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Multiple deprivation and excess winter deaths in Scotland

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Abstract

The recent publication of the Scottish Index of Multiple Deprivation (SIMD) has allowed some tentative statistical correlations to be undertaken to assess the impact poverty may have on mortality and morbidity. During the period 1989 to 2001, Scotland registered around 51,600 excess winter deaths (EWDs). EWDs is taken as the additional deaths during December to March than occurred in the preceding and subsequent four-month periods. Almost all of these EWD deaths were in the population aged over 65. This represents 50 more deaths per day in January than in July. The SIMD measured five criteria by region: income; employment; health and disability; education, skills and training; and geographical access to services. Glasgow was the most deprived region with an SIMD score of 46.88 and East Dunbartonshire, the least deprived region, with a score of 9.07. For the over 65s, the chance of becoming an EWD in Glasgow is one in 36, rising to one in 68 for North Ayrshire. The SIMD is positively correlated with EWD by region (0.35 at the 5% confidence level).

This correlation appears to go against the influence of climatic variations, house type, energy efficiency and access to the gas network which favours urban areas. Although some of the additional winter deaths have been ascribed to outdoor cold exposure - exacerbated by inappropriate clothing or culturally determined behaviour - the majority of EWDs are premature and essentially preventable if the elderly can be kept warm in their homes during the winter months.

INTRODUCTION

In 1991 Boardman[1] demonstrated that the UK has 30,000 to 60,000 more deaths between December and March than in the preceding and succeeding four-month periods. Although there is some evidence demonstrating a reducing trend in excess winter deaths (EWDs) in London and Scotland[2,3] - possibly due to increased levels of energy efficiency - the UK has much higher winter death rates than other countries with similar or more severe climates, implying that it is not outdoor exposure to cold that is the key determinant. Northern Finland - where winter temperatures regularly drop to minus 20°C - has a significantly lower rate of EWDs than London;[4] however, Finish dwellings have historically had much higher levels of insulation and whole house central heating is commonplace. In the UK, 90% of the EWDs are in the elderly population and are registered under three generic disease headings: ischaemic heart, cerebro-vascular and respiratory.[5] An EWD is taken as the additional deaths during December to March than occurred in the preceding and subsequent four-month periods.

COLD DAMP HOUSING AND POOR HEALTH

Although some of the additional winter deaths have been ascribed by the Eurowinter Group[4] as being due to external exposure - exacerbated by inappropriate clothing or culturally-determined behaviour - there remains an acceptance that the majority of these deaths are essentially preventable if the elderly can be kept warm in their homes during the winter months.

The biological mechanisms resulting from a lowering in core body temperatures are well known.[6] The body's defence against cold is to shut down blood vessels in the skin to reduce heat loss from the core. This displaces around a litre of blood and overloads the central organs. In order to reduce this excess, salt and water are excreted. This in turn requires more salt and water to leave the bloodstream through the walls of the blood capillaries. This adjusts the blood volume to the reduced capacity of the circulatory system, but leaves the blood more concentrated. Some of the smaller molecules of the blood plasma - including the anti-thrombotic vitamin C - are able to redistribute through the capillary walls, but the red and white blood cells, platelets, fibrinogen and cholesterol are too large and remain in increased concentration in the blood plasma. All promote viscosity and hypercoagulability, which increases blood pressure. Cold stress thus stimulates a range of biological processes that result in the blood becoming thicker, increasing the likelihood of cardio- or cerebro-vascular incidents. The immune system is also suppressed increasing the likelihood of airborne infectivity.[7] Reasons for the increase in respiratory infections are not fully understood but it appears that colder air induces bronchoconstriction and suppresses muco-ciliary defences, resulting in local inflammation. Cold air per se is not likely to result in respiratory infections in the absence of pathogens, as shown by a study carried out by Tyrrell[8] in ice-bound Spitsbergen, a town which lies inside the Arctic Circle. Despite exceptionally cold winter air temperatures, no increase in respiratory infections occurred until the arrival of the first ship in spring carrying urban sailors/passengers with various bacterial and viral infections, exposing an isolated indigenous population with relatively low immunity.

Work by Platt *et al*[9] published in 1989 established a causal link between dampness and a variety of medical complaints particularly associated with the respiratory tract. A major meta-analysis by Fung and Hughson[10] of 416 published articles concluded that the current human studies demonstrate a clear association between allergy and respiratory symptoms and exposure to moisture and mould.

There has been some suggestion that due to the UK's maritime climate, infectious aerosols are more common and produce increased transmission rates of diseases such as the common cold, influenza, adenovirus, measles, tuberculosis and other respiratory illnesses, and that these cyclical epidemics are a significant factor, increasing winter death rates. There is no question that flu epidemics can increase death rates in any given population. Bowie and Jackson[3] demonstrated that the flu epidemic that occurred in the winter of 1989/90, doubled the weekly Scottish death rate peak from *circa* 1,000 to 2,000.

Disease transmission rates by inhalation of infectious aerosols are primarily influenced by four factors, three of which are relatively independent of climate: indoor concentration of infectious agents, transport pathways between individuals, the viability of a specific infectious agent and the susceptibility of an individual to a particular disease. The likelihood of succumbing to an airborne flu virus will of course be increased if you occupy a cold damp home. Building design, construction and heating/ventilation system operation, can therefore have a major impact on infectivity rates. A study undertaken by the US army[11] revealed 50% higher rates of clinically confirmed acute respiratory illness with fever among recruits in newer barracks with closed windows, low rates of outside air supply, and extensive air recirculation, than among recruits in older barracks with frequently opened windows, more outside air and less recirculation. As has recently been demonstrated by the spread of the SARS virus - which had little impact on Britain - it is the movement and association of human hosts that determine the extent and spread of a particular disease. Flu epidemics invariably occur during the winter months where cold temperatures - both indoor and outdoor - suppress immuno-defences.

FUEL POVERTY AND MULTIPLE DEPRIVATION

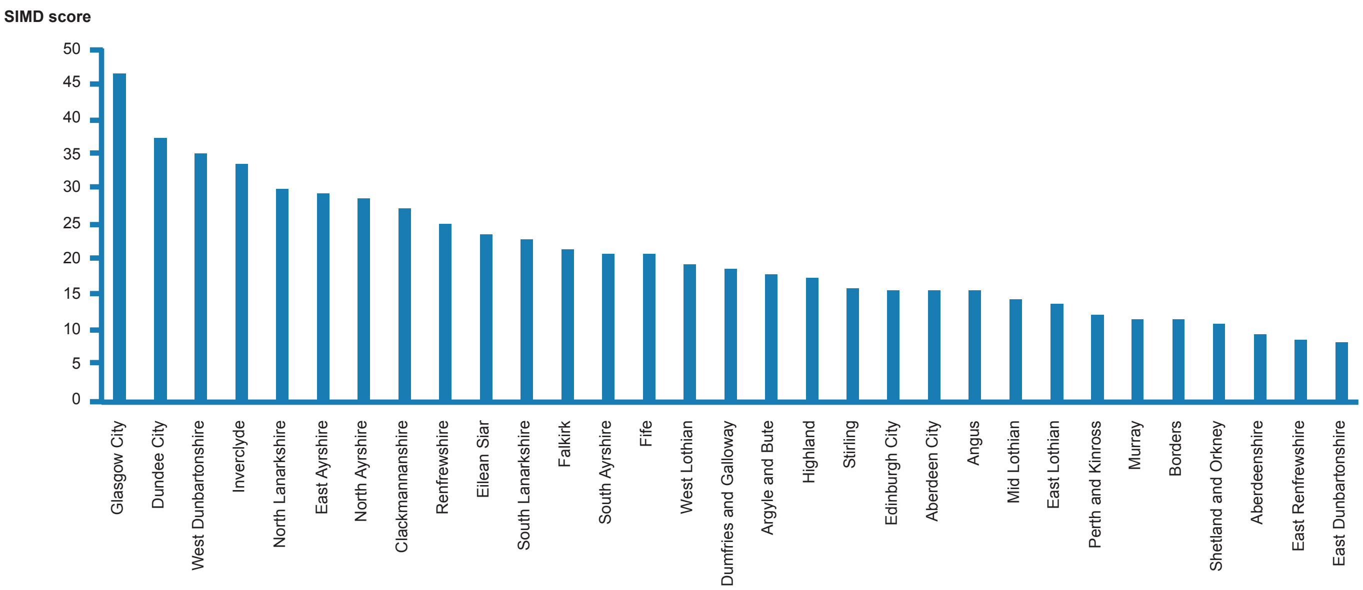
Section 95 of the Housing (Scotland) Act 2001[12] produced the following definition of 'fuel poverty':

'A household is in fuel poverty if, in order to maintain a satisfactory heating regime, 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.'

Although there remains some discussion as to whether benefits should be included as net income, the definition of a 'satisfactory heating regime' was clearly stated as

Figure 1

Scottish Index of Multiple Deprivation by region



one that achieves 21°C in the living room and 18°C in the other occupied rooms. Satsangi et *al*[13] have previously claimed that the poorest decile of Glasgow's population spend, on average, a remarkable 24% of their net income on fuel, with no guarantee that these indoor temperatures are actually achieved. This compares with 3.2% for the richest decile. A report by Energy Action Scotland[14] into the effects of VAT on fuel poverty confirmed the fuel poor's predicament: they are more likely to be living in poorly constructed, uninsulated dwellings without central heating and a high proportion are forced to use 'expensive' domestic tariff electricity for heating purposes.

Between 1991 and 2002, the prevalence of condensation dampness - a good indicator of poor energy efficiency - reduced from 19.3% to 11%;[15, 16] however, the tendency for the poorest section of the community (income of less than £100 per week) to live in the least energy-efficient dwellings, remains. The 2002 Scottish House Condition Survey (SHCS)[16] reported that, despite some improvements in energy efficiency, combined with a significant drop in real fuel costs, 369,000 (17%) Scottish households remain in fuel poverty under the SHCS definition.

In 2003 the Scottish Executive[17] published a new index of multiple deprivation (SIMD) by region. It attempted to measure and rank five key parameters: income; employment; health and disability; education, skills and training; and geographical access to services (see Figure 1). Glasgow is the most deprived region with a score of 46.88 and East Dunbartonshire, which actually shares a long boundary with Glasgow, the least deprived region, with a score of 9.07.

During the period 1989 to 2001, Scotland registered[3] around 51,600 EWDs. Almost all EWDs were from the population aged over 65.[3] This represents 50 more deaths per day in January, when the average 24 hour daily temperature is 1.9°C, than in July, when daily averages are 11°C. As death rates increase linearly with temperature drop,[18] the use of this somewhat crude time division undoubtedly underestimates the total excess deaths being driven by low temperatures, as it does not include cold days outside the December to March period. Furthermore, increases in summer peak temperatures and associated death rates (excess summer deaths), which occurred in 2003, may mask future differentials.

In terms of impact on mortality, cold weather is not quite as influential as smoking, but may have a similar influence on morbidity, as cold stress reduces the immune system's ability to fight infections. Bowie and Jackson[3] have demonstrated a close relationship between EWD rates and the incidence of individuals presenting with flu-like symptoms at 90 general practitioner practices in Scotland.

The chance of becoming an EWD in Glasgow is 1:36, rising to 1:68 for North Ayrshire.

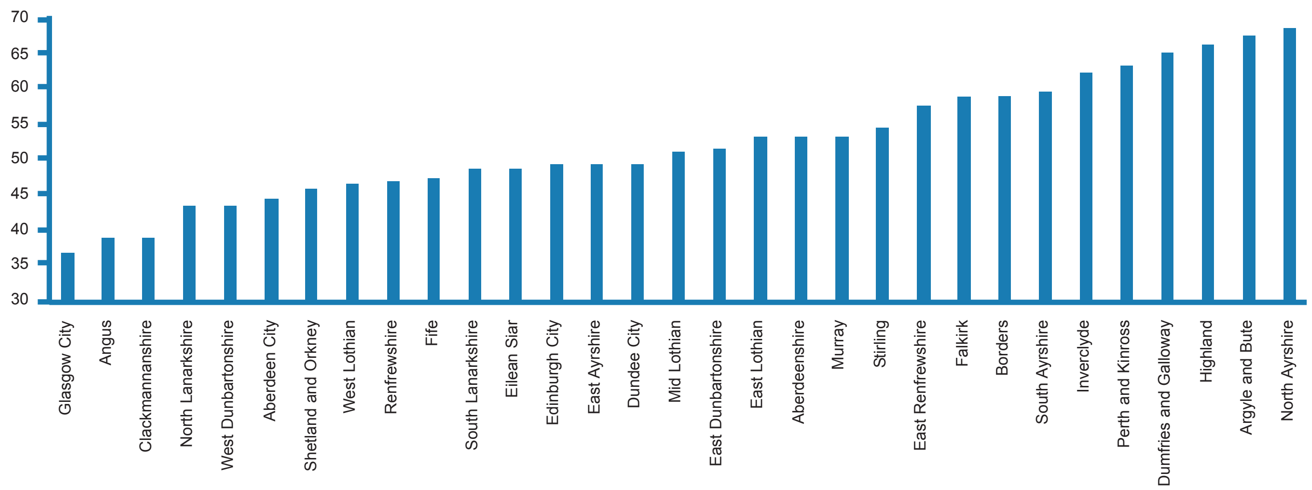
The SIMD is positively correlated with EWD by region (0.35 at the 5% confidence level). Although diet and lifestyle are important variables, this correlation appears to go against the influence of climatic variations, house type, energy efficiency and access to the gas network.

CLIMATIC VARIATIONS

There is a significant temperature gradient across Scotland, with Dumfries and Galloway in the south-west having the mildest climate [*circa* 2,300 degree days (DD)*] and Orkney and Shetland in the north-east having the coldest climate (over 25% colder at *circa* 2,900 DD), with wind speeds also generating higher wind chill factors. Mean 30 year average daily temperatures for January show a variation of 6°C across Scotland. Temperatures drop with latitude and distance from the coasts. As EWDs increase linearly with temperature fall, these colder regions should have significantly higher winter death rates, if outdoor exposure was the key causal factor. Although Figure 2 clearly shows that the death rates along the south-western seaboard (Dumfries and Galloway, Ayrshire and Argyle and Bute) are at the lower end, this does not appear to hold true for the rest of Scotland as

Figure 2

Odds for over 65s becoming an excess winter death by region



Glasgow, North Lanarkshire and West Dunbartonshire fall within a relatively mild climate zone but have the highest EWDs.

HOUSE TYPE AND HOME ENERGY-EFFICIENCY RATINGS

The size, configuration, construction type and efficiency of the heating provision will be influential in the occupant's ability to maintain 'healthy' indoor temperatures. Where indoor temperatures regularly fall below an average whole house temperature of 16°C, 'thermal safety'[19] will be compromised. Those living in large, uninsulated dwellings with expensive and or inefficient heating systems will be penalised. The plan, configuration and external surface area will also be influential. Urban locations have significantly more flats. A mid-floor flat that has an excellent ratio of surface area to volume enclosed will typically only lose heat through two external walls. A detached rural property could have four times the heat loss parameter (W/m²°C floor area) as heat is being lost through four walls, the floor and the roof. The EWD by region does not follow such a trend, with the dense tenemental city of Glasgow being at the top of the scale.

COST OF FUEL

Similar to energy-efficiency ratings, access to relatively cheap gas facilitates affordable warmth. Even when combusted in inefficient appliances, gas provides a kW of heat for under 2p (closer to 1.5p in condensing boilers). This compares with circa 3.5p/kW for off-peak electricity and over 7p/kW for the domestic on-peak tariff. The 2002 Scottish House Condition Survey[16] estimated that over a quarter of dwellings (612,000) do not have access to mains gas. Rural, northern and island communities are thus penalised, but the statistics by region do not have the sensitivity to isolate this as a key variable. As the initial scramble for market share by the privatised utilities - which has driven down fuel costs in real terms - is now coming to an end, many economists are predicting fuel price inflation. The next few years may very well see those who have recently been declassified falling back into fuel poverty, as fuel prices increase above the rate of inflation. The target set by the Scottish Executive[12] to end fuel poverty by November 2016 appears optimistic, unless increased funding can be found for retro-fitting the existing stock. The measures currently being applied remain somewhat piecemeal and their impact on domestic temperatures may have been overestimated. There is also a concern that - where they do not include complementary ventilation provision - they have a negative impact on indoor air quality.

STRATEGIC RESPONSES TO FUEL POVERTY

The Home Energy Efficiency Scheme (HEES - now re-titled 'Warm Deal' in Scotland), instigated in the early eighties, set out to provide grants for the draught-stripping of doors and windows, and the installation of insulation at ceiling level in roof-spaces. Although the scheme was subsequently expanded to cover cavity fill insulation and central heating, such a piecemeal approach was always unlikely to be effective - even over the medium term - in significantly reducing fuel poverty in many sections of the population due to their low income levels.

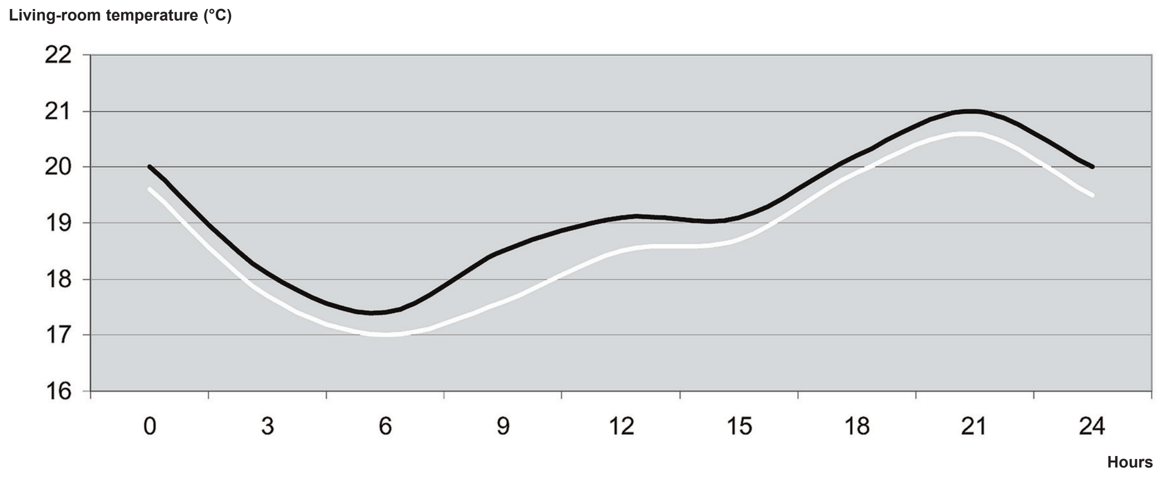
The publication of the 1996 English House Condition Survey,[20] classified 1,522,000 dwellings as unfit. Somewhat surprisingly this figure was greater than that contained in the 1991 survey, with dampness the prime reason for a dwelling failing the standard. A pilot study[21] into the effects of the HEES providing grants for low income groups to underwrite draught-stripping and loft and cavity insulation, confirmed a disappointingly modest increase in both bedroom and living room temperatures (on average less than 1°C).

Of even greater concern, the report concluded:

'The study found a number of features militating against health improvements. These include: twice the level of mould growth found on average in the English

Figure 3

Daily fluctuation in indoor living-room temperatures before and after Home Energy Efficiency Scheme improvements



housing stock; a poor level of ventilation (three out of ten homes with no purpose-provided ventilation); and almost all had conditions favourable to house dust mites. There were no appreciable signs of the intervention works having improved overall conditions or specifically reduced the health risks associated with dust mites.'

This outcome adds further weight to the hypothesis that the current UK asthma pandemic is primarily being driven by dust mite colonisation and proliferation in small, tight, warm and humid dwellings that have poor ventilation characteristics, and, as a consequence, suffer from poor indoor air quality and high airborne allergen burdens.[22]

CONCLUSIONS

EWDs are relatively easy to measure and may be considered as the acute outcome of cold damp housing. Mortality, however, is at the tip of an expensive morbidity 'iceberg'. House conditions play a decisive role, not only in determining at what age adults die, but more importantly, the impact on occupant health and quality of life. Investment in energy-efficiency measures, such as central heating, insulation, double glazing and complementary ventilation strategies to ensure good indoor air quality, can drive major improvements in public health and reduce EWDs. It is important to measure and cost the impact of poor housing and cold indoor temperatures on health. Poor housing conditions result in increased external costs, such as hospital admissions, prescription charges, medical consultations and absenteeism.

Measures currently being funded under the HEES (known as 'Warm Deal' in Scotland) do not, as yet, appear to be effective in raising indoor temperatures to a level that will ensure whole-house 'thermal safety'. A more holistic, comprehensive and capital intensive approach is thus required.

RECOMMENDATIONS

An index of 'disability-adjusted life years' and/or 'quality-affected life years' could quantify the cost-benefits of energy efficiency remediation and justify increased investment levels. A recent publication by the British Medical Association[23] entitled *Housing and Health: Building for the Future*, reviewed the available - if somewhat sparse - literature in this field, and concluded that housing quality is an important determinant of health. The report called for the formation of a *Healthy Housing Task Force* to provide a multi-sectorial approach to improve house conditions across the UK. All those working in the field of health promotion should endorse this call.

* A degree day (DD) is a measure of how often the external temperature drops below 15.5°C, a temperature considered to be the base at which domestic heating is required. Each degree below this reference temperature is counted as one degree day.

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