the construction of detached homes, which account for almost 40% of dwellings built in the last 30 years.

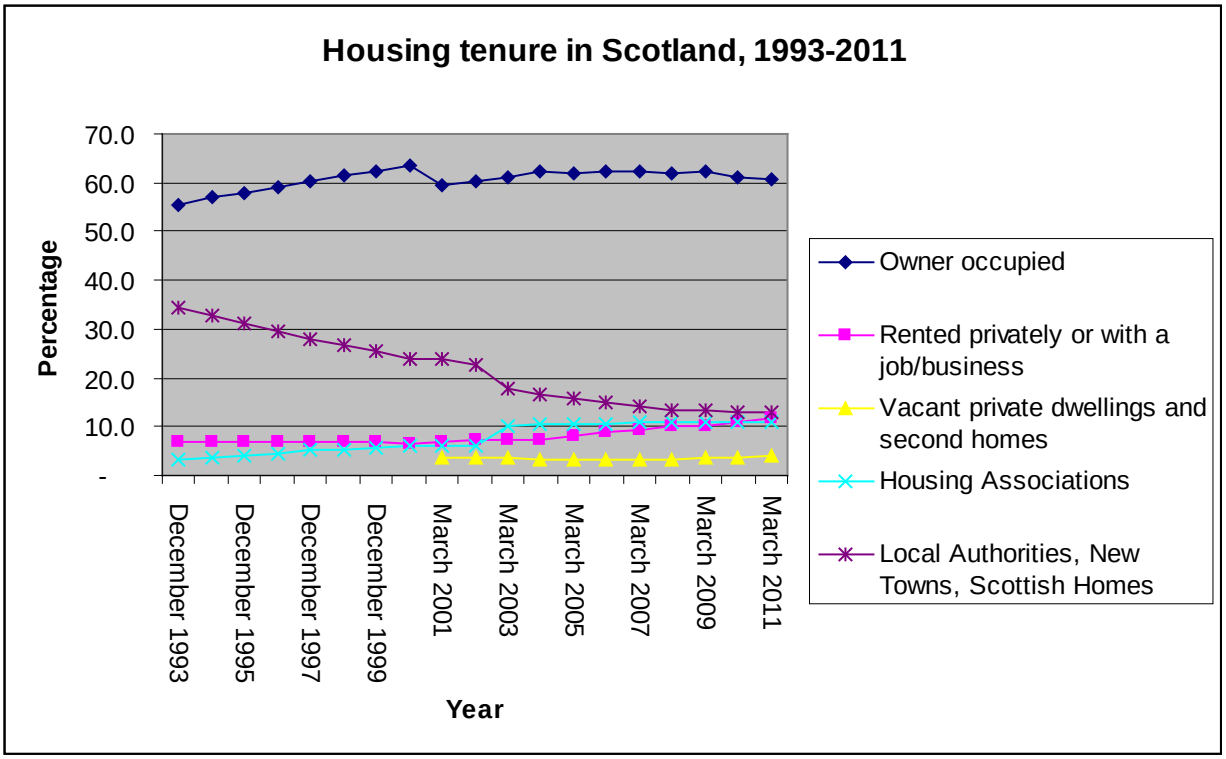
Table 4: Housing types in Scotland (in '000s of dwellings)[9]

Age of dwelling	Detached	Semi-detached	Terraced	Tenement	Other flats	Total
Pre 1919	105	62	67	166	56	455
1919-1944	39	73	37	45	103	298
1945-1964	47	145	175	107	79	554
1965-1982	103	132	163	94	46	539
Post-1982	208	82	54	124	43	511
Total	499	475	522	549	300	2,357
Share of total dwellings	21%	21%	21%	23%	14%	100%

Trends in tenure

Figure 5 below shows the trends in tenure mix since 1993. Owner occupied housing accounts for about 60% of the total tenure mix. In recent years there has been a gradual increase in private rental and housing association rental whereas local authority rental has been decreasing. Of the 2.377 million dwellings in Scotland, just under 100,000 remain unoccupied – almost 5% of the total housing stock.

Figure 5: Housing Tenure in Scotland, 1993-2011[5]



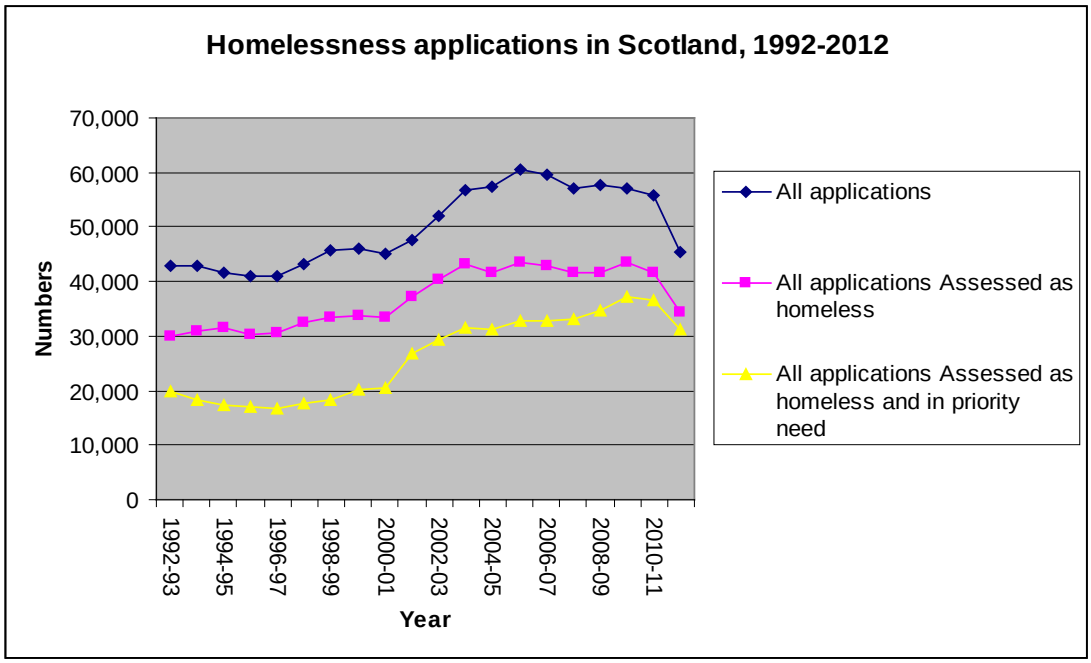
There is significantly more demand than supply for public and housing association housing. There were 187,935 applications to housing waiting lists in Scotland in the year to March 2012.[d] In the same year, just over 26,263 households were re-housed.[5]

Homelessness

The main consequences of the 2003 Homelessness (Scotland) Act are the requirement to abolish priority need categorisation and the onus on local authorities to provide unintentionally homeless clients with settled accommodation. Homeless services need to adjust to these requirements by 2013. The challenge presented by this change is clear from government recorded figures on homelessness.

[d] Note that there may be some double-counting as people may apply in more than one council area and may apply to council waiting lists and RSL waiting lists.

Figure 6: Number of applications to local authorities under Homeless Persons legislation, 1992/93 to 2011-12[10]



The total number of clients assessed as homeless has remained fairly consistent from 2000 until 2011-2012 in advance of the new homelessness legislation. In the years before 2012, more than 40,000 applications each year were assessed as homeless. The proportion assessed as in 'priority need' rose steadily from 73% in 2002-03 to 88% in 2010-11 and this has increased to 91% in 2012. The breakdown of priority applicants shows that single adults aged 25 to retirement age constitute the largest group, more than one third of all applicants. In 2011-12 single parents made up 25% of the applicant group.

Table 5: Number of applications assessed priority need by assessment and household type: 2007-08 to 2010-12[10]

Household type	2007-08	2008-09	2009-10	2010-11	2011-12
Total	**33,253**	**34,695**	**37,137**	**36,470**	**31,183**
Single person under 18	2,406	2,300	2,228	1,995	1,640
Single person 18-24	4,430	5,367	6,151	6,254	5,395
Single person 25-retirement	9,477	10,437	11,519	11,800	10,940
Single person over retirement age	939	889	877	919	686
Single parent under 25	3,052	3,153	3,326	3,088	2,513
Single parent 25+	7,381	7,365	7,614	7,172	5,997
Couple without children	1,509	1,618	1,686	1,674	1,285
Couple with children	2,341	2,064	2,189	2,074	1,551
Other household type	1,718	1,502	1,547	1,494	1,176

CHAPTER 2: HOUSING IMPROVEMENT AND HEALTH: RESEARCH FINDINGS

Catriona Macdonald and Hilary Thomson

Many housing characteristics have been linked to poor health. This chapter uses the best available research evidence to summarise:

- Observed associations between housing and health
- Health impacts following housing improvement
- Other important effects of housing improvement and regeneration

Searches were conducted to identify the best available and most recent evidence relevant to the Scottish context for this section. Where available, well conducted systematic reviews or expert reviews were used to inform the synthesis. Any included reviews were examined to ensure the methods were transparent and that study quality was considered in drawing conclusions. Where no well conducted review was identified, key papers of single studies were examined and the best available were included in the synthesis. The scope of the review was determined in discussion with the Scottish Health Impact Assessment Network and in consultation with the authors of this section to reflect available evidence.

OBSERVED ASSOCIATIONS BETWEEN HOUSING AND HEALTH

This section presents data on the strength of association between specific housing characteristics or hazards and specific health outcomes. It provides a selective review of observational and qualitative literature; where available systematic reviews or comprehensive expert reviews have been drawn on to present the best available evidence.

A comprehensive, expert review of the risks and health hazards of domestic buildings in the UK identified indoor air quality, hygrothermal conditions, radon, falls, house-dust mites, environmental tobacco smoke and fires as the highest health risks.[11] The main housing factors linked to health and which are commonly part of or accompany housing improvements are listed below; these should be considered in an HIA of housing improvements. A summary of research evidence on the links between these most common hazards and health impacts is presented below.

Housing factors linked to health
• Indoor air quality • Lead • Dampness and hygrothermal conditions • Infestation • Temperature • Overcrowding • Noise • Light • Asbestos and manufactured mineral fibres • Greenspace • Housing tenure • Housing design • Housing satisfaction

Indoor air quality

In an expert review of the health effects of exposure to airborne particles in the home, the findings of observational, human, epidemiological and toxicological animal studies were reviewed. Indoor air quality is determined by a number of factors including human activity, indoor furniture, building composition, weather and outdoor air quality. The most common indoor sources of indoor airborne particles in the home arise from environmental tobacco smoke, cooking, certain heating appliances and human activity. Outdoor air quality will also have a strong influence on indoor air quality. Although levels of outdoor air particles will be lower indoors it is thought that most homes are not able to prevent infiltration of small particles (less than 25µm diameter).[12] The World Health Organization published guidelines for indoor air quality in 2010. The guidelines draw on experts in the field and provide exposure thresholds for key pollutants at which risks to health will be reduced.[13,e]

Short-term elevations in ambient particles are strongly associated with increases in mortality and morbidity.[12] While it is accepted that air containing pollutants, including allergens, can exacerbate symptoms among those with existing respiratory disease it is less clear whether or not exposure to air pollutants have a role in the development of respiratory disease, specifically asthma *(see Hygrothermal conditions and allergens).* Following reference to systematic reviews of research evidence, the Committee on the Medical effects of Air Pollutants (COMEAP) have recently released a statement on the links between asthma and exposure to outdoor air pollution. They state that exposure to outdoor air pollution may exacerbate asthma symptoms in people who already have asthma, and exposure to outdoor air pollution may play a role in the development of asthma.[14,15]

A brief review of the specific common air pollutants is presented below.

Volatile organic compounds (VOCs)
Volatile organic compounds (VOCs) are associated with modern residential building materials and coatings. VOC levels may be exacerbated by decreased ventilation and may pose a risk to health.[16] VOCs are emitted from numerous indoor sources including organic solvents, flour adhesives, paint, cleaning products, furnishings, polishes and room fresheners.[17] A recent review[16] of indoor chemical emissions as risk factors for respiratory and allergic effects in children found that formaldehyde, a common source of which is particleboard (chipboard), was the most consistently identified risk factor. Health risks among under 16s associated with higher indoor concentrations of formaldehyde include asthma, chronic bronchitis, increased wheeze, respiratory symptoms, atopy and increased sensitization. Increased asthma diagnosis, bronchial obstruction, wheeze and cough, and phlegm and allergy were associated with higher concentrations of phthalate plasticizers. Painting and renovation was associated with wheeze, asthma, obstructive bronchitis, pulmonary infection and allergy. The review highlighted potential problems with the studies; these included a inadequate consideration of confounders, inaccurate measurement of risk factors and recall bias. Another review examined cross sectional and case control studies for links between formaldehyde exposure and asthma in children.[18] The authors pooled the results of ten studies and concluded that exposure to formaldehyde during childhood is linked to an increased risk of asthma. Children with the highest level of exposure (80 µg/m^3) may have up to 3.5 times higher risk of asthma than those with the lowest level of exposure to formaldehyde.

A survey conducted in England and Wales monitored levels of VOCs in homes,[19] comparing observed levels with a proposed threshold level. Overall levels were found to be low; concentration levels were influenced by season with levels higher in autumn and winter, recent painting and building age. Older houses had lowest VOC levels and flats highest, possibly due

[e] WHO thresholds for selected pollutants are available at:
http://www.euro.who.int/__data/assets/pdf_file/0004/128605/Factsheet_indoor_chem_15_Dec_10.pdf

to differences in ventilation. Recommendations for reducing exposure include the use of low emission materials in construction and furnishing of homes and good ventilation during construction and during first year of occupancy.[19]

Carbon monoxide (CO) and nitrogen dioxide (NO_2)
The health risks associated with carbon monoxide (CO) vary depending on the level of exposure. Potential health effects include diminished performance at complex tasks, cardiac ischemia in susceptible persons, headache, nausea, syncope, confusion, seizures, coma and death if untreated. Nitrogen dioxide (NO_2) can cause airway irritation and increased risk of respiratory conditions. The most common sources of CO and NO_2 are gas appliances especially gas cookers, unflued appliances for heating, and tobacco smoke.[19] A survey of levels in homes in England found that although average CO levels did not exceed WHO guideline levels, CO levels were higher in the autumn and winter months. This increase was associated with the increased use of fossil fuels and decreased ventilation in colder weather. The WHO annual average guidelines for exposure to NO_2 were exceeded in kitchens in a quarter of homes and in half of homes with a gas oven. Recommendations on reducing exposure include avoiding being in the same room as gas cooking and/or ensuring good ventilation.[19]

Radon
Radon is a chemically inert radioactive gas of natural origin which is produced by the disintegration of uranium and radium located in the earth's crust. Radon is the main source of radioactivity in the general population. It mainly comes from granite and volcanic subsoils and levels in homes vary widely with area and season. If radon escapes from the ground to the open air it is quickly diluted to low concentrations although it can reach high concentrations in enclosed spaces such as buildings. Radon gas progeny are electrically charged particles which can attach to natural aerosol and dust, if inhaled these can deposit in the lungs exposing the bronchial epithelial cells to alpha radiation.[20] Based on the pooling of European studies, an increase of 100 Bq/m³ in long term average radon concentration in the home would cause an increase in the risk of lung cancer of between 5% and 31%, with a central risk of around 16%.[21] Estimates on the percentage of all lung cancer deaths attributable to radon in homes range from 3.3% to 9%.[22 23] The effectiveness of interventions to reduce exposure to radon is reported in section 2.

Overall assessment: indoor air quality
Indoor air quality is determined by levels of both indoor and outdoor pollutants. Sudden increases in air pollutants are most detrimental to the elderly and asthmatics. Optimal levels of ventilation, allowing air replacement while minimizing heat loss, are recommended. Levels of VOCs, CO and NO_2 are important influences on indoor air quality.

Lead

Exposure to lead in some countries remains a common domestic hazard with significant health impacts, those most at risk are low income groups living in poor housing.[24 25 26 27] Adverse physical, mental, intellectual and developmental effects have been associated with lead exposure,[28] with impacts most commonly reported among children. Domestic exposure to lead is commonly from lead-based paints and drinking water supplied through lead pipes. The effectiveness of interventions to reduce exposure to lead is reported in section 2.

Overall assessment: lead
Exposure to domestic lead is most common through exposure to lead-based paint and lead pipes supplying drinking water. Even small levels of exposure can lead to adverse effects, especially among children.

Dampness and hygrothermal conditions

Dampness and temperature (hygrothermal conditions) are closely linked and can encourage allergen growth and viruses, both harmful to health. The following text presents an overview of the relationship between dampness and hygrothermal conditions which are of particular relevance in the moderate, wet climate of Scotland.

The dewpoint is the temperature at which water vapour in the air will turn into condensation; the higher the temperature the more water vapour can be held in the air before condensing into droplets. As well as climate and temperature, number of bodies, activities such as cooking, laundry, bathing and the use of certain fuels will influence levels of water vapour in indoor air.[29] An optimal level of ventilation will reduce internal water vapour, as well as expel noxious odours and gases. However, if too much indoor air is exchanged for cooler outdoor air, the lost heat increases the likelihood of condensation.[30] Windows are likely to be the first surface on which condensation appears, especially single glazing.

Dampness poses a health risk largely because damp, warm conditions provide an ideal environment for the proliferation of allergens (especially moulds and house dust mites) and viruses. While condensation is an indication of a damp environment and the condensation may damage the window frames, condensation on windows is unlikely to be harmful to health, since glass surfaces cannot support mould growth, and condensation itself is pure water.[30] Condensation on walls is more likely to encourage mould growth than structural dampness as salts that emerge with penetrating or rising damp tend to inhibit moulds.[31]

The relationships described above are complex, making it difficult to isolate effects of the specific hazard of dampness as opposed to other associated hazards of allergens and moulds, and temperature. To enable isolation of the health risks of these specific hazards it would be necessary to account for the many influences on domestic water vapour levels and hygrothermal conditions such as human activity, heating source, weather conditions etc.. In addition, there are also issues around accurate and reliable measures of respiratory illness, allergens[29] and dampness in the domestic setting as well as individual exposure to hygrothermal conditions in the home. For example, time spent in the home varies within and between individuals, and there are also considerable variations in the hygrothermal conditions within a house. Living rooms may be kept warm but have more water vapour due to human activity. In contrast, considerable time is spent sleeping in bedrooms which are often left unheated. Efforts to conserve heat may reduce ventilation leading to trapped water vapour which may cause dampness when the room cools down.

Allergens: House dust mite

The faecal pellets of house dust mites are one of the most common domestic allergens.[29] Increased levels of domestic allergens have also been linked to an increased risk of asthma among children[32] and exposure to domestic allergens has been established as a secondary cause of asthma, triggering attacks among asthmatics.[33 34] However, there is insufficient research evidence to suggest that allergen exposure is a primary cause or major risk factor in the development of asthma.[35] A review of the health impacts of interventions for the reduction in house dust mites is presented in section 2.

Allergens: Mould

Mould is an allergen whose growth is encouraged in warm, damp conditions. Fungal spores released by moulds thrive on the organic material of plaster and wall paper. Once established, moulds spread easily to furnishings and clothing. There are many thousand of different moulds and the ideal growing conditions for moulds vary widely as do the potential for toxic effects. Exposure to some mould spores may lead to toxic effects, infection or allergy and vulnerable groups such as the very young and elderly are at particular risk. Mould allergy is less common than house dust mite allergy.

Associations between mould growth and health status have been frequently reported. There has, however, been debate about the strength of the relationship owing to the many confounders mentioned above, as well as the range of moulds, different hazardous exposure levels, and measurement difficulties.[29] A number of reviews examining the relationship between dampness, mould and health have recently been published. Fisk *et al.* pooled the findings from 33 studies which examined the relationship between dampness and mould across different age groups. While the authors point to some difficulties in measuring damp and mould they conclude that building dampness and mould is associated with approximately 30-50% increase in a variety of respiratory and asthma related health outcomes.[36] A further meta-analysis pooled data from 12 studies from Russia, Europe and North American covering a study population of more than 58,000 children aged 6-12. The meta-analysis adjusted for several key confounders, and the authors conclude that across all the studies and the included countries the presence of mould in the home is consistently associated with adverse respiratory health outcomes in children. Specifically, risk for a night cough was increased by 30% (adjusted Odds Ratio 1.30, 95% Confidence Interval 1.22 to 1.39) and for morning cough by 50% (adjusted Odds Ratio 1.50, 95% Confidence Interval 1.31 to 1.73) for those living in houses with visible mould.[37]

The relationship between damp, mouldy housing and depression has also been investigated using data from eight European cities. Although a link between damp and mouldy housing and depression was reported, this association was not significant when other factors were considered, specifically physical health and levels of perceived control which an individual has over their housing environment.[38]

Overall assessment: dampness and hygrothermal conditions
A damp indoor environment encourages the growth of allergens and microbes, most commonly the faecal pellets of house dust mites, and mould. Living in a damp house with visible mould is linked to an increased risk of respiratory symptoms. Levels of ventilation sufficient for air replacement while also minimizing heat loss are recommended to reduce levels of trapped indoor moisture to prevent proliferation of allergens.

Infestation

There are many sources of domestic pest infestation. The most common sources that pose a health hazard inside the home are lice, bedbugs, fleas, cockroaches, mites (scabies and house dust mites), rats and mice. The health hazard of a pest infestation may arise through it being a direct parasite (e.g. bedbugs feeding on human blood), a disease vector (e.g. the large number of diseases transmitted by rats), a hygiene hazard (e.g. cockroaches and houseflies that carry harmful micro-organisms quickly among food sources) or the source of an allergen (e.g. house dust mite droppings). Control of these hazards is best achieved by prevention and includes careful food and waste storage and good hygiene to reduce the home's attractiveness to pests. In the event of an infestation, a series of remediation measures may be required including chemical treatments.[39] The effectiveness of interventions to reduce house dust mites is discussed in section 2.

Overall assessment: infestation
The most common sources of infestation that pose a health hazard inside the home are lice, bedbugs, fleas, cockroaches, mites, rats and mice. Infestation can be prevented through careful food and waste storage and good hygiene, which reduce the home's attractiveness to pests.

Temperature and warmth

Damp air has a greater cooling effect than dry air and damp cold air and penetrating damp in the structure of a house will contribute to interior cooling. Thermal comfort is determined by a number of environmental, physiological and psychological factors, as well as by personal taste. Personal preferences, habits and financial concerns mean that health problems associated with cold housing may be more strongly linked to fuel efficiency and affordability than to house or heating type.[40] Although minimum and maximum indoor temperatures have been recommended, it is not possible to predict which temperature limits are hazardous to health.[41]

Excess winter deaths have been observed across Europe and are linked to a fall in outdoor temperatures. Those at the extremes of life are particularly vulnerable, i.e. the newborn and the elderly. Influenza epidemics, respiratory illnesses, heart disease and cerebrovascular disease contribute to the seasonal variations in deaths, while deaths from hypothermia account for only a small part of the increase. The harshness of the climate is not a clear independent predictor of excess winter deaths. In Scotland, Portugal and Spain the levels of excess winter deaths are higher than in Scandinavia where winters are more severe.[42 43] Analyses suggest that the variation in excess winter mortality across countries is related to indoor rather than outdoor temperatures.

A recent systematic review examined the relationship between socio-economic status, housing quality and excess winter mortality (EWM) and excess winter hospitalisations (EWH). Very few studies of good quality were identified. In the available data there was no clear link between EWM and EWH and socio-economic status. Possible explanations offered for this were that the range of home heating levels and energy efficiency of houses may be as variable in homes of affluent groups as those less affluent, as well as improved warmth provision in UK social housing in recent decades. Although there was some suggestion that home heating had a protective effect, it was not clear whether housing quality was linked with excess winter deaths.[44] It is worth noting that most available research on EWM is from the UK and the links between socio-economic status and EWM are likely to vary in other countries depending on their own local climate, welfare and housing provision across the social spectrum. Initiatives to reduce the annual increase in winter deaths may need to focus on helping residents protect themselves from cold weather conditions regardless of socio-economic status.[45-47]

High temperatures in heat waves may also cause and contribute to deaths, especially among the elderly in urban areas. In a study of mortality rates during the Chicago heat-waves of 1995 and 1999, it was concluded that working air conditioners were the strongest protective factor against the heat-related deaths.[48] An analysis of mortality in England and Wales associated with the heat wave in 2003[49] found that there was a large short-term increase in mortality, with those aged over 75 years worst affected. Although this study did not attempt to separate out the effects of pollutants and temperature it did indicate that high ozone concentrations are an important co-exposure of heat waves.

Overall assessment: temperature and warmth
The elderly and very young are particularly at risk from both low and high indoor temperatures. Excess winter deaths may be prevented by providing affordable domestic heating. Affordability is an essential component of domestic heating provision and may also affect levels of dampness and allergen growth. In the UK excess winter mortality is not strongly related to socio-economic status.

Overcrowding

Domestic overcrowding has been linked to a number of adverse health outcomes.[50] Among children an independent relationship has been identified between overcrowding and child mortality and tuberculosis risk, as well as a small relationship with respiratory conditions and meningitis. A strong relationship was identified between childhood overcrowding and the prevalence of helicobacter pylori (a risk factor for gastric conditions including stomach cancer) in adulthood. Respiratory conditions in adulthood have been linked to a range of childhood housing factors but the strength and independence of the relationship with overcrowding is unclear largely due to the numerous confounding variables.

There is some limited evidence linking adult overcrowding and adult mortality rates and respiratory diseases, especially tuberculosis, and there is some suggestion that overcrowding may be linked to mental health problems among women. There is also a reported relationship between overcrowding and accidents in the home, however the lack of good quality research in this area makes the strength of the relationship unclear.

Identifying causal links between overcrowding and specific health impacts is very difficult as there are inevitably numerous ongoing factors related to poor housing and overcrowding such as deprivation, damp, mould growth, lack of basic amenities, housing type and tenure which are also determinants of poor health.[50]

Overall assessment: overcrowding
Overcrowded housing conditions have been linked to a number of adverse health outcomes, including overall child and adult mortality and tuberculosis. There is limited evidence linking overcrowding in childhood and the prevalence of infection with helicobacter pylori infection in adulthood. It is also possible that overcrowding is linked to domestic accidents and mental health problems among women. However, establishing an independent effect of overcrowding is very difficult as overcrowding often exists alongside other types of housing problems and socio-economic deprivation.

Noise

There is little strong evidence linking environmental noise in residential areas with subsequent health problems.[11 51 52] It is unlikely that outdoor sources of noise, or noise from neighbours in adjoining or nearby buildings, would be capable of causing physical damage to one's hearing,[11] however stress due to noise annoyance has been proposed as a mechanism through which noise may affect mental and physical health.[53] It is likely that the potential for noise to lead to a stress related health effect will depend on the threshold for noise annoyance within an individual which will inevitably vary.

Community health surveys have found little direct effect of noise on the prevalence of psychiatric disorders.[54-56] A meta-analysis of seven studies examined whether there is a dose-response relationship between noise and myocardial infarction, specifically whether risk increases as noise levels increase. Although the review reported a link between increasing road traffic noise levels and the risk of myocardial infarction among men, the link was only observed for noise levels of above 60dB(A) (equivalent to a noisy street through an open window); it is unlikely that similar noise levels would be experienced for prolonged periods in a domestic setting.[57] More commonly, neighbourhood noise is associated with stress, annoyance and sleep disturbance. The LARES study of eight European cities reported that levels of domestic noise annoyance varied by age with older people reporting less noise annoyance. This may be due to the development of age related deafness.[58]

A maximum noise level of 30 dB(A) has been recommended for bedrooms to prevent sleep disturbance, and of 35 dB(A) for indoor dwellings more generally.[59 60] Ways to reduce noise

include instituting building regulations to ensure soundproofing, and installing acoustic double-glazed windows and mechanical ventilation in homes subject to high outside noise. Disturbance from traffic noise can also be managed at local planning level, while statutory controls and public education may help change the behaviour of noisy neighbours.[11]

Overall assessment: domestic noise
Domestic noise may result in sleep disturbance and related stress due to noise annoyance. The effects of noise may depend on an individual's threshold for noise annoyance; links between domestic noise and subsequent health impacts are not clear.

Light

A possible link exists between inadequate levels of natural light and depression. A study in eight European cities on Housing and Health (LARES)[61] reported a link between satisfaction with levels of natural indoor light and depression. However, this single study is not sufficient to conclude that levels of indoor lighting influence mental health. The LARES survey also reported a link between inadequate indoor light and increased risk of accident and injury.[61]

Overall assessment: light
A potential link between depression and adequacy of interior light has been suggested. Poor lighting may also increase the risk of accident and injury in the home.

Asbestos and manufactured mineral fibres

The main route of exposure to asbestos fibres is through inhalation. The health consequences of exposure to asbestos may not appear for many years after exposure. This latency period may be up to 30 years and include lung cancer, mesothelioma, asbestosis and pleural disorders.[62] In the past, asbestos was used in a number of different products, including insulation, floor tiles and cement, and so may pose a potential hazard during the maintenance and repair of older properties.[62] The commercial use of asbestos peaked in the 1970s; however, in the UK bans on the use of blue and brown fibres have been in place since 1985 and for chrysotile since 1999. Asbestos is therefore unlikely to be used in new housing in the UK. The current advice on asbestos in homes is that it is generally safe if undamaged, it should never be sanded, drilled or sawn and that professional advice should be sought before the removal of asbestos materials. Relevant advice on asbestos is available from local authority web sites.[63]

Overall assessment: asbestos
The inhalation of asbestos fibres can lead to health problems several decades after exposure. Current advice is that asbestos is generally safe if undamaged but that professional advice should be sought before any attempts at removal. UK new build housing should not contain asbestos.

Greenspace

Greenspace is an important part of a residential neighbourhood and can provide direct protection from a number of physical environmental exposures, such as flooding, air pollution, noise and extremes of temperature. The role of greenspace in promoting physical activity will depend on a number of factors, including, the distance of residence from greenspace, ease of access, size and attractiveness. But greenspace may also pose some hazards such as infections from local wildlife and the potential for crime and anti-social behaviour in unsupervised public space.[64]

More detailed information about the health impacts of greenspace are available on the greenspace Scotland website. This includes a Health Impact Assessment guide to the health

impacts of greenspace (http://www.greenspacescotland.org.uk/SharedFiles/Download.aspx?pageid=133&mid=129&fileid=41).

Overall assessment: greenspace
Greenspace is a valuable part of any neighbourhood but while there is a potential for health benefits this may depend on the characteristics and accessibility of the greenspace. Greenspace may also mediate socio-economic health inequalities.

Housing tenure and stability

Home ownership is strongly linked to improved health but this relationship is strongly influenced by the socio-economic status of home owners compared to tenants of social housing. Nevertheless the link between home ownership and health is independent of income. Home ownership may generate a degree of security and control,[65] but home ownership could also be linked to improved housing and neighbourhood quality.[66] A study of older people in Wales reported better health among owner occupiers compared to those in social housing. Once housing difficulties were taken into consideration these differences in health were less clear suggesting that increased housing difficulties in social housing may account for part of the 'tenure' effect on health.[67] However, home ownership may not always promote health; for instance, people living on the margins of home ownership and those at risk of mortgage arrears may suffer increased insecurity and poorer mental health.[68]

Reviews examining the links between housing and health among those with long term illness, mental illness and HIV, have suggested that provision of permanent housing is linked to improved health outcomes. Tenure mix is a policy which is currently being promoted as part of housing led neighbourhood renewal. A review of research on the impacts of these policies is discussed in section 3.

Overall assessment: housing tenure
Financially secure home ownership has been linked to improved health, which may be due to better housing quality and feelings of security.

Housing design

The physical layout and design of a house, including house type are important and has the potential to affect life and health in both positive and negative ways. Housing design may be related to the frequency of injury occurring in the home. A study from Wales examined frequency of emergency department visits for home injury, adjusted for deprivation and distance to hospital, and found that risk of injury was substantially elevated for residents of purpose-built apartments.[69] Poorly designed kitchens with insufficient workspace have also been linked with an increased risk of accident and injury.[61]

Flat dwelling, in particular high-rise flats, has been linked to factors associated with stressful living conditions such as increased social isolation, crime, reduced privacy and opportunities for safe-play for children.[70] Potential advantages of high-rise flats in urban areas could include reduced commuting times and sufficient population density to support local amenities and transport links.[71 72] A review of epidemiological surveys reported that poorer mental health was associated with housing height and multi-unit dwelling; however, it is unclear how these studies were selected for review and the authors point out that they are unable to draw conclusions of a causal link due to the poor quality of research in this area.[73] Some recent studies have viewed high rise living in more sympathetic light. A study looking at families living in flats in Singapore concluded that the direct health effects of flat living on families were minimal.[71] It has been suggested that high-rise housing may be the site for but not the source or cause of social

problems. There are many factors related to flat dwelling such as neighbourhood and individual socio-economic deprivation, and overcrowding. These factors are likely to confound findings of surveys and there are insufficient data to conclude that height of home from ground level is associated with reduced health or satisfaction with housing.[74-76]

Specially designed houses are required for those with impaired physical mobility. Some residents with particular medical needs may be re-housed when their mobility levels limit their use of their house. Improvements in self-reported physical and mental health have been reported following such 'medical priority rehousing'.[77-81] However, there is no research available which has assessed the health effects of changes in housing design that are not specifically aimed at those with identified medical needs.

Overall assessment: housing design
Housing design features may affect mental health, accessibility and risk of domestic injury. Inevitably features of housing design are often strongly associated with other factors such as socio-economic deprivation and overcrowding and it is not clear if housing design has an independent effect on health.

Housing satisfaction

Overall satisfaction with neighbourhood has also been linked to health. Although not an explicit health or illness indicator, neighbourhood satisfaction has been used as a proxy for life satisfaction[82] and general affect influencing mental health.[83] Neighbourhood satisfaction is most strongly influenced by satisfaction with housing and private space[82-86] although it is unclear how neighbourhood satisfaction influences housing satisfaction.[86] There are also unanswered questions as to how specific area characteristics, especially amenities, influence overall neighbourhood satisfaction.[86] Poor quality housing, flatted housing and overcrowded housing have been associated with low levels of mental health and emotional wellbeing particularly amongst women and children.[70 87-93]

Overall assessment: housing satisfaction
Housing satisfaction may be linked to life satisfaction and mental health. Increased housing satisfaction following housing improvement is strongly linked to improvements in mental health.

Overall conclusions: associations between housing and health
A number of housing factors are linked to health; however, it is difficult to clearly separate the relationship between housing and health from individual, local and societal factors. Various elements of housing conditions overlap with each other and wider socio-economic factors to influence health. The following section will review the impact of housing interventions on the health of recipients.

STUDIES OF HOUSING IMPROVEMENT AND HEALTH

While the links between poor housing conditions and health suggest the potential for housing improvement to lead to health improvement, this cannot always be assumed. Evaluation studies of health impacts among residents who have benefited from improved housing are needed to confirm hypotheses about housing improvement and health.

The following section presents an evidence synthesis of what is known about the health impacts following housing improvements and interventions to reduce domestic hazards. The evidence summaries presented below have been prepared following an assessment of the quality of the evidence and risk of bias to prioritise best available evidence. The first two parts of this section draw on a systematic review of housing improvements that substantially alter the fabric of the house with the aim of improving indoor living conditions.[94 95 96] These include warmth and energy efficiency improvements and refurbishment or retrofitting. Table 1 in Appendix 2 provides a list of included studies together with an indicator of study design and quality as well as main health findings. The better quality studies had minimal or some potential for bias (Grade A and B respectively) and only these studies were included in the synthesis of effectiveness. There is an indication in the text when a poorer quality study (Grade C: judged to have considerable potential bias) is discussed. Table 2 in Appendix 2 provides details of the specific health outcome assessed and odds ratios where it was possible to calculate a standardised effect size. The final section provides an overview of evidence on the health impact of interventions to reduce exposure to a number of specific domestic hazards and less substantial housing improvements such as equipment, furniture and behavioural measures to reduce accidents, fires, exposure to allergens etc. These draw on the best available evidence identified in other literature reviews and where available Cochrane Collaboration reviews.

Housing interventions which may impact health
• Interventions to improve warmth and energy efficiency • Rehousing/retrofitting +/-neighbourhood renewal • Interventions to reduce exposure to house dust mite • Interventions to reduce injury due to falls, fires and poisoning • Interventions to reduce exposure to lead • Interventions to reduce exposure to radon • Interventions to adapt housing or rehouse residents to meet medical or mobility needs

Health impacts of warmth and energy efficiency improvements (post 1985)

Evidence on the health impacts of warmth and energy efficiency improvements was reviewed in a systematic review of housing improvement published in 2009.[96,f] This review identified nineteen studies which had assessed health impacts following warmth and/or energy efficiency improvements.[97-115] The type of interventions varied but included at least one of the following; insulation (roof and/or cavity wall), installation/upgrade of central heating system, replacement of an unflued with an improved flued (vented) combustion heat source. Some programmes included additional energy efficiency measures, e.g. light bulbs, domestic repairs and welfare advice. In many cases the nature and extent of housing improvement was tailored according to individual need, leading to considerable variation in the intervention delivered within a single study. For example, within the same programme the energy efficiency measures varied, ranging from minor heating repairs to installation of central heating and insulation measures.

[f] For full details of this review please see Thomson H, Thomas S, Sellstrom E, Petticrew M. The Health Impacts of Housing Improvement: A Systematic Review of Intervention Studies From 1887 to 2007. *Am J Public Health* 2009;99(**S3**):S681-692.

All the studies summarised below were set in developed countries and implemented since 1985. Most of the interventions were set in deprived areas, and some of the interventions were targeted at vulnerable groups such as children,[102 105 107 111] the elderly,[98 109 113] or people with cardiac or respiratory conditions.[97-99 102 106 107]

General health outcomes
Nine studies assessed general health outcomes after the installation of warmth and energy efficiency measures.[99 101 104 106 107 109 112 113 115] Two studies from New Zealand[106 107] one from the UK[109] and one German study[115] were well conducted. These studies found statistically significant improvements in general health outcomes in the intervention group compared to the control group following the installation of warmth and energy efficiency measures. Changes in general health outcomes in the less rigorous studies were unclear.[99 101 112 113]

Respiratory health
Eleven studies presented results on the impact of warmth and energy efficiency improvements on respiratory health.[100-102 106-112 115] Two studies from New Zealand[106 107] found that respiratory health improved when comparing the intervention with the control group. The remaining studies from European counties found a mix of positive, unclear or conflicting respiratory impacts regardless of study quality.[100-102 108-112 115]

Mental health
The impact of warmth and energy efficiency improvements on mental health was reported by seven studies.[98 99 105 106 110 112 115] All but one of these studies[105] reported a positive impact on mental health.

Other illness and symptoms
Ten studies presented results on the impact of warmth and energy efficiency improvements on other illnesses and symptoms. The overall impact was unclear due to conflicting findings across countries.

Socio-economic effects
Six studies reported data on fuel expenditure. Three studies[103 110 114] reported a reduction in fuel expenditure following the intervention but three did not.[101 112 104] In one case the authors suggest that the intervention group may have been taking fuel efficiency gains as greater warmth than reduced bills.[104] There is some indication that improvements in warmth and energy efficiency resulted in the increased use of the home for studying and leisure, inviting friends into the home, increased privacy and improved relationships between household members.[100 101 116 117]

Overall assessment: health impacts of warmth and energy efficiency improvements
Improvements in provision of affordable warmth can lead to health improvement in the short term, in particular respiratory and mental health. The greatest potential for health improvements is for those with existing respiratory illness who are living in houses that are difficult and costly to heat. Health improvements were more consistently reported in the New Zealand studies than in the UK studies. This may reflect differences in housing conditions at baseline, with greater potential to improve warmth in New Zealand housing. There is very little evidence to suggest that warmth improvements have adverse health impacts.

Health impacts of rehousing/retrofitting +/neighbourhood renewal (post 1995)

The systematic review of housing improvement identified ten studies which investigated the health impacts of rehousing or retrofitting.[76 118-126] These evaluated programmes of residential neighbourhood investment in which the major structural change was demolition and new build

housing or housing retrofitting, but in which other neighbourhood changes are implemented; relocation to a new neighbourhood was not part of this intervention. While it is likely that warmth improvement measures were part of the intervention in each study, only four studies specifically reported that the intervention included upgrading or installation of heating and energy efficiency measures.[120 121 123 124] Programmes of housing and neighbourhood improvement are delivered to whole neighbourhoods, and it is likely that the extent of improvement in housing conditions varied considerably between individual households within the same study sample. Nine studies assessed changes in housing conditions; six studies reported improved conditions, while three studies reported no change.[122-124] Each of these studies was set in socio-economically deprived UK neighbourhoods and included adults. Only one study reported impacts for children as well as adults.[124]

General health outcomes

Six studies presented findings on the impact of rehousing or retrofitting on general health.[118-120 122-124] The better quality studies either reported small improvements which were not statistically significant[118 119 122] or were not accompanied by supporting data or statistics.[120 123] One study (Grade C) reported a statistically significant increase in self-reported poor health (+12.3%) among adults but not children.[124]

Respiratory health

Three studies presented results on the impact of rehousing or retrofitting on respiratory health; however, there was little clear evidence of improvements in respiratory health.[118 124 125]

Mental health

Changes in mental health were assessed by nine studies.[76 118-125] In the three better quality studies[118-120] there was no clear impact on the measures of mental health. The less rigorous studies found that statistically significant improvements were reported across a range of mental health measures.[76 121-125]

Other illness and symptoms

Three studies considered the impact of rehousing/ retrofitting on a range of other illness and symptoms,[118 122 123] a mix of positive and negative impacts was reported and there was no clear overall indication of benefit or harm.

Overall assessment: health impacts of housing-led neighbourhood renewal
Despite programmes of housing-led renewal delivering major improvements to housing and the outdoor housing environment, it would appear that there is little evidence of associated improvements in health. There is some suggestion from poorer quality studies that mental health may improve. Little is known about possible impacts on respiratory health or other specific symptoms. It is important to emphasise that there is very little evidence from these studies indicating any adverse effects of neighbourhood renewal. There are many possible explanations for why the reported impacts of large scale investment are often small. This may be in part due to the nature of area based interventions where whole areas are targeted and the potential for individual health improvement will inevitably vary within the samples.

Health impacts of interventions to reduce exposure to house dust mite

The house dust mite is the major allergen to which asthmatics are most sensitive. A systematic review of the effectiveness of house dust mite control measures[127] concluded vacuuming and acaricidal chemical measures seem to be ineffective in the management of asthma. A further recent review[128] identified four US studies[129-132] which found little evidence that multi-faceted interventions, such as the provision of allergen reduction and avoidance measures as well as

education and home visits, led to significant improvements in key asthma measures or exposure to house dust mite. A systematic review on the effect of air filters on asthma found that the use of air filtration systems was not associated with any differences in medication use or symptom/medication scores, but was associated with significantly fewer symptoms.[133] These findings are supported by a recent study of home ventilation systems which found their use did not reduce mite allergen levels but did improve evening peak expiratory flow (PEF), although morning (PEF) remained unchanged.[134]

Health impact of humidity control equipment

Humidity control has been advocated for asthmatics to control the levels of moisture in indoor air, in particular to create an ambient environment which is less likely to allow house dust mites to proliferate. A number of studies have evaluated the use of Mechanical Ventilation Heat Recovery (MVHR) equipment. A systematic review of humidity control for asthma identified one completed experimental study of MVHR in a sample of people with asthma. Despite a fall in the levels of house dust mite and related allergens, there was no change in asthma symptoms.[135]

Overall assessment: health impacts of control of house dust mite and humidity
House dust mites are one of the most common domestic allergens. Although the health effects of house dust mites are poorly defined, limiting exposure to and proliferation of these allergens is recommended. Current measures to reduce house dust mites are not effective in the management of asthma. Equipment (MVHR) to control ambient humidity may lead to reductions in house dust mite and allergens but benefits in relation to asthma symptoms are not clear.

Health impact of interventions to reduce injury due to falls, fires and poisoning

The home is an important location for unintentional injury and death, most commonly resulting from falls, poisoning and fires. Children and the elderly are most particularly at risk. One way in which to avoid home injury is through the promotion of safety awareness.[136] A systematic review of targeted programmes for the free distribution of safety devices along with education and home visits found these led to an increase in the use of safety equipment and implementation of safety practices in the home but the subsequent impact on domestic injury is unknown.[137] A review of US interventions also found that safety devices which are affordable and easy to use may be more likely to be used and therefore increase effectiveness.[138]

Two studies of smoke alarms also found that homes with working smoke alarms reduced the risk of injury and death from residential fires.[139] [140] However, promotion programmes, including mass media, education and free smoke alarm give-aways, have not been shown to be an effective way to increase ownership and correct use or maintenance of a smoke alarm or to reduce fire or fire-related injury.[141] Proper installation and maintenance are essential if the potential prevention of fire-related injury is to be achieved.[142] Photoelectric smoke alarms using lithium batteries are the most likely to be functioning 42 months after installation.[143]

A systematic review of interventions to prevent falls among the elderly living in the community found that effectiveness varied depending on the components of the intervention and may vary considerably between individuals.[144] [145] Interventions considered included; exercise, balance training and tailored interventions for those on sedative/hypnotic drugs or suffering from postural hypotension. There is a lack of evidence showing whether environmental modifications to the home, i.e. removing clutter and electrical cords, securing rugs, reduce injury but they are thought likely to reduce falls in the elderly.[144] [146] There is some preliminary evidence suggesting that community based initiatives aimed at preventing falls and fall-related injury among the elderly may be effective.[147]

Overall assessment: health impacts of measures to reduce unintentional injuries at home, including prevention of falls and fires
Poisoning, falls and fires in the home are preventable causes of death and injury. Effective prevention measures include individually tailored safety devices. Exercise, balance training and hazard removal can help to prevent falls among elderly people at risk. Accompanying educational outreach and home visits are essential if prevention programmes are to result in injury reduction. Smoke alarms need to be properly installed and maintained in order to prevent fire-related injury and death.

Health impacts of interventions to reduce exposure to lead

Widespread public awareness, government and private action to reduce childhood exposure to lead has led to sharp declines in blood lead concentrations in children.[148] There is increasing evidence of the growing breadth of effective prevention and treatment.[149] However, a recent systematic review of interventions for the prevention of lead exposure in children concluded that there is currently no evidence of effectiveness of household interventions for education (addressing parental awareness of lead exposure pathways, hygiene, and household dust control measures to prevent ingestion of dust and soil) and there is insufficient evidence for environmental measures such as soil abatement in reducing blood lead concentrations in children as a population health measure.[150]

Overall assessment: health impacts of lead control measures
Lead exposure in children leads to physical, mental and intellectual problems. Lead exposure among children may stem from lead-based paint, which is found mainly in older, poorer housing. Numerous effects to control childhood exposure have been successful in reducing blood lead concentrations and adverse health effects of lead hazards. However there is no evidence that current educational interventions to reduce lead exposure among children are effective.

Health impacts of interventions to reduce exposure to radon

Radon can be transported into a home from the underlying ground through structural defects in the basement including; cracks in solid floors and walls; gaps and cracks in suspended concrete and timber as well as around pipes and construction joints.[20] In the UK policies have been in place for radon prevention since 1987. These policies are triggered by a threshold or Action Level of radon concentrations above 200 Bq/m³. In areas with high radon concentrations this means that new homes must have basic radon prevention measures such as a sealed membrane at ground level. For existing homes the policy is for the identification of homes with radon levels above the Action Level and appropriate remediation measures. A cost effectiveness analysis of these policies in terms of cost per quality adjusted life year gained found that current policies to prevent radon in new homes are highly cost effective, and that programmes for the measurement and remediation of radon in existing homes are not cost effective at present.[23] However, a recent report by an independent advisory body for the Health Protection Agency found that the majority of radon deaths in the UK are a result of exposure at concentrations well below 200 Bq/m³, the current Action Level. They report authors recommended a more population based approach to reducing the collective dose response to radon, that is a lowering of the Action Level threshold and the extension of basic radon prevention measures to more new homes.[21]

Overall assessment : health impacts of radon control measures
Current policies to prevent radon in new homes in selected areas are highly cost effective and would remain cost effective if extended to the whole of the UK. However, identifying and remediating existing homes with high radon levels is neither cost effective

nor effective in reducing lung cancer deaths. A extension of radon prevention measures has been recommended to reduce the current number of radon related deaths still reported in the UK every year.

Health impacts of interventions to adapt housing or re-house residents to meet medical or mobility needs

There is a growing literature assessing the impact of housing adaptations to help those with a specific medical or mobility need. However, a detailed synthesis of this literature is beyond the scope of this guide. A UK review and a Japanese study found that residents reported a reduced need for personal care following adaptations to their homes.[151 152]

Social housing tenants in the UK can apply for medical rehousing on a number of grounds including mobility problems, dampness and mould as well as health problems linked to neighbours and the quality of the local neighbourhood.[81] In most studies, rehoused residents report improvements in both physical and mental health.[77 80 81 153 154]

Overall assessment: health impact of housing adaptations to meet medical or mobility needs

Housing adaptations to promote independent living and rehousing to meet medical or mobility needs can have health benefits for residents.

Housing interventions for vulnerable groups such as homeless, mentally ill and people with learning difficulties

A search for relevant reviews for interventions related to homelessness and supported living found limited evidence on which to base any conclusions. Two reviews of interventions for homeless people focused on increasing engagement with health services; no review examined the health impacts of improved housing conditions for homeless people.[155 156] Three further reviews related to housing or independent living were identified which focused on young people leaving care,[157] people with HIV,[158] and people with severe mental illness.[159] A common theme in the reviews, which identified suitable studies examining the relationship between housing and health for vulnerable groups, was the importance of stability and availability of permanent housing for those with unpredictable health conditions.[158 159] Frequently the reviews found very few good quality studies limiting what is known on this topic.

Overall conclusions: health impacts of housing improvements

Both the quantity and the quality of research evidence on the health impacts of housing improvements have grown in recent years, in particular for warmth and energy efficiency improvements. Investment in affordable warmth measures that are targeted at those in poor housing, and with pre-existing illness can lead to health improvements, in particular respiratory improvements. Health improvements following area-based programmes of housing-led neighbourhood renewal are less clear. There is little suggestion that housing improvement leads to negative health impacts.

Interventions most likely to lead to measurable health improvements are those that target groups in most need where the potential to benefit is greatest, i.e. residents in the poorest housing who are also most vulnerable to the detrimental health effects of poor housing. Programmes delivering warmth and energy efficiency improvements are more likely to target individual households and tailor the improvement according to individual need. This contrasts with programmes of housing-led renewal which are rolled out across whole areas or neighbourhoods and are less discriminating about the varying

needs of individual households within a geographical area.

A range of other measures are available to limit exposure to domestic hazards such as house dust mite, lead, radon, and to prevent fires and unintentional injury in the home. Some of these measures are instituted into UK law to limit domestic exposure, e.g. lead and radon; these measures are considered to be successful in preventing much harmful exposure and actual harms. Housing adaptation to meet medical and mobility needs and some measures to prevent unintentional injury can have health benefits and prevent injury but educational programmes and distribution of free equipment cannot be assumed to be beneficial. Measures to reduce exposure to house dust mite allergen do not appear to have health benefits among asthmatics.

OTHER IMPORTANT EFFECTS REPORTED IN STUDIES OF HOUSING IMPROVEMENT AND ASSOCIATED AREA REGENERATION

Programmes of investment to improve housing improvement rarely occur in isolation. Especially in programmes of housing-led neighbourhood regeneration there are often other changes and initiatives which are delivered as part of the housing improvement. These simultaneous changes may be intentional or not and may also affect health. It is important that these other changes are taken into consideration when assessing the health impacts of housing improvement as the health impacts of an overall housing programme may be determined by changes other than the housing improvement. It is essential to try to identify possible interactions among such changes in the socio-economic context in order to explain both the negative and positive health consequences of housing improvements. The issues covered in this section are listed below.

Additional effects of housing improvement and associated area regeneration

- Increased rents
- Effects on the social context and local area
- Relocation to a new area and the process of moving
- Population displacement
- Social exclusion and community division
- Tenure mix
- Housing design
- Gentrification
- School and work absences

Increased rents

Housing improvement may be accompanied by rent increases that can add to the financial strain on the householder. For example, an increase in mortality rates following rehousing from slum Newcastle slums to modern housing were attributed to a doubling of rents, which in turn affected the householders' ability to provide themselves with an adequate diet.[160] It should be noted that this is an example from the 1930s and with comprehensive welfare provision it is unlikely that such dramatic rises in rent would be passed on to tenants these days. Nevertheless, it is common for rents to increase as a result of rehousing or refurbishment. Ambrose reported that in the 1990s in Stepney, London rent increased by around 15% following housing improvements. The increased rents necessitated economising on food purchases and resulted in a welfare benefit trap and a barrier to employment opportunities, since the higher wages needed to meet the increased rent resulted in withdrawal of welfare benefits and a subsequent reduction in household income.[125]

Overall assessment: change in rent and related health impacts

Housing improvement is often accompanied by increased rents which may require economising in other areas of the household budget such as food and fuel bills. This

may in turn have negative health impacts. The impact of increased rents will depend on the size of increase and also to what extent the increases will be absorbed by welfare for low income residents.

Effects on the social context and local area

Housing improvement may lead to other changes in the local area. These changes will vary considerably from area to area and may be both positive and negative. Some changes which have been reported include: a reduced sense of isolation, reduced fear of crime, increased sense of belonging and feelings of safety, increased involvement in community affairs, greater recognition of neighbours and improved view of the area as a place to live.[76 125 161 162]

In a recent programme of housing led neighbourhood renewal across Scotland, positive effects reported included; a growing sense of community and attachment to the neighbourhood, reports of looking out for neighbours; keeping the area well maintained; and increased pride and feelings of safety.[163] A less positive impression of is given by a study which used in-depth interviews to assess the influence of regeneration in a part of Manchester.[164] This study found that attitudes towards the actual improvements were ambivalent, although there was a positive reaction to proposed improved transport links. The study used the narrative accounts to explore the effect of neighbourhood environment on mental health. Although it was felt that the standing of the area had improved residents felt that the area was viewed negatively by outsiders. The agencies responsible for improvement were also viewed as ineffectual. Anti-social behaviour was linked with feelings of entrapment, lack of social control and fear leading to reduced opportunities for personal involvement and movement. This study recommends that agencies involved in urban development promote security, increased leisure opportunities and improve the image of the locality in addition to structural changes.

Changes to the local physical area and also to less tangible aspects of the social environment and area reputation are important and may affect residents' satisfaction with their house and neighbourhood. It is not known if improvements in such measures translate into health improvements.

Overall assessment: changes to the social context and local area and related health impacts
Housing improvement can have a positive impact on residents' perception of their local area, in particular area based programmes that involve changes to the wider neighbourhood. It is not known to what extent neighbourhood changes are linked to health impacts.

The process of moving and relocation to a new area

Although moving to an improved house may be a positive experience in the long term, the process of moving house may be a stressful, health damaging life event,[120 165 166] this may be exacerbated by a lack of opportunity to negotiate with the housing authority regarding the move.[167]

Housing relocation has also been associated with loss of community, uprooting social networks[168] and unsatisfied social aspirations.[169] Consultation with residents about the proposed housing and neighbourhood changes is an important consideration and may help both to avoid changes unacceptable to the local neighbourhood as well as increasing feelings of control over one's living environment. However, consultation alone is not sufficient and genuine consideration of residents' needs is essential for the consultation to be beneficial.

The socio-economic characteristics of a neighbourhood may have an effect on an individual's health status,[170] and it is possible that relocation to a different neighbourhood could have a health effect independent of the housing improvement. In the US residents who relocated from deprived areas to improved housing in middle-income areas reported sustained increases in employment opportunities, improved educational possibilities and better social integration.[171 172] While improvements in socio-economic indicators is welcome the nature and size of a neighbourhood health effect is small and not well understood.[170 173]

Overall assessment: the process of moving and relocation to a new area and related health impacts
Moving house can be stressful and may also involve relocating to another area which may mean uprooting social networks. While the stress of moving may be short term other changes may have more lasting impacts. The importance of the neighbourhood environment on health is not well understood and likely to be small.

Population displacement

Some area and housing regeneration projects can lead to displacement of original residents.[174] So while there may be an improvement in health outcomes in the regenerated area this may not relate to changes for those who originally lived in the area. This underlines the need for evaluations to report outcomes or impacts at an individual level to be clear who it is that is benefiting from the investment as opposed to focusing simply on the area being regenerated. It is important to identify the potential and reasons for displacement of current residents in advance of neighbourhood change. If health impacts of housing improvement are to be predicted it must be clear who the recipients of the improved housing will be and where existing residents will be relocated.

Overall assessment: population displacement and related health impacts
Housing regeneration can lead to the displacement of original residents. Where there is displacement improved health outcomes for an area may not reflect improvements for the original population.

Social exclusion and community division

Programmes of regeneration have the potential to increase exclusion and division within neighbourhoods where it is clear that some populations or areas benefit more than others from the investment.[166] For those living on the margins of a regenerated area, feelings of exclusion may exacerbate levels of stress and depression,[125 166] although direct links between feelings of exclusion to health impacts are not clear.

Overall assessment: social exclusion, community division and related health impacts
Housing improvement can lead to feeling of exclusion and resentment amongst those not in receipt of intervention; related health impacts are not clear.

Tenure mix

The promotion of mixed tenure is frequently a key component of neighbourhood regeneration strategy and is a key component of UK housing and urban policy. Mixed tenure neighbourhoods typically aim to achieve a seamless mix of social rented, privately rented and owner occupied housing with no clear demarcation across the different tenures. The level of mix achieved varies, with some areas mixing at household level and others mixing at a higher level, for example street level, neighbourhood level, or small areas within neighbourhoods. The visibility of the mix also varies. The potential benefits of mixed tenure neighbourhoods are thought to include: better

neighbourhood reputation, better facilities and services, increased social cohesion and community participation, role models for work and education, job opportunities and residential sustainability. The potential for mixed tenure to have an impact on the wider social environment and individual residents will clearly vary widely and depend largely on the extent and nature of tenure mix in the neighbourhood.

A systematic review of the impacts of mixed tenure strategies did not identify much empirical support for the predicted benefits of mixed tenure.[175] The review found conflicting evidence that mixed tenure achieves most of the claims listed above and the reported benefits may be a by-product of mixed tenure, such as the provision of better quality housing and physical environment, rather than a direct result of tenure mixing. Bond *et al.* suggest that the push to mixed tenure is not supported empirically although they emphasise that current findings are based on limited evidence.

Overall assessment: tenure mix and related health impacts
Mixed tenure is currently a high profile housing policy and increasingly a key component of neighbourhood renewal programmes. There is very little research evidence confirming the predicted benefits of mixed tenure, and the health and socio-economic impacts remain largely unknown. The potential for impacts will depend heavily on the nature of tenure mix, e.g. level and visibility of mixing in the neighbourhood.

Housing size and design

There is very little research which has investigated the impacts of changes in house type or design yet this may be a significant part of a housing improvement programme. Gibson *et al* asked residents about changes and impacts following a move into new build social housing. Most moved from a flat to a house with a private garden. Residents reported benefits of having a private garden and their own front and back door rather than communal entrances saying that they were less exposed to anti-social behaviour and had more control over their immediate environment. Some residents had moved into smaller housing and others into larger housing, and some moved to housing more suitable for those with restricted mobility; residents reported the benefits of having a house which is appropriate to their needs and stage in life. Some residents reported these changes to be linked to improvements in wellbeing.[176] Additionally some of the studies of improved warmth report that householders benefited from increased usable space due to being able to heat the whole house. Qualitative findings from these studies and a further study from New Zealand which involved housing extensions to alleviate overcrowding indicate that the benefits of increased usable space include improved relationships among household members, increased privacy, increased ability to study and to complete homework, and increased pride in the house as it is easier to keep tidy.[177 116 117 178 101]

Overall assessment: housing size and design
Housing improvement programmes may result in a change in house type and size. Provision of private entrances and a private garden may improve residents' feelings of control over their immediate environment and reduce exposure to anti-social behaviour. Size of house needs to be appropriate to the needs of the household. Increasing usable space among families may generate improvements in household relations as well as providing opportunities for members to study.

Gentrification

Neighbourhoods undergoing regeneration may also undergo gentrification, in which traditionally working-class areas are transformed into middle class areas.[179] A systematic review of the benefits and harms associated with this process reported a range of conflicting findings that involved changes in housing demand, housing prices, social mix, crime, occupancy rates,

private and local investment, and the population of other areas,[180] though the subsequent impacts on health are unclear.

Overall assessment: gentrification and related health impacts
A by-product of regeneration may be that traditionally working-class areas are transformed into middle class areas leading to the displacement of the original target population. Health related impacts of gentrification are not known.

School and work absences

Reductions in absences from both school and work have been reported following housing improvements. A large experimental study from New Zealand also found that absences from both school (Odds Ratio 0.47, 95% CI 0.27 to 0.81) and work (Odds Ratio 0.62, 95% CI 0.4 to 0.97) absences were significantly reduced following the installation of insulation in homes of people with a pre-existing respiratory condition such as asthma.[106]

Two further smaller studies from the south west of England reported on the effect of warmth and energy efficiency interventions on school absences amongst children with asthma. In one study absences from school due to asthma, but not for other causes were significantly less after the housing improvement. [111] There was no effect on school attendance in the second study. [100]

Overall assessment: school and work absences and related health impacts
The introduction of measures to improve warmth and energy efficiency may reduce school and work absences amongst those experiencing respiratory symptoms, especially asthma.

Overall summary: additional effects of housing improvement and associated area regeneration and related health impacts
Housing improvements may have wider social impacts which may be positive or negative. Many of these wider impacts are related to area improvements and regeneration often associated with large-scale housing improvement. It is difficult to attribute impacts to specific changes in housing or to wider area changes. However, it is important to investigate these secondary impacts in order to identify ways in which the health impacts of the housing improvement may be maximised. Issues of relocation and displacement should be clear before a health impact assessment is conducted so as to determine which residents will benefit from improved housing or area improvements. If residents are to be relocated to a new area an assessment of the change in their economic and educational opportunities should be made. Positive impacts of housing and area improvement reported include improved reports of safety, community involvement, area satisfaction, and changes in house type and size. Negative impacts reported include increased housing costs, displacement of original residents, social exclusion and community division for those in neighbouring areas not benefiting from the improvements, disruption, uncertainty and lack of control around the move. Only some of these impacts have been linked to subsequent health impacts, the most notable being the result of substantial increases housing costs following housing improvement.

Summary of conclusions

Overall conclusions: associations between housing and health
A number of housing factors are linked to health; however, it is difficult to clearly separate the relationship between housing and health from individual, local and societal factors. Various elements of housing conditions overlap with each other and wider socio-economic factors to influence health.

Overall conclusions: health impacts of housing improvements
Both the quantity and the quality of research evidence on the health impacts of housing improvements have grown in recent years, in particular for warmth and energy efficiency improvements. Investment in affordable warmth measures that are targeted at those in poor housing, and with pre-existing illness can lead to health improvements, in particular respiratory improvements. Health improvements following area-based programmes of housing-led neighbourhood renewal are less clear. There is little suggestion that housing improvement leads to negative health impacts. Interventions most likely to lead to measurable health improvements are those that target groups in most need where the potential to benefit is greatest, i.e. residents in the poorest housing who are also most vulnerable to the detrimental health effects of poor housing. Programmes delivering warmth and energy efficiency improvements are more likely to target individual households and tailor the improvement according to individual need. This contrasts with programmes of housing-led renewal which are rolled out across whole areas or neighbourhoods and are less discriminating about the varying needs of individual households within a geographical area. A range of other measures are available to limit exposure to domestic hazards such as house dust mite, lead, radon, and to prevent fires and unintentional injury in the home. Some of these measures are instituted into UK law to limit domestic exposure, e.g. lead and radon; these measures are considered to be successful in preventing much harmful exposure and actual harms. Housing adaptation to meet medical and mobility needs and some measures to prevent unintentional injury can have health benefits and prevent injury but educational programmes and distribution of free equipment cannot be assumed to be beneficial. Measures to reduce exposure to house dust mite allergen do not appear to have health benefits among asthmatics.

Overall conclusions: additional effects of housing improvement and associated area regeneration and related health impacts
Housing improvements may have wider social impacts which may be positive or negative. Many of these wider impacts are related to area improvements and regeneration often associated with large-scale housing improvement. It is difficult to attribute impacts to specific changes in housing or to wider area changes. However, it is important to investigate these secondary impacts in order to identify ways in which the health impacts of the housing improvement may be maximised. Issues of relocation and displacement should be clear before a health impact assessment is conducted so as to determine which residents will benefit from improved housing or area improvements. If residents are to be relocated to a new area an assessment of the change in their economic and educational opportunities should be made. Positive impacts of housing and area improvement reported include improved reports of safety, community involvement, area satisfaction, and changes in house type and size. Negative impacts reported include increased housing costs, displacement of original

residents, social exclusion and community division for those in neighbouring areas not benefiting from the improvements, disruption, uncertainty and lack of control around the move. Only some of these impacts have been linked to subsequent health impacts, the most notable being the result of substantial increases housing costs following housing improvement.

CHAPTER 3: APPLYING THE EVIDENCE IN HEALTH IMPACT ASSESSMENT

Margaret Douglas, Martin Higgins, Susie Palmer and Hilary Thomson

DOING A HEALTH IMPACT ASSESMENT

A health impact assessment of a housing proposal should identify:

- The populations who will be affected by the proposal
- The positive and negative health impacts that they will bear
- Recommendations to improve positive and mitigate negative impacts

The steps involved in doing a HIA are well established and can be summarised as follows.

Step 1	Screening	Decide whether doing an HIA is appropriate
Step 2	Scoping	Set the geographical, population and time boundaries; identify affected population groups and areas of health impact to assess.
Step 3	Set up the HIA team	Ensure appropriate expertise is included. Including people with knowledge of the proposal, housing policy, the local area and health.
Step 4	Assess impacts	Collate evidence from range of sources to assess the likelihood and severity of the health impacts identified during scoping. The types of evidence are likely to include: • A profile of the local population and features of the area(s). This should help identify the most vulnerable populations. • Views of local people and other stakeholders • Research evidence, such as presented in Chapter 2.
Step 5	Make recommendations	Use findings to recommend changes to the proposal or other changes that would improve health impacts, especially for the most vulnerable populations.
Step 6	Monitor impacts	Monitor actual impacts that arise after implementation of the proposal.

Full guidance on each of these stages is available on the Scottish Health Impact Assessment Network website at: http://www.healthscotland.com/documents/3551.aspx

KEY QUESTIONS

The following are some key questions based on the research literature in Chapter 2. These may be used in a health impact assessment, particularly at the scoping stage, to identify the potential areas of health impact to assess.

Populations
Which populations will be affected by the proposal?
Consider existing residents, new residents, people living nearby, workers etc.

Are there vulnerable groups (for example, elderly, asthmatic people, children) who may be most affected?

Housing improvement
What are the specific housing changes/improvements that are proposed?
Detail the changes to housing conditions that are planned -- for example improved warmth, new kitchens, more space etc?

What are the current housing conditions (before the planned improvements)?
Is the current housing condition and housing satisfaction poor to the extent that the planned housing improvements can be expected to make a tangible difference to living conditions?

How much variation in changes to housing conditions is there likely to be?
If this is a programme that is being delivered to an area -- will everyone in the area receive the housing improvement?

Will there be changes in the outdoor environment?
Consider:

- The immediate environment around the house and any changes to housing design such as communal entrances or private gardens?
- The wider neighbourhood environment -- changes in facilities such as leisure, shops, transport, health services

Are there other housing or neighbourhood changes not detailed in the proposals that may occur?

Health impacts
What is the evidence that the housing improvements and associated changes outlined above will affect health?
Specify what type of health impacts might be expected based on the evidence synthesis, for example improvement in child asthma, improved mental health

When can health impacts be realistically expected?
How big or small will the predicted health impact be?
Will the health impact be too marginal to detect? (consider the size of the population receiving the housing improvement)

Household costs
Will there be any changes in housing costs?
Is there any other change that may affect living costs -- transport, food, access to amenities?

Consultation
Was there consultation about the housing improvements?
Were the residents' concerns incorporated into the planned housing improvements?

Displacement
What levels of displacement can be predicted over the period of improvement?
What explanations might there be for displacement?

CASE STUDIES

The following are brief summaries of some HIAs of housing-related proposals that have been done in Scotland. Further examples are available on the HIA Gateway at: http://www.apho.org.uk/default.aspx?QN=P_HIA

HIA of the master plan for Pennywell in Edinburgh

The proposal that was assessed

21st Century Homes is The City of Edinburgh Council's £150 million house building project. Pennywell, a small residential area in north Edinburgh, is one of the areas in Edinburgh where new council homes are being built. The council commissioned a masterplan for the new homes in Pennywell to inform the planning application.

How the assessment was done

This was a standalone HIA led by members of NHS Lothian public health department. It was done in parallel with development of the masterplan. Architecture and Design Scotland funded an enabler to liaise between the public health team and the masterplanners. The steering group included the council professionals leading on the 21st century homes development.

The HIA team held two stakeholders workshops with groups who had knowledge of the local community. Participants identified the different populations who would be affected by the proposals, then used prompts from the 'Healthy Sustainable Neighbourhood' model to identify areas of potential health impact. Participants drew specific issues relating to the area on large maps and these were then provided for the masterplanners. The team then identified the research questions that needed to be answered to allow a more complete understanding of the impacts.

These questions were addressed using different kinds of evidence:
- Routine data to form a health profile of residents of the area
- Review of relevant literature
- Interviews and meetings with key informants and groups of residents

The team compared and collated findings from all these sources to develop a matrix summarising potential impacts of the proposals. The steering group then used this to generate recommendations.

Key areas of impacts

The HIA identified impacts arising from provision of improved housing, changes to the neighbourhood environment, and also from changes in the demographic profile of the area. These included:

- Improved housing quality -- probable positive impact on physical and mental health for people who get new homes
- Change in tenure mix -- influx of owner occupiers into predominantly social rented area may reduce stigma but possible adverse effect on social cohesion
- Improved maintenance regime for public spaces -- likely to improve mental wellbeing for all residents
- Provision of homes for varying need -- positive impact on older people and people with a disability
- Loss of a community centre -- adverse impacts on groups who made use of the centre
- Provision of parks and greenspace -- likely positive impacts on mental wellbeing and physical activity in residents

- Increased street parking provision -- likely to increase car use, discourage walking and cycling
- Construction hazards -- potential risks to workers and children if sites not well managed in accordance with health and safety standards
- Employment -- potential benefit to those gaining work on the sites
- Provision of sustainable urban drainage (SUDS) -- reduced risk of flooding, which has significant adverse health effects
- The masterplan did not address residents' concerns about the severance effect of Pennywell Road and an unsightly shopping centre

Recommendations made

The recommendations related not only to the masterplan itself but also to the wider issues that were identified during the HIA. They included:

- Homes should be built to highest standard of energy efficiency and also include safety measures such as lockable cupboards
- Rents and maintenance costs should be monitored as there was concern that housing costs might rise
- The mix of house types should provide accommodation for an age structure similar to the city as a whole
- There should be community development work to integrate existing and new communities
- There should be a review of community facilities to address concern about the loss of the community centre
- Cycle ways and footpaths should be built early in the development
- There should be further development of greenspace suitable for use by different ages
- There should be further work to develop the shopping centre and address the severance effect of Pennywell Road

Results of the HIA

The HIA had a limited impact on the masterplan itself. The masterplanners shared the aspiration of the HIA team to create a walkable environment with high quality public spaces including greenspace. But the final masterplan was restricted by issues beyond the control of the master planners. They had originally hoped to create 'home zones' to discourage traffic and encourage walking and cycling, but this was abandoned due to a legal challenge to another home zone in the city. The final masterplan also included increased street parking provision to meet new parking standards. These restrictions limited any improvement in walkability.

However many of the recommendations were wider than the masterplan itself, and need to be implemented later in the 21st Century Homes project. The work established a positive working relationship between the public health team and both housing and planning colleagues in the City of Edinburgh Council. This has facilitated joint work on these wider recommendations.

The HIA highlighted the lack of evidence to either support or refute the policy of creating mixed tenure communities. The HIA team is seeking funding for primary research to study this further.

The HIA also highlighted the importance of physical activity as a public health issue, and the role of walkable environments in promoting physical activity. The public health department has continued to work with the City of Edinburgh Council on other planning proposals, focusing among other things on ways to improve walkability of the city environment.

HIA of the Glasgow Housing Strategy

The proposal that was assessed

The HIA set out to investigate the impact of the City Council's Local Housing Strategy (LHS) 2011-2016 on the health and wellbeing of the residents of Glasgow in order to devise action to maximise health gain and minimise any negative impacts on health status.

How the assessment was done

This was a standalone HIA. In 2009, a Housing HIA steering group was established to lead the assessment process. The steering group comprised of staff from Corporate Policy with specialist knowledge of health policy and staff from the Housing Strategy Team who were responsible for the development of the LHS.

In May 2010, a HIA scoping event was held which identified potential health and wellbeing impacts of Glasgow's Local Housing Strategy (LHS). This interactive half-day workshop gathered around 40 key professional stakeholders from a variety of health backgrounds, not only those working in the NHS, but also others who play a key role in influencing many of the social determinants of health including housing, regeneration, transport and planning. Importantly, the workshop examined some of the potential differential impacts of the consultative draft of the LHS on different population groups.

- The LHS Health Impact Scoping Report was published and disseminated in June 2010 and detailed potential impacts of the LHS on health and equality and included a set of research questions to inform the next phase of the assessment. The HIA steering group then prioritised the key impacts identified at the workshop and decided what research questions needed to be examined during the appraisal phase to inform any changes to policy.

In July 2011, a workshop was held with key stakeholders to identify potential evidence sources relating to the four impact areas that would address the policy questions developed during the scoping stage. There was a comprehensive range of research evidence identified at this workshop and only a limited selection has been reviewed in developing the recommendations set out in this report. The process of appraising the research evidence on the four priority impact areas will continue and inform the development of detailed actions plans on Homelessness, Fuel Poverty/Affordable Warmth, Housing Support and Private Sector Housing.

Key areas of impacts

The priorities identified were:

- Fuel Poverty
- Housing Conditions
- Homelessness
- Housing Support and Specialist Housing.

Recommendations

1) Fuel Poverty and Energy Efficiency

- Revise and update the Fuel Poverty (Affordable Warmth) /Energy Efficiency Action Plan which includes the following objectives:

- Provide information and advice on energy related issues to householders across the city, targeting vulnerable groups who are fuel poor
- Increase the energy efficiency of our housing stock to reduce the amount of energy that is needed to heat the home adequately
- Work with partners to support the installation of gas networks where there is no access to the gas grid and where this is the best solution for an area
- Work in partnership to gain investment through traditional routes, through utilities and through government initiatives such as CERT, CESP, UHIS, FIT and RHI and create funding packages of these to maximise the amount of funding available
- Support micro generation projects where these are economically viable

- Work towards zero carbon standards and eradicate fuel poverty in existing housing through investment in energy efficiency, renewable energy and appropriate advice.

2) Housing Conditions

- Develop and implement a Private Sector Housing Action Plan which includes tackling issues of house condition in the private sector and management of the private rented sector

3) Homelessness

- Engage with stakeholders and service users to develop and implement a detailed Homelessness Action Plan which includes the following objectives:

    - Develop a Housing Options pilot, to offer personalised advice to anyone in housing need including the delivery of a one stop shop with information and advice services

    - Engage with stakeholders and service users to plan the development of a range of effective homelessness prevention and tenancy sustainment activities, including initiatives to facilitate access to private sector tenancies, family mediation services and enhanced support services for survivors of domestic violence

4) Housing Support and Specialist Housing

- Enhance existing property-related support services for older owner occupiers and the development of appropriate services

- Engage with partners and service users to explore alternative models of care within a community setting and to look at what changes could be made to current provision to deliver an appropriate service.

- Review how adaptations are delivered in the city to ensure equality of access across all tenures/groups and impact of resources are maximised

- Review and implement new wheelchair accessible housing targets for new RSL development

Results of the HIA

Health is one of the key objectives of the Glasgow Housing Strategy:

- We strive to promote health and wellbeing through this Housing Strategy in order that housing which is built, improved or delivered for Glasgow's people enhances their quality of life.

It is evident throughout the strategy that health is a motivation for many housing actions; reducing negative health impacts related to energy efficiency and dampness is a key theme and the links between inequalities, housing and health are mentioned repeatedly. There are commitments to improve partnership working on issues such as social care, housing for older people, independent living and homelessness. The Joint Housing Options Pilot will involve Glasgow City Council, Glasgow Housing association, NHS Greater Glasgow and Clyde, registered social landlords and voluntary sector agencies.

SOURCES OF INFORMATION AND DATA ON HOUSING AND PUBLIC HEALTH

Some useful sources of information and data about housing are given below.

All of these websites were operational in September 2012. The summaries are largely provided from the sites themselves.

Chartered Institute of Housing
www.CIH.org
The Chartered Institute of Housing (CIH) is the professional body for people working in housing. Its purpose is to promote the science and art of housing, its standards and ideals and the training and education of those engaged in the profession of housing practice. It has an office in Scotland.

National Records of Scotland
www.gro-scotland.gov.uk
This site includes data on births, marriages, civil partnerships, deaths, divorces, and adoptions. Census and other data is used to publish information about population and households. The site includes information on household type, property, amenities, tenure, limiting long term illness. National Records of Scotland is the new name for the General Register Office for Scotland.

Health Impact Assessment Gateway
www.apho.org.uk/default.aspx?QN=P_HIA
The HIA Gateway (funded by the Department of Health, England) provides access to resources and information on Health Impact Assessment for those new to HIA, practitioners of HIA and those wishing to commission HIAs or some other Impact Assessment process (i.e. Integrated Impact Assessment, Mental Well-being Impact Assessment and health-related Strategic Environmental Assessment). It is both a National and International site. The Gateway is a repository for guidance, evidence summaries and previous HIAs.

Registers of Scotland (Property Sales and House Prices)
www.ros.gov.uk/
Property prices are available from a range of commercial websites. Registers of Scotland is the official listing compiled from legal documents submitted as part of the sale and purchase process.

Scottish Government Housing resources
www.scotland.gov.uk/Topics/Statistics/Browse/Housing-Regeneration/HSfS
Housing Statistics for Scotland includes links to a range of quarterly and annual publications on subjects such as house building, housing tenure and housing type.

Information about homelessness legislation and tenants' rights and owners' rights can be accessed at www.scotland.gov.uk/Topics/Built-Environment/Housing/homeless
Homelessness statistics can be accessed from the homelessness reference section of the site: www.scotland.gov.uk/Topics/Statistics/Browse/Housing-Regeneration/RefTables. Data are available for national and local level.

Scottish Health and Inequality Impact Assessment Network
www.healthscotland.com/resources/networks/shian.aspx
The Scottish HIIA Network is coordinated by Health Scotland and aims to develop and support HIA in Scotland. It aims to raise awareness of HIA and encourage its use as part of partnership work at all levels. The site hosts the Network's guides to HIA and housing, transport and greenspace. The Network has developed its own HIA e-learning course. Support and information is available on Health Impact Assessment, Equality and Diversity

Impact Assessment, Strategic Environmental Assessment and Integrated Impact Assessment. The network works closely with colleagues working on Health Inequalities Impact Assessment: http://www.healthscotland.com/equalities/eqia/health-inequalities.aspx

Scottish House Condition Survey (SHCS)
www.scotland.gov.uk/Topics/Statistics/SHCS
The SHCS includes a physical inspection of the property by a building professional and an interview with one of the householders. It is run as a continuous survey with results reported annually. Prior to 2003, the survey was run every five years. Data from 2003 onwards can be analysed in five year blocks so that the sample size is similar to that achieved in 1991, 1996 and 2002. It includes sections on energy efficiency, fuel poverty and housing quality. From 2012, SHCS will be conducted as part of the Scottish Household Survey.
Data available at Scotland level only. Data by local authority may be available where an authority has boosted its sample.

Scottish Household Survey
www.scotland.gov.uk/shs
The SHS is a continuous (since February 1999) cross-sectional survey with a full dataset collected from 31,000 households every two years. Topics include household composition, property, amenities, housing types, health of household. Data is available on large councils annually an all councils biennially.

Scottish Index of Multiple Deprivation (SIMD)
www.scotland.gov.uk/Topics/Statistics/SIMD
The Scottish Index of Multiple Deprivation identifies small area concentrations of multiple deprivation across all of Scotland in a consistent way. The index incorporates measures of income, employment, education, health, housing, access and crime to create a ranking of 6505 datzones in Scotland which range from most deprived to least deprived. There are interactive tools for analysing SIMD data at www.scotland.gov.uk/Topics/Statistics/SIMD/SIMDInteractive while the Scottish Neighbourhood Statistics website allows more detailed analysis.

Scottish Neighbourhood Statistics (SNS)
www.sns.gov.uk/
Scottish Neighbourhood Statistics is the main website on which the Scottish Government disseminates the range of small area statistics including information on health, education, poverty, unemployment, housing, population, crime and social / community issues at the data zone level and above, which support a number of the Government's targets and commitments aimed at closing the gap between disadvantaged areas and the rest of Scotland.

Scottish Public Health Observatory (ScotPHO)
www.scotpho.org.uk/home/home.asp
The Scottish Public Health Observatory is the main repository for public health data and interpretation in Scotland. ScotPHO provides summary data and statistics, background information, interpretation, policy notes, commentaries on data sources, references and links to further information for a wide range of topics relating to the health of the Scottish population. The Scotland and European Health for All Database and Community Health and Wellbeing Profiles for CHPs in Scotland are produced by ScotPHO. The profiles allow users to generate spine graphs, rank charts and time trends for a range of indicators for all small areas (intermediate geography zones) in Scotland, as well as for CHPs and NHS Boards.

Scotland Performs
www.scot.gov.uk/About/Performance/scotPerforms
Scotland Performs is the government's performance reporting platform. It measures and reports on progress of government in Scotland in creating a more successful country, with opportunities for all to flourish through increasing sustainable economic growth.

APPENDIX 1: REFERENCES

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APPENDIX 2: EVIDENCE TABLES FOR REVIEW OF HOUSING AND HEALTH

Table I: Summary of included studies and reported quantitative health impacts

Author Year	Study design	Study quality	Housing condition	Final Sample Int/Cont	Time since interv'n	General health	Respiratory	Mental	Illness/ symptoms
Intervention: Warmth & Energy Efficiency improvements (post 1985)									
Heyman et al *(subm)*	RCT	A	▲	~96/82	2 years	<>$_2$			
Howden-Chapman et al 2008 ***	RCT	A	▲	175/174	4-5 months	▲	▲$_{11}$		◀▶$_4$
Barton et al 2007 **	RCT	A	◀▶	14/13	<2 years		▲$^a_7$		◀▶$^a_2$
Howden-Chapman et al 2007 **	RCT	A	▲	1689/1623	<1 year	▲$_3$	▲$_5$	▲$_3$	
Braubach et al 2008	PC	A	Λ	~210/165	5-8 months	Λ	Λ	▲$_4$	
Platt et al 2007	PC	A	▲	1281/1084	1-2 years	▲$_2$	◀▶$_2$		▲$_2$
Lloyd et al 2008	PC	B		9/27	1-2.5 years				▲^{a}
Shortt et al 2007	PC	B	▲	46/54	1-3.5 years		◀▶$^b_3$	▲^{b}	▲$^b_3$
Somerville et al 2000 ***	P	B	▲	72	3 months		▲$_7$		
Hopton et al 1996 ***	PC	B	▲	55/77	5-11 months			◀▶$^b_2$	◀▶$^b_{11}$
Warm Front Study Group 2006	RC	C	Λ	1561/619	~3-5 months	◀▶	◀▶	▲$^{\mp}$	◀▶
Allen 2005 a	P	C	^	16	<1 year			▲	
Allen 2005 b	P	C	^	24	<3 years	▼		▲$_3$	
Health Action Kirklees 2005	R	C	Λ	102	2-8 months				Λ
Eick et al 2004 ***	RCT	C	◀▶	41	4-12 months		▲$^b_2$		
Winder et al 2003 *	P	C	Λ	72	14 months	<>			
Caldwell et al 2001 **	PC	C	▲^{a}	302/110	6-12 months		▲^{b}		◀▶$_4$
Green et al 1999	RC	C	Λ	111/94	~2-4 years	◀▶$_3$			
Iversen et al 1986	PC	C	Λ	106/535	3-6 months		▲		▲$_3$
Intervention: Rehousing/retrofitting +/- neighbourhood renewal (post 1995)									
Kearns et al 2008 **	PC	A	▲	262/284	24 months	▲	▼	▲$_4$	◀▶$_3$
Thomson et al 2007	PC	A	▲	50/50	12 months	▲$_2$		◀▶^{a}	
Critchley et al 2004 $^{\mp}$	PC	A	Λ	246	1-12 months	<>^{a}		<>^{a}	
Thomas et al 2005 $^{\mp}$	PC	B		585/759	22 months			◀▶^{b}	
Barnes et al 2003	PC	B	◀▶	45/45	18 months	▲$_4$		▲	▲
Evans et al 2002	PC	B	<>	17/17	6-18 months	Λ^b		<>^{b}	V^b
Halpern 1995	P	B		27	10 months			▲$_2$	
Blackman et al 2001 **	P	C	<>	166	5 years	▼	▼$_2$	▲	
Ambrose 1999	P	C	▲	227	4 years		◀▶$_2$	▲	◀▶$_2$

* narrative only, no data reported; ** data for children also available; *** children only; **** area level data not relating to study population alone; ǂ sub-group analysis (presented in favour of main analysis where there were high levels of contamination within control group, or where data only available for a sub-group)
Study design: RCT: Randomised Controlled Trial; PC: Prospective controlled study; P: Prospective uncontrolled study; RC: Retrospective controlled study; R: Retrospective uncontrolled study
Effect direction: upward arrow= positive health impact, downward arrow= negative health impact, sideways arrow= mixed effects/conflicting findings
Sample size: Final sample size (individuals) in intervention group Large arrow >300; medium arrow 50-300; small arrow <50
Statistical significance: Black arrow p<0.05; grey arrow p>0.05; empty arrow= no statistics/data reported
Statistical tests: Controlled studies- Difference between control and intervention group at follow-up (unless stated); [a] Difference in change between control and intervention group; [b] Change within intervention group only; Uncontrolled studies: Change since baseline
Number of outcomes within each category synthesis is 1 unless indicated in subscript beside effect direction

Synthesis of multiple outcomes within same outcome category
Where multiple outcomes all report effect in same direction and with same level of statistical significance, report effect direction and indicate overall level of statistical significance
Where direction of effect varies across multiple outcomes:
Report direction of effect and statistical significance where 70% of outcomes report similar direction and statistical significance.
If <70% of outcomes report consistent direction of effect report no clear effect/conflicting findings ◄► (size to reflect sample size)
Where statistical significance varies:
If direction of effect similar & >60% outcomes statistically significant, report as statistically significant.
If one conflicting outcome judged to be distinct from other outcomes or of less value/validity do not include, or report separately.

Table 2: Summary of standardised measure of health effect (Odds Ratios) following housing improvement: Odds Ratio for Intervention group compared to control group at study endpoint

Study	Study size Int/Con (Time since intervention)	Study grade	Specific outcome	Odds ratio for intervention group (95% CI)
Intervention: Warmth & Energy Efficiency improvements (post 1985)				
General health (n=2)				
Howden-Chapman et al (2008a) [Ψ]	175/174 (4-5 months)	**A**	Poor/fair self-reported health	0.480 (0.310 to 0.740)***
Howden-Chapman et al (2007b)	1689/1623 (<1 year)	**A**	Poor/fair self-reported health	0.589 (0.467 to 0.743)***
Respiratory health (n=5)				
Howden-Chapman et al (2008) [Ψ]	175/174 (4-5 months)	**A**	Sleep disturbed by wheeze	0.550 (0.350 to 0.850)***
			Speech disturbed by wheezing	0.690 (0.400 to 1.180)
			Dry cough at night	0.520 (0.320 to 0.830)*
			Wheeze during exercise	0.670 (0.420 to 1.060)
Barton et al	14/13 (<2 years)	**A**	Asthma	~0.946 (0.598 to 1.496)
			Bronchitis	~1.007 (0.477 to 2.127)
			Other respiratory symptoms	~1.010 (0.560 to 1.820)
Howden-Chapman et al (2007)	965.961 (<1 year)	**A**	Morning phlegm *(adults only)*	0.640 (0.523 to 0.784)***
Howden-Chapman et al (2007)	1689/1623 (<1 year)	**A**	Wheezing in past 3 months	0.570 (0.467 to 0.696)***
(adults & children)			Cold/flu	0.545 (0.430 to 0.691)***
Howden-Chapman et al (2007) [Ψ]	512/471 (<1 year)		Sleep disturbed by wheeze	0.570 (0400 to 0.812)**
			Speech disturbed by wheezing	0.514 (0.310 to 0.852)*
Platt et al	1281/1084 (1-2 years)	**A**	Ever diagnosed nasal allergy	1.520 (1.050 to 2.200)*
			Ever diagnosed asthma	0.92 (0.63 to 1.34)
			Ever diagnosed bronchitis	1.29 (0.97 to 1.72)
Shortt et al	46/54 (1-3.5 years)	**B** [◊]	Asthma [ǂ]	~0.568 (0.099 to 3.254)
			Chest infection/bronchitis [ǂ]	~1.875 (0.495 to 7.102)
			Pneumonia/hypothermia [ǂ]	~3.593 (0.143 to 90.361)
Hopton et al [Ψ]	55/77 (5-11 months)	**B** [◊]	Persistent cough	~0.973 (0.441 to 2.149)
			Wheezing	~1.125 (0.467 to 2.708)
			Runny nose	~0.686 (0.337 to 1.394)
Mental health (n=3)				
Howden-Chapman et al (2007)	977/964 (<1 year)	**A**	Low happiness (SF-36)	0.560 (0.409 to 0.767)***
		A	Low vitality (SF-36)	0.510 (0.408 to 0.637)***
Braubach et al	~210/165 (5-8 months)	**A**	Depression	1.404 (0.329 to 5.987)
Shortt et al	46/54 (1-3.5 years)	**B** [◊]	Stress/Mental illness	~0.261 (0.053 to 1.299)
Hopton et al	55/77 (5-11 months)	**B** [◊]	Feeling down	~0.663 (0.233 to 1.891)
			Irritability	~1.545 (0.569 to 4.196)
			Temper tantrums	~0.973 (0.441 to 2.149)
Illness/symptom (n=4)				
Howden-Chapman et al (2008) [Ψ]	175/174 (4-5 months)	**A**	Diarrhoea	0.720 (0.450 to 1.160)
			Ear infection	1.160 (0.680 to 1.990)
			Vomiting	0.880 (0.550 to 1.400)
			Twisted ankle	1.86 (1.03 to 3.35)*
Barton et al	14/13 (<2 years)	**A**	Arthritis	~1.058 (0.533 to 2.100)
			Rheumatism	~1.908 (0.829 to 4.395)
Platt et al	1281/1084 (1-2 years)	**A**	Ever diagnosed hypertension	0.770 (0.610 to 0.972)*
			Ever diagnosed heart disease	0.690 (0.520 to 0.916)*
			Ever diagnosed circulation problem	1.06 (0.83 to 1.34)
			Ever diagnosed eczema	1.43 (0.89 to 2.28)
Shortt et al	46/54 (1-3.5 years)	**B** [◊]	'Other' illnesses [ǂ]	~0.568 (0.099 to 3.254)
			Arthritis [ǂ]	~1.619 (0.343 to 7.641)
			Angina [ǂ]	~0.200 (0.041 to 0.966)*
Hopton et al	55/77 (5-11 months)	**B** [◊]	Aches & pains	~1.537 (0.664 to 3.555)
			Diarrhoea	~0.735 (0.254 to 2.123)
			Earache	~0.977 (0.347 to 2.749)
			Fever	~0.784 (0.328 to 1.875)
			Headaches	~0.681 (0.233 to 1.986)
			Poor appetite	~0.342 (0.146 to 0.803)**
			Sore throat	~1.355 (0.668 to 2.747)
			Vomiting	~0.963 (0.380 to 2.443)
			Tiredness	~1.524 (0.644 to 3.607)

Table 2 cont'd: Summary of standardised measure of health effect (Odds Ratios) following housing improvement (controlled studies only): Odds Ratio for Intervention group compared to control group at study endpoint

Intervention: Rehousing/Retrofitting +/- neighbourhood renewal (post 1995)				
General health (n=3)				
Kearns et al	262/284 (2 years)	**A**◊	Self-reported poor health	0.769 (0.500 to 1.176)
			Long standing illness	0.680 (0.440 to 1.050)
			Health not improved since 1 year ago	0.787 (0.541 to 1.163)
Thomson et al	50/50 (1 year)	**A**	Fair/poor health	1.757 (0.777 to 3.973)
			Lower SF-36 Physical Component Score	0.960 (0.437 to 2.110)
Barnes et al	45/45 (18 months)	**B** ◊	Fair/poor health	~0.273 (0.110 to 0.682)*
			Health somewhat/much worse than 1 year ago	~0.356 (0.135 to 0.942)
			Health interferes with daily activities	~1.516 (0.617 to 3.730)
			Physical/emotional problems with daily life (in past 4 weeks)	~0.338 (0.138 to 0.829)
Respiratory health (n=1)				
Kearns et al	262/284 (2 years)	**A**◊	Wheezing in past year	1.040 (0.690 to 1.560)
Kearns et al Ψ	221/208 (2 years)	**A**◊	Asthma	1.039 (0.650 to 1.661)
			Breathlessness	1.185 (0.459 to 3.063)
			Persistent cough	1.093 (0.663 to 1.800)
			Bronchitis	0.311 (0.032 to 3.010)
			Sinus/catarrh	0.890 (0.480 to 1.650)
Mental health (n=2)				
Thomson et al	50/50 (1 year)	**A**	Lower SF-36 Mental Component Score	0.733 (0.333 to 1.613)
Barnes et al	45/45 (18 months)	**B** ◊	Anxiety/Depression self-reported	~0.361 (0.152 to 0.856)*
Illness/symptom (n=2)				
Kearns et al	262/284 (2 years)	**A**◊	Smoker	1.470 (0.849 to 2.546)
			Heavy drinker	0.610 (0.300 to 1.240)
			Less than 5 portions fruit/veg per day	0.794 (0.519 to 1.215)
Kearns et al Ψ	221/208 (2 years)	**A**◊	Chronic illness	1.039 (0.549 to 1.966)
			Headaches	0.991 (0.604 to 1.626)
			Indigestion	0.941 (0.058 to 15.145)
			Sleeping problems	1.128 (0.618 to 2.059)
			Eczema	1.148 (0.683 to 1.931)
			Hay fever	0.990 (0.513 to 1.913)
Barnes et al	45/45 (18 months)	**B** ◊	Pain & discomfort	~0.400 (0.170 to 0.940)
			Mobility	~0.533 (0.215 to 1.322)

* p<0.05, ** p<0.01, *** p<0.001, Ψ children only ǂ proportion of households as opposed to individuals
◊ Inadequate control for confounding Grade C/key confounder emerged in analysis
~ estimated OR as no indication of missing data for specific outcomes, or estimated sample size

APPENDIX 3: GLOSSARY

GLOSSARY OF TERMS

Fuel poverty	A household is defined as being in fuel poverty if it is required to spend more than 10% of its income on all household fuel use.
Housing Association	A not for profit organisation whose main purpose is to provide social housing for rent.
Priority Need	A homeless household must be in priority need to quality for permanent housing. A household is in priority need if anyone in the household is: • Pregnant • Responsible for dependent children • Homeless because of an emergency • Aged 16-17 • Aged 18-20 and have been in care or are at risk of sexual or financial exploitation or drug or alcohol misuse • At risk of violence or harassment because of your religion, sexuality, race, colour or ethnic or national origin • At risk of domestic abuse • Vulnerable because of being elderly, a disability, mental health problem, learning disability, chronic illness, have just left hospital, prison or the armed forces or for some other reason.
Tolerable standard	A test of housing conditions below which a house is deemed unfit to live in. A house meets the tolerable standard if it: • is structurally stable; • is substantially free from rising or penetrating damp; • has satisfactory provision for natural and artificial lighting, for ventilation and for heating; • has satisfactory thermal insulation; • has an adequate piped supply of wholesome water available within the house; • has a sink provided with a satisfactory supply of both hot and cold water within the house; • has a water closet or waterless closet available for the exclusive use of the occupants of the house and suitably located within the house; • has a fixed bath or shower and a wash-hand basin, each provided with a satisfactory supply of both hot and cold water and suitably located within the house; • has an effective system for the drainage and disposal of foul and surface water; • in the case of a house having a supply of electricity, complies with the relevant requirements in relation to the electrical installations for the purposes of that supply; • has satisfactory facilities for the cooking of food within the house; and • has satisfactory access to all external doors and outbuildings.

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