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Social deprivation and the causes of stillbirth and infant mortality

Z E S Guildea, D L Fone, F D Dunstan, J R Sibert, P H T Cartlidge

Abstract

**Aims**—To investigate the relation between social deprivation and causes of stillbirth and infant mortality.

**Methods**—Stillbirths and infant deaths in 6347 enumeration districts in Wales were linked with the Townsend score of social deprivation. In 1993–98 there were 211 072 live births, 1147 stillbirths, and 1223 infant deaths. Poisson regression analysis was used to estimate the magnitude of effect for associations between the Townsend score and categories of death by age and the causes of death. The relative risk of death between most and least deprived enumeration districts was derived.

**Results**—Relative risk of combined stillbirth and infant death was 1.53 (95% CI 1.35 to 1.74) in the most deprived compared with the least deprived enumeration districts. The early neonatal mortality rate was not significantly associated with deprivation. Sudden infant death syndrome showed a 307% (95% CI 197% to 456%) increase in mortality across the range of deprivation. Deaths caused by specific conditions and infection were also associated with deprivation, but there was no evidence of a significant association with deaths caused by placental abruption, intrapartum asphyxia, and prematurity.

**Conclusions**—Collaborative public health action at national and local level to target resources in deprived communities and reduce these inequalities in child health is required. Early neonatal mortality rates and deaths from intrapartum asphyxia and prematurity are not significantly associated with deprivation and may be more appropriate quality of clinical care indicators than stillbirth, perinatal, and neonatal mortality rates.

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Keywords: social deprivation; cause of death; stillbirth; mortality

Perinatal and infant mortality rates in Britain also have wide regional variations that may in part reflect an increased incidence of low birth weight and prematurity in low social class families. Yet mortality rates are also likely to be affected by the provision and accessibility of high quality clinical care. Indeed, it is probable that the importance of these influences varies according to the condition leading to death, and in this respect it would be advantageous to know what diseases are less dependent on deprivation.

The aim of this study was therefore to investigate the relation between social and material deprivation and the causes of stillbirth and infant mortality in a geographically defined population. We wished to determine if any causes of death, or categories of death by age (stillbirth/neonatal death/postneonatal death), are less dependent on levels of deprivation and thus more appropriate indicators of the standard of clinical care.

**Subjects and methods**

The data in this study relate to births to women resident in Wales in the six years 1993–98, irrespective of the place of delivery. There were 211 072 registrable births, 1147 stillbirths, and 1223 infant deaths. Live births were identified with the Child Health System (CHS) database, which collects data from the birth notification form. Stillbirths and infant deaths were identified with the All Wales Perinatal Survey (AWPS), a population based register of mortality between 20 completed weeks of gestation and 1 year of age. The AWPS regional coordinating team verified complete ascertainment of mortality by cross checking with data from the CHS database and the Office for National Statistics.

Information about each death was collected on the survey questionnaire, which was normally completed by the team in whose unit the baby died. This included detailed information about the mother (medical and obstetric history, current pregnancy, labour, and delivery) collected prospectively at booking, and the baby (sex, birth weight, gestational age, clinical management, and postmortem findings). This information was used to classify the cause of death according to the clinicopathological system, modified to clarify certain ambiguities and expanded to take account of postneonatal deaths. For the purposes of this study, an accidental death was classified as a specific condition.

All births and deaths were assigned by postcode to the enumeration district of maternal residence using Postpoint Professional in MapInfo, version 5.5. The accuracy of the postcode was checked using the Post Office PAF computer file that links address to postcode.
Table 1  Effect of Townsend (deprivation) score on the combined stillbirth and infant mortality rate

<table>
<thead>
<tr>
<th>Townsend score (range)</th>
<th>Number of stillbirths and infant deaths</th>
<th>Total number of births</th>
<th>Mortality rate (per 1000 births)</th>
<th>Relative risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.92 to 3.13</td>
<td>495</td>
<td>41767</td>
<td>11.85</td>
<td>1.26 (1.1, 1.44)</td>
</tr>
<tr>
<td>3.13 to 10.79</td>
<td>602</td>
<td>41779</td>
<td>14.41</td>
<td>1.53 (1.35, 1.74)</td>
</tr>
<tr>
<td>−0.77 to 0.92</td>
<td>450</td>
<td>41744</td>
<td>10.78</td>
<td>1.15 (0.98, 1.32)</td>
</tr>
<tr>
<td>0.25 to −2.54</td>
<td>426</td>
<td>41765</td>
<td>10.2</td>
<td>1.08 (0.94, 1.24)</td>
</tr>
<tr>
<td>−2.54 to −0.77</td>
<td>393</td>
<td>41778</td>
<td>9.41</td>
<td>1.00</td>
</tr>
<tr>
<td>−7.55 to −2.54</td>
<td>426</td>
<td>41765</td>
<td>10.2</td>
<td>1.08 (0.94, 1.24)</td>
</tr>
</tbody>
</table>

Table 2  Association between age at death and Townsend score

<table>
<thead>
<tr>
<th>Number of deaths</th>
<th>Magnitude of effect (%) (95% CI)</th>
<th>Increase in mortality rate over range (%)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perinatal</td>
<td>3.2 (1.7, 4.6)</td>
<td>29 (15, 45)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Neonatal</td>
<td>2.2 (0.04, 4)</td>
<td>20 (0, 42)</td>
<td>0.0483</td>
</tr>
<tr>
<td>Infant</td>
<td>5.1 (3.3, 6.8)</td>
<td>50 (30, 71)</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

For stillbirths and neonatal deaths the post-code used was that of the mother at the time of delivery, and for postneonatal deaths that of the infant at the time of death. Postcodes were missing or invalid in 2259 (1.1%) registrable births and 4 (0.17%) deaths; these cases were excluded from the analysis.

The Townsend social and material deprivation score is calculated using unemployment, car ownership, owner occupation, and overcrowding variables derived from the 1991 census. The individual score for each component was standardised to zero mean and unit variance across the enumeration districts in England and Wales. The Townsend score ranged from −7.55 in the least deprived enumeration district to +10.79 in the most deprived.

The relations between social deprivation and death were initially explored by ranking the enumeration districts according to Townsend score, dividing them into quintiles with approximately equal numbers of births in each, and comparing total mortality rates between the quintiles. The associations between the various categories of death by age (stillbirth, neonatal death, etc), the causes of death, and deprivation were quantified using Poisson regression analysis on data from individual enumeration districts. In each situation the magnitude of the effect, defined as the percentage change in the mortality rate arising from a unit change in the Townsend score, was determined. From this the percentage increase in the mortality rate between the median Townsend score in the least deprived quintile and median Townsend score in the most deprived quintile of births in Wales was estimated. All analyses were performed using SAS and SPSS.

Results

The combined stillbirth and infant mortality rate in individual enumeration districts ranged from 0/1000 registrable births to 333.3/1000 (median 0, interquartile range 0 to 17.6). No deaths were reported from 4536/6347 (71%) enumeration districts that had births between 1993 and 1998.

The combined stillbirth and infant mortality rate increased according to the level of social deprivation (Townsend score), from 9.41/1000 in the least deprived quintile, to 14.41/1000 in the most deprived quintile, a relative risk of death of 1.53 (95% confidence interval (CI) 1.35 to 1.74; table 1).

Using Poisson regression we found that stillbirths, neonatal, and postneonatal mortality rates within enumeration districts were each significantly associated with the Townsend score of deprivation (table 2). The strongest association was for postneonatal mortality, with a magnitude of effect of 10.1% (95% CI 7.2 to 13), equivalent to an increase in mortality rate across the range of deprivation of 120% (95% CI 77% to 172%). For stillbirths the magnitude of effect was 4.3% (41% across the whole range) and for neonatal deaths the magnitude of effect was 2.2% (20% across the range). However, the association with neonatal death varied according to the age at death. In late neonatal deaths the association was significant (p = 0.008) with a magnitude of effect of 5.9% (95% CI 1.4% to 10.3%). In contrast, for early neonatal deaths the magnitude of effect was only 1% (95% CI −1.6% to 3.6%), equivalent to an increase in mortality rate across the range of deprivation of 8% (95% CI −14% to 34%; p = 0.4399).

The cause of death most strongly associated with social deprivation was sudden infant death syndrome, with a magnitude of effect of 18.7% (95% CI 14.2% to 23.3%), equivalent to an increase in mortality rate across the range of 307% (95% CI 197% to 456%). Similarly, death caused by an unexplained stillbirth, infection, and a specific condition was also significantly associated with deprivation (table 3). In contrast, there was no significant association between social deprivation and death caused by placental abruption prior to the onset of labour, intrapartum asphyxia, congenital anomaly, and conditions consequent on preterm birth.
Discussion

This population based ecological study has shown a significant association between stillbirth and infant death and social deprivation. The relative risk of death occurring between 24 weeks gestation and 1 year of age was 1.53 times higher in the most deprived enumeration districts in Wales compared to the least deprived. Two other studies have been reported using a similar methodology. In Derbyshire, an investigation of 129 post perinatal deaths using the Jarman underprivileged area index found a relative risk of death of 1.93, and in North West Thames using the Carstairs deprivation index applied to 4243 perinatal deaths, a relative risk of 1.65 was found between the extremes of deprivation.10 11 The lower risk in the latter study is probably related to the varying influence of deprivation on mortality rates that is dependent on the age at death of the baby. This is consistent with the findings in our study, in which postneonatal deaths were increased by 120% in the most deprived enumeration districts compared to the least deprived, stillbirths were increased by 41%, and neonatal deaths by 20%. We also found a significant association between social deprivation and deaths caused by unexplained stillbirth, infection, a specific condition, and in particular the sudden infant death syndrome. In contrast, death caused by intrapartum asphyxia, congenital anomalies, prematurity, and also early neonatal deaths were not significantly associated with deprivation. Nevertheless, since there are a large number of early neonatal deaths and deaths caused by prematurity, even a small effect, which cannot be excluded by our analysis, could result in a large number of deaths.

Public Health

The high rate of stillbirth and infant mortality in deprived areas is a cause of great concern and will be distressing to many people within those communities. Reducing inequalities in mortality requires collaborative action within communities, and improvements in wider economic and educational environments. This is particularly relevant given that the trends in the social determinants of stillbirth and infant death in Britain are not encouraging. The proportion of 15 year old girls who are regular cigarette smokers increased from 25% in 1982 to 29% in 1998, the conception rate in under 16 year olds remains high, and the percentage of low birthweight babies is rising.12 13 The evidence for effective interventions to reduce health inequalities is highlighted in the Acheson report, Independent inquiry into inequalities in health.14 The report recommends action to reduce poverty in families, improve the nutrition of women and children, promote sexual health, reduce the prevalence of smoking in pregnancy, reduce alcohol related harm, and promote breast feeding, and advocates the social and emotional support of parents. In addition there need to be improvements in education, housing, employment, and the physical environment. These are political objectives that are best achieved by working across traditional government departmental boundaries to promote better public health.

Appendix

Definitions of Mortality Rates

- Stillbirths—late fetal deaths after 24 weeks gestation
- Early neonatal—deaths occurring in the first six days of life
- Perinatal—stillbirths, and deaths in the first six days of life
- Late neonatal—deaths at 7–27 completed days of life
- Neonatal—deaths in the first 27 completed days of life
- Postneonatal—deaths at age 28 days and over but under 1 year
- Infant—deaths at age under 1 year (excluding stillbirths).
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