Deprivation and excess winter mortality

Sunil Shah, Janet Peacock

Abstract

Objective—To investigate the effect of material deprivation on the winter rise in mortality and temperature dependent variations in mortality.

Design—Ecological comparison of seasonal mortality at electoral ward level. Main outcome measures were ratios of winter to rest of the year mortality rates (seasonality ratios) and monthly deaths as the outcome variable in a model with monthly average temperature and Townsend score as main predictors.

Setting—Croydon, London, United Kingdom.


Main results—There was a clear relation between overall mortality and deprivation. There was no evidence of a relation between age and sex standardised seasonality ratios and Townsend scores for all ages (Kendall’s τ = −0.066, p=0.63) or cardiovascular deaths or respiratory deaths. There was no evidence of an interaction between Townsend score and temperature in the model of ward mortality rates (p=0.73). These findings were not affected by exclusion of deaths of nursing and residential home residents.

Conclusion—This study provides no evidence of an effect of deprivation on excess winter mortality or temperature dependent variations in mortality. The findings question simple assumptions about the relation between deprivation and excess winter mortality and highlight the need for further study to guide interventions.

Methods

STUDY DESIGN

The study used ecological comparison at electoral ward level of seasonality ratios and temperature dependent variation in mortality,14 15 Seasonality ratios are a widely used quantitative description of the seasonal mortality. They are the ratio of mortality rates in winter (December to March) to those in the rest of the year multiplied by one hundred. Townsend scores were used as a measure of socioeconomic deprivation at ward level.17

SUBJECTS AND DATA SOURCES

Croydon is an outer London district with a population of one third of a million. Mortality data for Croydon residents for a six year period (1990–5) were available in the Croydon Mortality Database.19 This contained details of 17 761 deaths including age, ward of residence, date of death, cause of death and whether the individual was a permanent resident in a residential or nursing home at the time of death. Complete data were available on 17 744 deaths and these were used in subsequent analyses.

Data from the 1991 census were used to calculate Townsend scores for each electoral ward based on the Croydon ward average.17 Wards were allocated into deprivation quintiles based on these scores. Daily temperature data for London were obtained from the London
Weather Centre and national estimates of quarterly influenza incidence, based on Royal College of General Practitioners spotter practice data, were extracted from Office for National Statistics series MB2. Statistical analysis was undertaken with SPSS 6.1 for Windows.

**Table 1** Standardised mortality ratios (SMRs) for ward deprivation quintiles, based on Townsend scores, before and after exclusion of nursing and residential home deaths

<table>
<thead>
<tr>
<th>Ward deprivation quintile</th>
<th>All age SMR before exclusion (observed)</th>
<th>95% Confidence intervals</th>
<th>All age SMR after exclusion (observed)</th>
<th>95% Confidence intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (most affluent)</td>
<td>89.5 (3745)</td>
<td>86.7 to 92.4</td>
<td>89.1 (3064)</td>
<td>85.9 to 92.2</td>
</tr>
<tr>
<td>II</td>
<td>97.8 (3550)</td>
<td>94.6 to 101.0</td>
<td>94.2 (2770)</td>
<td>90.7 to 97.7</td>
</tr>
<tr>
<td>III</td>
<td>102.2 (3772)</td>
<td>99.0 to 105.5</td>
<td>100.1 (2974)</td>
<td>96.5 to 103.7</td>
</tr>
<tr>
<td>IV</td>
<td>100.8 (2976)</td>
<td>97.2 to 104.4</td>
<td>104.9 (2499)</td>
<td>100.8 to 109.0</td>
</tr>
<tr>
<td>V (most deprived)</td>
<td>112.6 (3701)</td>
<td>108.9 to 116.2</td>
<td>114.8 (3322)</td>
<td>110.9 to 118.7</td>
</tr>
</tbody>
</table>

(Before exclusion, $\chi^2$ for trend $= 90.3$, p<0.001. After exclusion, $\chi^2$ for trend=118, p<0.001).

**Table 2** Age and sex standardised seasonality ratios for all deaths by ward deprivation quintiles before and after exclusion of nursing and residential home deaths

<table>
<thead>
<tr>
<th>Ward deprivation quintile</th>
<th>Standardised seasonality ratio (95% confidence intervals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (most affluent)</td>
<td>121.7 (109.1 to 135.8)</td>
</tr>
<tr>
<td>II</td>
<td>120.3 (107.5 to 134.6)</td>
</tr>
<tr>
<td>III</td>
<td>117.2 (105.0 to 130.8)</td>
</tr>
<tr>
<td>IV</td>
<td>125.4 (110.9 to 141.8)</td>
</tr>
<tr>
<td>V (most deprived)</td>
<td>115.9 (103.7 to 129.5)</td>
</tr>
</tbody>
</table>

(Institutional deaths excluded)

**Table 3** Details of the model of all monthly ward deaths after square root transformation* and the effect of an interaction term

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>95% Confidence intervals</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean temperature (°C)</td>
<td>-0.0264</td>
<td>-0.033 to -0.019</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Influenza incidence†</td>
<td>1.23×10⁻⁴</td>
<td>0.381 to 2.09×10⁻⁴</td>
<td>0.0046</td>
</tr>
<tr>
<td>Total population</td>
<td>1.39×10⁻⁴</td>
<td>1.26 to 1.53×10⁻⁴</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>% pop below 16</td>
<td>-0.033</td>
<td>-0.044 to -0.022</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Townsend score</td>
<td>0.027</td>
<td>0.019 to 0.035</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Interaction term$^\dagger$</td>
<td>-2.67×10⁻⁴</td>
<td>-0.001 to 0.018</td>
<td>0.73</td>
</tr>
</tbody>
</table>

*Deaths are expressed as number of deaths per 30 day month. †Influenza incidences are national estimates per 100 000 of population per year. ‡The interaction term is the product of mean temperature and Townsend score.

In the model included average monthly temperature, Townsend score, population size, influenza incidence, and ward age structure. All models met the assumptions of least squared regression. The relation between temperature dependent variations in mortality and deprivation was tested by addition of a linear interaction term between temperature and Townsend score.

**Results**

**Table 3** Details of the model of all monthly ward deaths after square root transformation* and the effect of an interaction term

**Discussion**

This study confirms the relation between overall mortality and deprivation and the marked rise in mortality in winter but shows no evidence of a relation between deprivation and excess winter mortality. The study was based on the mortality experience of two million
person years and should have been able to detect effects of the magnitude previously described in social class based analysis. This is the first detailed study that has examined the relation between deprivation and excess winter mortality and it tackles some of the potential problems in national analysis. In particular, this study is not subject to problems of geographical dispersion of the study population and was able to examine the effect of a number of confounders. The main design issues are the validity of Townsend scores as a measure of fuel poverty and the adequacy of control for confounding factors.

VALIDITY OF THE MEASURE OF FUEL POVERTY

The hypothesis tested in this study is that socioeconomic deprivation predisposes to excess winter mortality. Socioeconomic deprivation is used as a proxy for fuel poverty that describes the inability of households to maintain adequate indoor temperatures because of economic and material circumstances. Seasonal mortality is primarily a phenomenon that affects older people while measures of deprivation, such as Townsend scores, relate to the experience of younger people. However, in this study, Townsend scores were used ecologically and the assumption of this study is that areas defined as deprived contain a greater proportion of older deprived people subject to fuel poverty. The consistency of Townsend scores between censuses and low levels of migration by older people are likely to make this assumption valid. Ideally, the measure of deprivation used in this study should reflect the determinants of fuel poverty, that is income, housing conditions and house size, among older people. Possible sources of such data in the United Kingdoms are social security benefit claims and data from housing condition surveys conducted by local authorities.

Irrespective of the validity of the measure used, ecological studies cannot definitively prove or disprove relation at the individual level. However, evidence from studies of deprivation and mortality in the United Kingdom suggest that relations at the ecological level reflect relations at the individual level.

CONFOUNDING

This study was able to examine the confounding effects of age, sex, and nursing and residential home deaths. The potential importance of nursing home deaths as confounders in the relation between deprivation and health has been previously described. Control for these factors did not affect the findings of this study. Possible unmeasured confounders in this study are air pollution and social isolation.

The relation between air pollution and seasonal mortality has been explored by other authors. They suggest that controlling for air pollution has little impact on temperature dependent variations in mortality. Furthermore, in our study area, deprived areas were urban areas, which are likely to experience higher levels of air pollution. Thus, the confounding effects of air pollution would increase any positive relation between deprivation and winter mortality.

Social isolation is a potential risk factor for excess winter mortality but, in our population, the proportion of older people living alone was positively associated with deprivation measured by the Townsend Score (Kendall's Z = 0.37, p = 0.006). Thus, social isolation would act as a positive confounder in this study.

IMPLICATIONS

The findings of this study are discordant with individual based studies and this may be the result of better control of confounding factors and the ecological study design. The results are, however, consistent with an analysis that failed to find a relation between central heating availability and seasonal mortality. Similarly, a study of older people with unlimited access to home heating found that they experienced excess winter mortality to the same extent as other older people.

The simplest interpretation of our findings is that deprivation and fuel poverty do not predispose to excess winter mortality as outdoor exposure to the cold or responses to cold indoor temperatures, which are not related to deprivation, are more important determinants. This is consistent with findings from the Eurowinter study and studies of cold related mortality in Russia. However, an alternate explanation is that people in deprived areas are more likely to adopt individual protective measures in response to fuel poverty that reduce its impact or that smaller, crowded accommodation in deprived areas may allow maintenance of adequate indoor temperatures.

There is a need for further study to understand the social and economic determinants of excess winter mortality. Individual based studies with large sample sizes are needed to detect differences in excess winter mortality between study groups. It is possible that existing datasets from large cohort studies may permit analysis of excess winter mortality by factors such as income or housing conditions including access to central heating with adequate control for confounding.

In conclusion, our study highlights that the determinants of excess winter mortality in the
Shah, Peacock

UK are still not adequately understood and that the potential for resolving inequalities in health through action on fuel poverty is not clear. An understanding of the determinants of excess winter mortality is important to guide policy initiatives that aim to improve the health and well-being of older people.

We would like to thank Dr E S Williams, former Director of Public Health at Croydon Health Authority, for permission to use the Croydon Mortality Database and his support of the study. We also wish to thank Ms Catherine Scott, Department of Public Health, Croydon Health Authority who was responsible for developing and maintaining the database.

Conflicts of interest: none.

Funding: none.


Tolerance and reconciliation: the spiritual prerequisites to health

“Tolerance is the highest law in each community and it is that spiritual factor which protects all that is best in the thinking of people. No gain from flood, pass by before they understood another form of courage; that is—to recognise the convictions of their close ones and their right to the freedom of conscience.

Tolerance is the most important consequence of education: in earlier times people fought for and died for their convictions, but many centuries had to elapse before knowledge of the importance of education was generalised and people learned to tolerate convictions different from their own. Tolerance and reconciliation: the spiritual prerequisites to health

Health workers individually, through health services and organisations have a prime duty and responsibility to spread tolerance and do all that is possible to prevent and combat hatred in any form it manifests itself and to work towards reconciliation.

Tolerance is not just the absence of hate. Tolerance is a positive inner, spiritual feeling of security, a desire and willingness to live in peace with all people. Freedom, democracy, human rights, respect, justice, solidarity and reconciliation are the tools that enable us to live in peace with each other. Tolerance is a positive inner, spiritual feeling of security, a desire and willingness to live in peace with all people. Freedom, democracy, human rights, respect, justice, solidarity and reconciliation.

Healthy Cities Conference, Stockholm, 1990

SLOBODAN LANG
JOHN ASHTON