Age, sex, material deprivation and respiratory mortality

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Summary The aim of this study was to examine the effects of age, sex and social deprivation on mortality rates for respiratory infection. An ecological study was undertaken, using official public health mortality data and population census data for the West Midlands health region, UK. Postcodes at the time of death were used to assign Townsend deprivation scores and the resulting deprivation quintile. Poisson regression analysis was used to estimate the association between respiratory mortality, deprivation quintile, age and sex. In most age groups there was a statistically significant trend of increasing mortality with increasing deprivation. The relative risk for the most deprived was highest in the 45–64 year age-group (RR = 4.4, 95% CI 4.0, 4.8). However, the absolute risks were greater in those aged 75–84 years (RR = 1.3, 95% CI 1.3, 1.4) where the annual death rate was 669 per 100,000. Consistently higher mortality rates were seen in males. These results suggest that the risk of mortality from respiratory infection varies by sex and generally increases with increasing age and deprivation quintile. The identified association between deprivation and mortality from respiratory infections is consistent with the effect of deprivation on many other diseases. Addressing the social determinants of ill health may help to reduce the high burden of respiratory
mortality in the UK. However, individual level studies and examination of other areas are needed to explain the mechanisms by which deprivation increases the risk of mortality from respiratory infection, and thereby identify target groups for effective interventions.

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Introduction

Research has consistently shown that those in lower socioeconomic groups experience poorer health than those in more affluent socioeconomic groups.1–7 Although this relationship is extensively documented in a number of age-groups, particularly the young, it is comparatively less well described in those aged 65 years or more.

Respiratory infections are a common cause of mortality and every year in the UK about 35,000 people, mainly those aged > 65 years, die from pneumonia and other respiratory infections. This is nearly twice the European Union (EU) average and constitutes over 7% of total elderly deaths in the UK.8,9

Given the high interest and importance of socioeconomic risk factors in contributing to ill health, and the impact of respiratory diseases on mortality, there is remarkably little recent data available on the potential association between social deprivation and mortality from respiratory infection. Furthermore, few studies have examined differences across widely different age-groups.

This study uses 1991 census data linked to mortality data for respiratory infections from 1983 to 1999 to examine the effects of age, sex and social deprivation on mortality rates for respiratory infection in the West Midlands health region, UK.

Methods

Anonymized mortality data for the West Midlands Health Region, from 1983 to 1999, were obtained from the official public health mortality files of the Office for National Statistics. Deaths caused by respiratory infections were identified using previously published aggregations of respiratory ICD-9 codes that included acute respiratory infections (460–466), pneumonia (480–486, 770) and influenza (487).10 Between 1984 and 1993 there was a change in interpretation of World Health Organization rule 3,11 referring to the assignment of underlying cause of death. This resulted in a sudden artificial reduction in the number of deaths attributed to certain causes, particularly pneumonia. To adjust for this artificial reduction, we multiplied the number of deaths between 1984 and 1993 by ICD code-specific conversion factors.11

Postcode at time of death was used to identify census enumeration district (ED) and assign a Townsend deprivation score to each. This area-based score is derived from four 1991 census variables (the proportion of households that: are owner-occupied; have no car; are overcrowded, and; have unemployed residents). The more deprived an area, the higher the score.12 EDs were then ranked by deprivation score and divided into five approximately equal deprivation quintiles (from 1 [least deprived] to 5 [most deprived]).

Data were analysed in STATA 5.0 using Poisson regression analysis with log population as an offset to take account of variation in population size, and the variables age, sex and Townsend quintile as covariates. The models were tested for significance and adjusted for over-dispersion or under-dispersion (that is, more or less variation than expected for a Poisson model). Significant interaction ($P < 0.001$) was found between age, sex and Townsend quintile. The effect of deprivation was calculated within each age group separately. For some of the age groups there was also a significant interaction between quintile and sex. We have presented the results for the quintile relative risks averaged across the sexes.

Results

During the 17-year study period, 90,448 deaths were attributed to respiratory infections. Of these 87,479 (96.7%) could be assigned a Townsend score. Table 1 shows death rates and relative risks of death for Townsend quintile score by age-group, adjusted for sex. Death rates increase markedly with increasing age in adults, with highest rates in those aged ≥ 85 years at 36 per 1000 population per year and consistently higher rates in males. With the exception of the oldest age-group, a statistically significant positive mortality trend with increasing deprivation can be seen. The relative risk for the most deprived is highest in the 45–64 year age-group ($RR = 4.4$, 95% CI 4.0, 4.8), where 30% of deaths are in the most deprived quintile. In all age-groups > 75 years the relative risks are greater than two. For the 15–44 year age-group,
Table 1  Adjusted relative risks of death from respiratory infection, West Midlands 1983-99, by Townsend quintile score and age-group

<table>
<thead>
<tr>
<th>Townsend quintile</th>
<th>Relative risk of death (95% CI)</th>
<th>0–4 yr</th>
<th>5–14 yr</th>
<th>15–44 yr</th>
<th>45–64 yr</th>
<th>65–74 yr</th>
<th>75–84 yr</th>
<th>85+yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (least deprived)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1.3 (1.2, 1.5)</td>
<td>1.8 (1.5, 2.2)</td>
<td>1.1 (1.0, 1.3)</td>
<td>1.5 (1.3, 1.7)</td>
<td>1.2 (1.1, 1.3)</td>
<td>1.03 (0.97, 1.09)</td>
<td>0.96 (0.91, 1.02)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.2 (1.0, 1.4)</td>
<td>2.2 (1.8, 2.6)</td>
<td>1.5 (1.3, 1.7)</td>
<td>1.9 (1.7, 2.2)</td>
<td>1.4 (1.3, 1.5)</td>
<td>1.07 (1.01, 1.13)</td>
<td>0.97 (0.92, 1.03)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1.9 (1.6, 2.2)</td>
<td>1.9 (1.6, 2.2)</td>
<td>2.0 (1.8, 2.3)</td>
<td>2.8 (2.5, 3.1)</td>
<td>1.8 (1.7, 2.0)</td>
<td>1.15 (1.09, 1.22)</td>
<td>0.89 (0.84, 0.95)</td>
<td></td>
</tr>
<tr>
<td>5 (most deprived)</td>
<td>2.4 (2.1, 2.8)</td>
<td>2.6 (2.2, 3.0)</td>
<td>3.0 (2.7, 3.4)</td>
<td>4.4 (4.0, 4.8)</td>
<td>2.2 (2.1, 2.4)</td>
<td>1.3 (1.3, 1.4)</td>
<td>0.88 (0.83, 0.94)</td>
<td></td>
</tr>
<tr>
<td>RR (female)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(0.73, 0.84)</td>
<td>(0.83, 1.01)</td>
<td>(0.51, 0.58)</td>
<td>(0.66, 0.74)</td>
<td>(0.65, 0.71)</td>
<td>(0.70, 0.75)</td>
<td>(0.92, 1.01)</td>
<td></td>
</tr>
<tr>
<td>Total deaths (1983–99)</td>
<td>557</td>
<td>96</td>
<td>851</td>
<td>3938</td>
<td>11,072</td>
<td>29,918</td>
<td>41,037</td>
<td></td>
</tr>
<tr>
<td>Population (1991)</td>
<td>351,037</td>
<td>652,025</td>
<td>2,184,504</td>
<td>1,154,745</td>
<td>462,279</td>
<td>263,091</td>
<td>66,591</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10</td>
<td>0.9</td>
<td>3</td>
<td>24</td>
<td>167</td>
<td>803</td>
<td>4166</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>8</td>
<td>0.8</td>
<td>2</td>
<td>16</td>
<td>117</td>
<td>587</td>
<td>3441</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>0.9</td>
<td>2.3</td>
<td>20</td>
<td>141</td>
<td>669</td>
<td>3625</td>
<td></td>
</tr>
</tbody>
</table>
males have twice the mortality risk compared with females.

Discussion

The results of this study suggest that the risk of mortality from respiratory infection varies by sex and generally increases with increasing age and deprivation quintile. Consistently higher mortality rates were seen in males, with those aged 15–44 years having approximately twice the mortality risk of females. Death rates increased markedly with increasing age. Furthermore, within separate age-groups mortality increased with increasing deprivation and was significantly higher in the most deprived quintile compared to the least deprived quintile. However, this relationship was not observed in the oldest age group and the trend appeared to be in the opposite direction. This phenomenon of 'attenuation' has been described previously. It is not clear why 'attenuation' occurs, it may be that in the elderly population factors such as degree of frailty, comorbidities and social support override any effect of deprivation. It may also be that area-level measures of deprivation are not as relevant for the very elderly.

This study is subject to ecological bias, whereby we cannot assume that associations at group level would also hold at the individual level. However, there is evidence to show that deprivation measures at both area-level and individual-level make independent contributions to mortality. In addition, the associations identified are both biologically plausible and in line with the effect of deprivation on other infectious diseases and chronic diseases.

It is possible that the inequalities identified in this study are due primarily to confounding social or environmental factors. The design of this study does not permit examination of potential explanatory variables such as smoking, comorbidities (e.g., chronic lung disease), nursing home residency, housing, heating, cold exposure and vaccination status. Individual level studies as well as examination of other area characteristics are required to quantify the direct effect of deprivation, and clarify the mechanisms by which deprivation increases the risk of mortality from respiratory infection, not only in the elderly, but also younger populations.

The identification of modifiable factors and implementation of proven policy interventions such as improved uptake of influenza and pneumococcal vaccine may reduce the overall impact of deaths from respiratory infections. However, there would need to be strategic targeting of areas and individuals in order to prevent identified inequalities increasing.

Conflict of interest and source of funding

None of the authors have any conflict of interest.

References