Childhood Socioeconomic Position and Adult Cardiovascular Mortality: The Boyd Orr Cohort

Stephen Frankel, George Davey Smith, and David Gunnell

The relation between childhood socioeconomic position and adult cardiovascular mortality is examined in 3,750 individuals whose families took part in the Carnegie survey of family diet and health in England and Scotland between 1937 and 1939. The trend in coronary heart disease mortality across social position groups was not statistically significant at conventional levels (p = 0.12), while a strong linear trend was seen for stroke mortality (p = 0.01). Adjustment for the Townsend deprivation index of area of residence during adult life did not materially alter these findings, indicating that the effects of socioeconomic influences upon particular cardiovascular diseases differ according to the age at which they are experienced. Am J Epidemiol 1999:150:1081-4.

Epidemiologic interest has shifted over recent years from an almost exclusive interest in adult risk factors toward examining the extent to which adult disease may represent the outcome of processes occurring early in life. The relevance of this work to understanding mechanisms of disease and to guiding preventive strategies lies in determining the relative importance of early and later life influences and the interactions between them (1, 2). The broad impact of socioeconomic influences upon health is well known, but it is now becoming clear that these may have a cumulative effect over the life course (3) and that different disease outcomes may be influenced by socioeconomic circumstances prevailing at different stages of life (4). Here we investigate the extent to which cardiovascular disease may be associated with social position in childhood by means of a 60-year follow-up of a cohort of children studied in the 1930s.

MATERIALS AND METHODS

The methods used to establish the Boyd Orr Cohort have been described elsewhere (5, 6). The material is drawn from the original records of the Carnegie survey of family diet and health in pre-war Britain, which was carried out on 1,352 families living in 16 urban and rural centers in England and Scotland between 1937 and 1939. The centers were chosen to reflect particular industrial and social conditions. The original purpose of the pre-war survey was to investigate the diets of families with children and in particular associations between diet, food expenditure, and the children's health. The researchers aimed to survey all families whose children attended particular schools, chosen on the advice of the local Medical Officer of Health (7).

The National Health Service Central Register has been used to trace the 4,973 children whose families participated in the survey. Survey members who were alive and resident in Britain on January 1, 1948, are included in the mortality analyses that are based on deaths occurring up to September 30, 1997. Of this total population of 4,900, 767 were not traced, 293 individuals could not be assigned to social classes I-V or identified as unemployed, and data were missing for date of death (n = 8) and adult deprivation (Townsend) score (n = 87); five subjects had missing data for more than one of these variables. The analyses presented here are therefore based upon a total sample of 3,750.

The social position in childhood was classified according to the Registrar General's Decennial Supplement for 1931, and assignment was on the basis of the occupation of the male head of household. Social position was categorized into five groups: 1) I (professional and higher managerial) and II (intermediate); 2) III (skilled workers); 3) IV (semiskilled workers); 4) V (unskilled workers); and 5) unemployed. The proportion of subjects whose fathers were unemployed was high (33 percent). This was because the survey was carried out at a time of high unemployment (12 percent of the working population were unemployed) (8), and the survey sample was selectively drawn from families living
in economically deprived areas. The weekly per capita household food expenditure was also assessed in the original pre-war survey, and we have used this to assess the validity of our measure of childhood social position. In the absence of information on the adult occupation of study members, an aggregate census-based measure, the Townsend index, was used as a proxy measure of adult socioeconomic position. The Townsend index is constructed from census data on levels of car ownership, unemployment, overcrowded housing, and housing tenure in the subject's Health Authority of residence (9). Deaths due to coronary heart disease and stroke were those with International Classification of Diseases, Ninth Revision, codes 410–414 and 430–438, respectively.

Tests for trend for mean household expenditure and Townsend deprivation score for the area of current residence or area of residence at the time of emigration or death were performed by linear regression of each continuous variable on childhood social position. Hazard ratios for the effects of childhood social position on mortality were determined using Cox proportional hazards models as four dummy variables for each outcome of interest, adjusted for age, with social class III regarded as the reference category. These analyses were repeated with the Townsend deprivation score entered into the models to adjust for the level of adult deprivation for the area of current residence or area of residence at the time of emigration or death. Tests for trend for mortality rates across social position groups were performed by entering social position as a continuous variable into Cox proportional hazards models for each outcome of interest, adjusted for age, with social class III regarded as the reference category. These analyses were repeated with the Townsend deprivation score entered into the models to adjust for the level of adult deprivation for the area of current residence or area of residence at the time of emigration or death. Tests for trend for mortality rates across social position groups were performed by entering social position as a continuous variable into Cox proportional hazards models for each outcome of interest. We included the unemployed category of childhood social position in trend tests, as household food expenditure in the unemployed families was lower than in other families as is the Townsend score for current area of residence (table 1). To determine whether the associations between Townsend score and mortality were consistent with a linear trend, we performed likelihood ratio tests comparing models with quintiles of Townsend score fitted as either four dummy variables or as a single linear term. Proportional hazards models were stratified for sex and district of residence at the time of the original survey. The analyses were repeated with interaction terms to test for interactions between sex and social position and between social position and adult Townsend score. Analyses were performed using Stata software (10).

RESULTS

The mean household expenditure at the time of the survey shows a clear negative trend across childhood social position groups (p < 0.001), with the children of families experiencing unemployment having approximately half the household expenditure of social classes I and II (table 1). The Townsend score, reflecting levels of deprivation in the area of adult residence, shows a similar trend. The range of adult Townsend scores across the childhood social position groups was from −1.11 to 1.03 (a lower score implies relative affluence). The range of values across quintiles of Townsend scores was from −3.27 (standard deviation = 0.51) to 7.58 (standard deviation = 4.89). The correlation coefficients between childhood social class and Townsend score and between childhood household expenditure and Townsend deprivation score were 0.14 and −0.12, respectively.

An association between childhood social position and age-adjusted all-cause mortality was seen, with the hazard ratio rising from 0.84 for social classes I and II to 1.28 for the unemployed and with a clear trend across the social position groups (p = 0.004) (table 2). The hazard ratios for coronary heart disease mortality were raised in those from more deprived childhoods, with those in social classes I and II in childhood having lower mortality than the other more deprived childhood groups. The trend in coronary heart disease mortality across social position groups was not statistically significant at conventional levels (p = 0.12). A strong trend

<p>| TABLE 1. Frequencies and mean age, household expenditure, and Townsend score by childhood social position, Boyd Orr Cohort, England and Scotland, 1937–1939 |</p>
<table>
<thead>
<tr>
<th>Social position*</th>
<th>No.</th>
<th>%</th>
<th>Age at time of survey (years)</th>
<th>Mean household expenditure (£/week)</th>
<th>Townsend score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I and II</td>
<td>252</td>
<td>6.7</td>
<td>8.7 (4.9)†</td>
<td>0.51 (0.18)</td>
<td>−1.11 (2.69)</td>
</tr>
<tr>
<td>III</td>
<td>721</td>
<td>19.2</td>
<td>6.9 (4.7)</td>
<td>0.37 (0.12)</td>
<td>−0.24 (4.02)</td>
</tr>
<tr>
<td>IV</td>
<td>888</td>
<td>23.7</td>
<td>7.1 (4.7)</td>
<td>0.36 (0.09)</td>
<td>−0.35 (2.93)</td>
</tr>
<tr>
<td>V</td>
<td>640</td>
<td>17.0</td>
<td>7.2 (4.9)</td>
<td>0.31 (0.09)</td>
<td>0.66 (5.2)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>1,249</td>
<td>33.3</td>
<td>6.4 (4.7)</td>
<td>0.25 (0.07)</td>
<td>1.03 (4.75)</td>
</tr>
</tbody>
</table>

Trend test

* Social position groups: I, professional and higher managerial; II, intermediate; III, skilled workers; IV, semi-skilled workers; V, unskilled workers.
† Numbers in parentheses, standard deviation.

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TABLE 2. Hazard ratios and 95% confidence intervals for mortality (up to October 1997) in each childhood social position group (1937–1939) adjusted for age and for age and adult Townsend score, stratified by sex and district, Boyd Orr Cohort, England and Scotland

<table>
<thead>
<tr>
<th>Social position*</th>
<th>All causes of death (n = 776)</th>
<th>CHD† (n = 189)</th>
<th>Stroke (n = 50)</th>
<th>All causes except CHD/stroke (n = 537)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age adjusted</td>
<td>Age and Townsend adjusted</td>
<td>Age adjusted</td>
<td>Age and Townsend adjusted</td>
</tr>
<tr>
<td>I and II</td>
<td>0.84 (0.61, 1.22)†</td>
<td>0.41 (0.19, 0.98)</td>
<td>0.80 (0.55, 1.15)</td>
<td>0.81 (0.55, 1.17)</td>
</tr>
<tr>
<td>III</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
</tr>
<tr>
<td>IV</td>
<td>1.16 (0.99, 1.49)</td>
<td>0.98 (0.76, 1.28)</td>
<td>1.15 (0.91, 1.47)</td>
<td>1.20 (0.96, 1.51)</td>
</tr>
<tr>
<td>V</td>
<td>1.20 (1.03, 1.50)</td>
<td>1.14 (0.71, 1.79)</td>
<td>1.40 (0.65, 2.96)</td>
<td>1.66 (0.87, 3.21)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>1.28 (1.05, 1.56)</td>
<td>1.04 (0.68, 1.59)</td>
<td>2.99 (2.10, 4.36)</td>
<td>1.04 (0.80, 1.35)</td>
</tr>
</tbody>
</table>

Trend  
\( p = 0.004 \)  \( p = 0.006 \)  \( p = 0.12 \)  \( p = 0.15 \)  \( p = 0.01 \)  \( p = 0.01 \)  \( p = 0.09 \)  \( p = 0.10 \)

* Social position groups: I, professional and higher managerial; II, intermediate; III, skilled workers; IV, semiskilled workers; V, unskilled workers.
† CHD, coronary heart disease.
‡ Numbers in parentheses, confidence intervals.

Values for the likelihood ratio tests comparing the models with Townsend score as a categorical or linear term suggested that the associations were consistent with a linear trend. The \( p \) values for the likelihood ratio tests comparing the two models were as follows: all-cause mortality (\( p = 0.18 \); coronary heart disease (\( p = 0.33 \); stroke (\( p = 0.27 \); and deaths other than coronary heart disease and stroke (\( p = 0.27 \). In these fully adjusted models including terms for age, Townsend score (as a linear variable), and social position, the hazard ratios for adult Townsend scores were the following: in relation to all-cause mortality (hazard ratio = 1.02; 95 percent confidence interval: 1.00, 1.04; \( p = 0.01 \) and coronary heart disease mortality (hazard ratio = 1.04; 95 percent confidence interval: 1.01, 1.08; \( p = 0.02 \); however, there was no significant trend in relation to stroke mortality (hazard ratio = 1.05; 95 percent confidence interval: 0.98, 1.12; \( p = 0.2 \) or for deaths other than coronary heart disease and stroke (hazard ratio = 1.01; 95 percent confidence interval: 0.99, 1.04; \( p = 0.2 \). No significant interactions between sex and social position or between childhood and adulthood socioeconomic measures were found in relation to all-cause, coronary heart disease, and stroke mortality.

**DISCUSSION**

These findings indicate that the effects of socioeconomic influences upon particular cardiovascular diseases differ according to the age at which they are experienced. The overall disadvantageous effects of deprivation in early life upon all-cause mortality are seen to correspond with a strong and graded trend in stroke mortality but a less marked trend in coronary heart disease.

Before this differential effect of socioeconomic circumstances upon these two forms of cardiovascular disease can be interpreted, the alternative explanation must be considered, that is, that social position in childhood is simply a marker for lifetime social circumstances. The finding that the associations between childhood social position and coronary heart disease, stroke, and other causes of death are different from those in relation to the adult Townsend score is an indication of a true difference between childhood and adult effects. In the absence of a direct measure of the subject’s adult social class, this was the best proxy measure available to us, although we recognize that this ecologic marker may not fully adjust for the effects of adult social class.

Social position in childhood does appear to be a robust marker for childhood living conditions, as is shown by the stepped differences in mean household food expenditure in the five social position groups. The unemployed are the most deprived, as shown by their mean household food expenditure, and in line with contemporary evidence (11). An association was found between childhood social position and adult living conditions, but this is not strong; the range of mean Townsend scores across childhood social position groups is small in comparison with the range across Townsend score fifths, and the correlations between Townsend score and both childhood social position and household expenditure were low. Finally the trivial effects of entering the Townsend score into models of childhood social position upon mortality indicate that these influences are operating through different pathways, and that childhood social position is not simply a proxy for adult living conditions. It therefore does appear that individuals carry throughout their
lives a risk of stroke set in childhood and one more marked than the equivalent effect of childhood social circumstances upon the later risk of coronary heart disease.

This study closely replicates findings from the West of Scotland (4) and Norway, where height was negatively associated with stroke mortality; shorter stature can be regarded as a marker for those unfavorable conditions during early life that contribute to risk of stroke (12). This effect did not emerge in a study of middle-aged US women (13), and one other study showed no association between stroke and the father’s social class, but this was a prevalence study of nonfatal stroke, and selective survival differences may have influenced the findings (14).

The delineation of these differences in the timing of socioeconomic factors upon these two forms of cardiovascular mortality is relevant to interpreting the epidemiology of coronary heart disease and stroke. It is striking that, while these conditions share so many adult risk factors, including hypertension, smoking, and obesity, the time trends and geographic patterns of the two diseases differ (15). There is a clear relation between stroke mortality and deprivation, but the complexity of this relation (16) may be explicable by the interaction between deprivation at an early age and later factors. Studies of this sort are consistent with patterns of disease arising from interactions between influences operating at different ages (17). These findings strengthen the case that the origins of cardiovascular disease must be sought through investigation of factors operating throughout the life course.

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REFERENCES

10. StataCorp. Stata statistical software, release 5.0. College Station, TX: Stata Corporation, 1996.

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