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 deaths (Kendall’s $\tau = -0.066$, $p=0.63$) 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.

Seasonal variations in mortality are well described in the United Kingdom and other industrialised countries. Mortality in England and Wales rises by up to 20% in the period from December to March and this represents approximately 40 000 additional deaths a year. Analyses in a number of countries show that outdoor temperature and influenza incidence are key determinants of excess winter mortality.

Tackling inequalities in health is central to current UK health policy but there is a recognised deficit in our knowledge of its determinants and effective interventions to reduce inequalities. A widely held belief is that excess winter mortality is determined by socioeconomic deprivation and, in particular, fuel poverty. The Acheson Report on Inequalities in Health in the United Kingdom has recommended action on fuel poverty to reduce inequalities in health.

International comparisons of seasonal mortality, which demonstrate greater excess winter mortality in the United Kingdom, support this belief. Similarly social class analysis of routine mortality data and data from the Office for National Statistics Longitudinal Study show a socioeconomic gradient in seasonal mortality. However, other studies have questioned these findings and postulated alternative hypotheses that emphasise behavioural determinants or the importance of brief outdoor exposure to the cold. Differences in the use of outdoor clothing and physical activity may explain international variations in excess winter mortality and the paradox that countries with colder winters experience lower levels of excess winter mortality. There have been no detailed studies that have attempted to test the hypothesis that socioeconomic deprivation predisposes to excess winter mortality.

In this study, we attempt to test this hypothesis in a single district with marked variations in mortality. The restriction of analysis to a relatively small geographical area reduces the potential confounding effect of geographical dispersion of the study population. Also, local data allowed the exclusion of deaths of nursing and residential home residents whose thermal environment is unlikely to be determined by socioeconomic circumstances.

Methods

STUDY DESIGN

The study used ecological comparison at electoral ward level of seasonality ratios and temperature dependent variation in mortality. 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.

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. 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. 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 quintiles</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, χ² for trend = 90.3, p<0.001. After exclusion, χ² for trend=118, p<0.001).

### Table 2: Age and sex standardised seasonality ratios for all deaths by ward deprivation quintiles

<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>
<thead>
<tr>
<th>Ward deprivation quintile</th>
<th>Standardised seasonality ratio (95% confidence intervals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Croydon</td>
<td>119.7 (116.1 to 123.4)</td>
</tr>
</tbody>
</table>

### 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>1.23×10⁻¹</td>
<td>0.381 to 2.09×10⁻¹</td>
<td>0.0046</td>
</tr>
<tr>
<td>Total population</td>
<td>1.39×10⁻¹</td>
<td>1.26 to 1.53×10⁻¹</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>% pop above 65</td>
<td>0.082</td>
<td>0.068 to 0.096</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‡</td>
<td>−2.67×10⁻¹</td>
<td>−0.0018 to 0.0012</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.

### Results

**Descriptive epidemiology of seasonal mortality and inequalities in mortality**

The seasonality ratio for Croydon for 1990 to 1995 was 119.7 (95% CI 116.1 to 123.4). In other words, mortality rates were 20% higher in the winter months of December to March compared with the rest of the year. This represents an additional 1084 deaths. Four hundred and sixty (42%) of these deaths were attributable to cardiovascular disease and 364 (34%) were attributable to respiratory causes. Overall mortality showed marked variation between affluent and deprived wards (table 1). This effect was stronger after exclusion of residential and nursing home deaths.

### 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.1
This is the first detailed study that has exam-
ined 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 popula-
tion 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 ex-
cess winter mortality. Socioeconomic depriva-
tion is used as a proxy for fuel poverty that
describes the inability of households to main-
tain adequate indoor temperatures because of
economic and material circumstances. Sea-
sonal mortality is primarily a phenomenon that
affects older people while measures of depriva-
tion, 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 pro-
portion 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 assump-
tion valid.22,23 Ideally, the measure of depriva-
tion used in this study should reflect the deter-
minants 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 con-
ducted 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 depri-
avation and mortality in the United Kingdom
suggest that relations at the ecological level
reflect relations at the individual level.24

CONFOUNDING
This study was able to examine the confound-
ing effects of age, sex, and nursing and residen-
tial home deaths. The potential importance of
nursing home deaths as confounders in the
relation between deprivation and health has
been previously described.14 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.25 Further-
more, 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 depriva-
tion 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
\( r = 0.37, p = 0.006 \)). 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.2 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.16

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.6 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 under-
stand the social and economic determinants of
excess winter mortality. Individual based studies
with large sample sizes are needed to detect dif-
fences 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

KEY POINTS
- This study confirms the well established
  relation between deprivation and mor-
  tality and the importance of excess winter
  mortality as a contributor to overall mor-
  tality.
- There is no evidence that excess winter
  mortality is greater in deprived areas
  compared with affluent areas.
- Better measures of deprivation and fuel
  poverty in older populations are needed.
- The uncertainties over the determinants
  of excess winter mortality mean that
  interventions must continue investigating
  indoor and outdoor cold exposure and
  behavioural responses to cold weather as
  well as fuel poverty.
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 most important consequence of education: in earlier times people fought for and died for their convictions, but many centuries had to 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 highest law of each community and it is that spiritual factor which protects all that is best in the thinking of people. No loss from flood, no fire, neither destruction of cities and churches by the inimical forces of nature—has not robbed humanity from so many noble lives and intentions as it was destroyed by mutual intolerance.”

Helen Keller (Optimizam, 1931)

Hate is the biggest danger to health and the quality of life. Health workers and health services of all countries and in all communities have the responsibility to inform people about the health consequences of hate and to stimulate them to tolerance and reconciliation—reconciliation is also needed between people and the natural environments to which they owe their sustenance.

Any analysis of our world today shows the enormous presence and spread of hatred as a major force of destruction, suffering and death. It also shows how weak is the ability of the health and other sectors to cure hatred once it has been unleashed. If hatred grows even further, the gap between needs and possibilities for health will grow.

Hate is the most dangerous inner pollution; it is the pollution of the spirit.

Hate can take different forms, hatred in the family through the abuse of children, women and old people, as hatred and abuse of other people because of their political or religious beliefs, because of their (ethnic origin), nationality, physical or medical condition or as universal hate of others. Tolerance towards everybody is the most important spiritual prerequisite 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 evaluating our social relations, inner spirit and consciousness. They are mutually dependent and supportive. Nowhere can tolerance be developed for all times. Everybody should develop, promote, practice, cherish and sustain tolerance. Tolerance includes respect and support for all in freely choosing and living their own way of life. Tolerance also includes co-operation among groups and nations based on the principles of equity, solidarity and respect for all.
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