Childhood socio-economic position and risk of coronary heart disease in middle age: a study of 49 321 male conscripts

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Background: Poor social circumstances in childhood are associated with increased risk of coronary heart disease (CHD). In previous studies, social circumstances and risk factors in adulthood have been suggested to explain this association. In the present study, we included potential explanatory factors from childhood and adolescence. Methods: We investigated the association between childhood socio-economic position (SEP) and CHD in middle age among 49 321 Swedish males, born during 1949–51, who were conscripted for military service at 18–20 years of age. Register-based data on childhood social circumstances, educational attainment and occupational class in adulthood were used in combination with information on cognitive ability, smoking, body mass index and body height in late adolescence obtained from a compulsory conscription examination. Incidence of CHD from 1991 to 2007 (between 40 and 58 years of age) was followed in national registers. Results: We demonstrated an inverse association between childhood SEP and CHD in middle age: among men with the lowest childhood SEP the crude hazard ratio of CHD was 1.47 (95% CI = 1.30–1.67). Adjustment for crowded housing in childhood, body height, cognitive ability, smoking and BMI in late adolescence attenuated relative risks of CHD considerably. Additional adjustment for educational level had a further, although limited, attenuating effect on associations, but additional adjustment for occupational class had no such effect. Conclusions: Results showed that social, cognitive and behavioural factors evident prior to adulthood may be of greater importance in explaining the association between childhood SEP and CHD later in life than socio-economic indicators in adulthood.

Keywords: conscription cohort, coronary heart disease, life course, socio-economic position

Introduction

Being born into disadvantaged socio-economic circumstances is associated with an increased risk of coronary heart disease (CHD), as well as other common causes of death.1–3 Robust inverse associations between childhood socio-economic circumstances and CHD later in life have been found in most of the previous studies.4 Childhood social disadvantage have been recognized as a possible CHD risk factor per se, but the importance of continuous social disadvantage may have been emphasized even more as an explanation. Adjustment for indicators of social circumstances in adulthood has been found to weaken the association between childhood social disadvantage and CHD in several studies.2,4,5 However, we find that explanations of the relationship have been based on studies with limited information on, for instance, pre-adult differences in cognitive ability and health behaviours, which may have led to an overestimation of the relative importance of adult social circumstances. We know from previous research that lower childhood socio-economic positions (SEPs) are associated with poorer cognitive development6,7 and higher prevalence of behaviour-related risk factors in adolescence and early adulthood.8–10

Some of the previous studies of the relationship between socio-economic circumstances in childhood and later CHD have been register based, with the advantage of prospectively gathered information on SEP. Associations have been stronger in this kind of studies than in studies based on recall of childhood circumstances, likely due to better classification of childhood SEP.11,12 However, register-based studies generally have lacked information on factors from pre-adulthood that may be important in explaining associations. The few previous studies on Swedish data containing analyses of associations between childhood SEP and CHD have not included such information.3,14,15

The present study was aimed at answering the following questions: (i) Is childhood SEP associated with CHD in middle age among Swedish men? (ii) If so, to what extent do other indicators of social circumstances in childhood, cognitive ability and behavioural factors in late adolescence, final educational level and occupational class in adulthood contribute to explain the association? In the study, a cohort of almost 50 000 Swedish male conscripts born around 1950
were followed with regard to fatal and non-fatal cases of CHD between 40 and 58 years of age.

Method

The study was based on data from a nationwide survey of all Swedish males who were conscripted for compulsory military service in 1969/1970. Only 2–3% of all Swedish men were exempted from conscription at that time, in most cases due to severe handicaps or congenital disorders. Only men born during 1949–51 were included in this study, accounting for 97.7% of all conscripts in 1969/1970. The remaining 2.3% were born before 1949.

At any of the seven regional conscription centres in Sweden, the men went through an extensive health examination. All conscripts were seen by a physician who diagnosed any disorders according to the Swedish version of ICD, eighth revision (ICD-8). During the conscription examination, the men were also asked to complete two extensive questionnaires, of which the first contained questions on social and behavioural factors while the second contained questions that dealt specifically with substance use, e.g. tobacco smoking.

Childhood SEP

Information on parental SEP was obtained from The National Population and Housing Census of 1960 (response rate 99%). The study subjects were 9 to 11 years old at that time. The conscripts and their parents (or any other head of household if different from the biological parents) were linked to each other between censuses through their personal identification numbers by Statistics Sweden. A classification into six socio-economic groups was used, based on information on the occupation of the head of the household (the father, if present): (i) unskilled workers, (ii) skilled workers, (iii) assistant non-manual employees, (iv) non-manual employees at intermediate or higher level, (v) farmers and (vi) those that could not be classified into a socio-economic group (among whom 40% lived with their biological mother only and no more than ~30% with both biological parents). The farmer category is likely to consist of men in different socio-economic circumstances. Self-employed people were not possible to identify in the 1960 census and instead classified according to occupation. For 2.2% of the men, information on childhood SEP was missing.

Potential explanatory factors

Crowded housing in childhood and body height were used as indicators of early-life social conditions that may vary within SEPs. Information on crowded housing was obtained from The National Population and Housing Census of 1960, and more than two people per room (kitchen not included) was classified as crowded.

Information on the following potential explanatory factors were obtained from the conscription examination: body mass index, based on measurements of weight and height \(\text{BMI} = \frac{\text{weight in kg}}{\text{height in m}^2}\); body height; smoking divided into five levels (from 0 to >20 cigarettes/day), which was reported in a questionnaire; and general cognitive ability over nine levels, based on a multidimensional intelligence test. Information on systolic/diastolic blood pressure and sports activities were also available from the conscription examination, but these variables were excluded from the final analyses of this study due to their minor contributions in models.

Information on final educational level was obtained from The Longitudinal Database of Education, Income and Occupation (LOUISE) of 1990, held by Statistics Sweden. A variable based on years in education was used. Information on occupational class in adulthood was obtained from The National Population and Housing Census of 1990 (response rate >98%), and a classification into the following eight occupational classes was conducted by Statistics Sweden: unskilled workers, skilled workers, assistant non-manual employees, non-manual employees at intermediate level, non-manual employees at higher level, farmers, self-employed and those for whom no occupation was reported.

Outcomes

Information on CHD between 1991 and 2007 was obtained by record linkage with the National Hospital Discharge Register (HDR), administered by the Center for Epidemiology at the National Board of Health and Welfare in Sweden. From 1987 HDR covers all public in-patient care in Sweden. Personal records were also linked with the National Cause of Death Register for information on fatal CHD. Codes for CHD according to International Classification of Diseases (ICD code) were as follows: eighth revision (ICD-8): 410–414, ninth revision (ICD-9): 410–414 and tenth revision (ICD-10): I20–I25.

Statistical analyses

Cox proportional-hazards regression was used for the analyses of the association between childhood SEP and incidence of CHD. Men who emigrated during follow-up were censored on the day of first emigration regardless of any re-migration during follow-up. Hazard ratios (HR), with 95% confidence intervals, were estimated in crude and adjusted models of the association using the PHREG procedure (Cox proportional-hazards regression) in the SAS computer package. The LIFETEST procedure in SAS was used to test the proportionality assumption.

In Sweden, farmers are in general self-employed and it is considered unclear how they compare hierarchically with manual workers and non-manual employees. In the analyses on test of trend over socio-economic groups (table 4) farmers (as well as the unclassified) were therefore excluded.

Results

From the cohort, 45 499 men could be used for analyses within the present study. Inclusion criteria are shown in table 1.

Table 2 shows the similarity between the population used in the analyses (only subjects with full information) and a total population in which subjects with any missing information are also included.

Table 3 shows the distribution of explanatory risk factors, measured between 10 and 40 years of age approximately, in relation to childhood SEP. The risk factors increase considerably in prevalence with descending childhood SEP. For instance, low final educational level were about three times, and crowded housing in childhood four times, as common in men whose father was an unskilled worker as compared to men whose father was a non-manual worker on high or
Table 2 Prevalence or means with SD of potential explanatory factors measured between approximately 10 and 40 years of age among Swedish men born in 1949–51

<table>
<thead>
<tr>
<th>Factor</th>
<th>Totala</th>
<th>Analyticalb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>48.282</td>
<td>45.499</td>
</tr>
<tr>
<td>Crowded housing at ~10 years of age</td>
<td>20.6 (47.457)</td>
<td>20.6</td>
</tr>
<tr>
<td>Height at ~18 years of age</td>
<td>178.21 (SD = 6.35) (47.868)</td>
<td>178.20 (6.34)</td>
</tr>
<tr>
<td>Cognitive ability at ~18 years of agec</td>
<td>5.40 (SD = 2.06) (47.780)</td>
<td>5.39 (2.05)</td>
</tr>
<tr>
<td>Smoking at ~18 years of age</td>
<td>58.4 (47.507)</td>
<td>58.2</td>
</tr>
<tr>
<td>BMI (kg/m²) at ~18 years of age</td>
<td>20.98 (SD = 2.56) (47.873)</td>
<td>20.96 (2.56)</td>
</tr>
<tr>
<td>Education &lt;3 years</td>
<td>26.2 (47.562)</td>
<td>26.2</td>
</tr>
<tr>
<td>Unskilled manual work at ~40 years of age (%)d</td>
<td>19.2 (44.727)</td>
<td>19.1</td>
</tr>
</tbody>
</table>

a: Total population = subjects alive at baseline of follow-up (number of subjects with information on the specific variable in parenthesis)
b: Analytical population = subjects with information on all variables used in the study
c: General cognitive ability over nine levels measured during the conscription examination
d: Calculations excluded 2960 men who could not be classified on SEP in 1990

Table 3 Prevalence or means (with SD) of potential explanatory factors measured between approximately 10 and 40 years of age among Swedish men born in 1949–51, in relation to childhood SEP in 1960

<table>
<thead>
<tr>
<th>Childhood/parental SEP</th>
<th>Non-manual worker</th>
<th>Manual worker</th>
<th>Farmer</th>
<th>Unclassified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High/mid (%)</td>
<td>Low (%)</td>
<td>Skilled (%)</td>
<td>Unskilled (%)</td>
</tr>
<tr>
<td>N</td>
<td>9945</td>
<td>4660</td>
<td>9826</td>
<td>15102</td>
</tr>
<tr>
<td>Height</td>
<td>7.5</td>
<td>11.2</td>
<td>25.1</td>
<td>29.5</td>
</tr>
<tr>
<td>Crowded housing at ~10 years of age (%)</td>
<td>179.27 (6.26)</td>
<td>178.95 (6.30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive ability at ~18 years of agec</td>
<td>6.36 (1.89)</td>
<td>5.91 (1.89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking at ~18 years of age (%)</td>
<td>55.0</td>
<td>57.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²) at ~18 years of age (%)</td>
<td>20.66 (2.35)</td>
<td>20.81 (2.48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education &lt;3 years</td>
<td>11.7</td>
<td>16.7</td>
<td>27.6</td>
<td>34.0</td>
</tr>
<tr>
<td>Unskilled manual work at ~40 years of age (%)d</td>
<td>10.6</td>
<td>13.1</td>
<td></td>
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</tr>
</tbody>
</table>

a: General cognitive ability over nine levels measured during the conscription examination
b: Calculation excluded 2960 men who could not be classified on SEP in 1990

discussion

In summary, we demonstrated an inverse association between childhood SEP and risk of CHD followed between 40 and 58 years of age in a large cohort of Swedish men. Adjustment for crowded housing in childhood, body height, cognitive ability, smoking and BMI in late adolescence attenuated relative risks of CHD considerably. Additional adjustment for final educational level had a further, although limited, attenuating effect on the association, but additional adjustment for occupational class in adulthood had no such effect. Men whose father could not be classified into a SEP in 1960 had the highest relative risk of CHD during follow-up both before and after full adjustments of the association.
Comparison with previous studies

Most previous studies have reported inverse associations between socio-economic circumstances in childhood and later-life CHD. In a systematic review, the authors found that 31 out of the 40 studies demonstrated robust inverse associations. They concluded that associations between childhood social circumstances and CHD were often considerably diminished after adjustments for indicators of social circumstances and cardiovascular risk factors in adulthood. Results of studies on younger cohorts included in a more recent review by the same authors were consistent with this conclusion.

In the present study, the association between childhood SEP and CHD was attenuated after adjustment for indicators of poor childhood social circumstances (height and crowded housing) that may vary between subjects within a childhood SEP. Although this could be considered as overadjustment, it helped to examine whether social circumstances in childhood may contribute to long-term risk of CHD. Height and crowded housing in childhood have been used in previous studies as indicators of childhood socio-economic circumstances, and both have been shown to be independent predictors of CVD. Further, we found that lower childhood SEP predicted low cognitive ability, smoking and overweight in late adolescence, and that these behaviour-related factors mediated the relationship between childhood SEP and CHD in middle age. The importance of childhood SEP in cognitive development is well-established, as is its importance to early adoption of health behaviours. The association between childhood SEP and later-life CHD has previously been shown to diminish after adjustment for cognitive ability. Smoking and high BMI have, among other traditional CVD risk factors, been found to contribute strongly to the association between childhood SEP and CHD, when adjusted for in previous studies.

In the present study, the category of men whose father was a farmer had the lowest rate of smoking in late adolescence among socio-economic groups in childhood, but these men also had a low final educational level as adults. In populations in general, a relatively low smoking rate would be expected to associate with a higher final educational level.

We found that adjustments for educational level and occupational class in adulthood attenuated the associations between childhood SEP and CHD. However, we also found that the attenuating effect of adjustments for education and occupational class was small or none when indicators of social circumstances in childhood and cognitive ability, smoking and BMI in late adolescence had already been adjusted for. Several previous studies have found stronger mediation by education and occupational class, but these studies did not include information on factors that may confound associations between education/occupation and CVD. Findings in these studies may thus have resulted from incomplete mediation analyses.

Interpretation of findings

How may the associations between childhood socio-economic circumstances and CHD later in life be explained? Kuh and co-authors proposed some major hypotheses of relevance. First, a poor childhood socio-economic environment may have negative effects on biological development, which determines health and resilience to environmental insults in adulthood. Possibly, the effects of childhood SEP, crowded housing and body height seen in the present study may reflect such a mechanism, in which early environmental circumstances and CHD later in life may be explained. A poor and distressful childhood environment may have negative effects on biological development, which may contribute to a long-term risk of CHD. Height and crowded housing in childhood have been used in previous studies as indicators of childhood socio-economic circumstances, and both have been shown to be independent predictors of CVD.

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present study. Previous studies showing that poor social circumstances in childhood are associated with compromised cognitive development, as well as increased risk factor prevalence and clustering of risk factors in adolescents and young adults, suggest that the pre-adult period is likely to be of great importance in explanations of associations between childhood SEP and modifiable causes of death, such as CHD. Previous research has also demonstrated that behaviour-related cardiovascular risk factors, measured in adolescence or early adulthood, have relatively high consistency over the life course. We, and others, have shown that risk factors measured in adolescence or early adulthood, e.g., smoking, overweight and elevated blood pressure, are predictors of future risk of CHD.

Third, the association between childhood SEP and CHD may hypothetically be explained by differences in adulthood socio-economic circumstances, determined by educational and occupational opportunities. This explanation has frequently been emphasized in studies in which educational level and occupational class in adulthood have been found to mediate associations between childhood social circumstances and cardiovascular risk. However, after adjustment for indicators of childhood social circumstances, cognitive ability and behaviour-related factors measured in late adolescence in the present study, educational level had a limited effect and occupational class had no effect on the association between childhood SEP and CHD in middle age. Thus, it is likely that estimated mediation by social position in adulthood in previous studies to a large extent have proxied for (and been confounded by) effects on CHD from early negative social experiences, lower cognitive ability and behaviours accumulated from early childhood onwards in persons who attain lower positions in adulthood. This is consistent with research on young persons demonstrating that factors such as short stature, risky alcohol consumption, smoking, physical inactivity, unhealthy diet and overweight in adolescence predict low-educational level and low occupational class positions independently of childhood SEP.

Strengths and limitations

The present study had several strengths compared with previous studies. First, it combined information from registers on parental SEP and housing, educational level and occupational class in adulthood, and follow-up information on incident and fatal CHD, with information from a compulsory conscription examination on explanatory factors in adolescence: body height, cognitive ability, smoking and BMI. Information on systolic/diastolic blood pressure and sports club membership (a crude measure of physical activity) was also available from the conscription examination but not used in the final analyses due to the minor contributions of these variables in models. Second, the information was obtained from sources with a minimal loss of information. The almost full cohort of Swedish men born around 1950 (only severely handicapped men were exempted from the conscription examination) combined with national registers provided a large and socio-economically unselected study population for the study. Third, only prospectively gathered information was used in the study so that misclassification, related to recall of early life circumstances and underestimation of associations could be avoided. Studies based on recall of parental SEP have shown relatively weaker associations between childhood social circumstances and CVD.

Some sources of error may potentially have affected the study. Information on parental/childhood SEP was obtained from one point in time, at ~10 years of age and childhood SEP could thus have been misclassified in some men as a consequence of changes in SEP during childhood or adolescence. Changes in SEP should not have involved dramatic changes in socio-economic circumstances in most cases, but could have resulted in some underestimation of childhood SEP as predictor. This pertains to crowded housing in childhood as well. Furthermore, crowded housing and short stature/body height used in the analyses were crude measures of childhood disadvantage. With better measures perhaps more of the association between childhood SEP and CHD might have been attributable to poor childhood circumstances.

The information on smoking and BMI at age 18–20 years must, to some extent, be misclassified as indicators of the situation at the start of the follow-up 20 years later and also as indicators of long-term exposure. Yet, adjustment for these factors attenuated the association with CHD considerably. The attenuation seen after adjustment for educational attainment in addition to factors measured in childhood and adolescence could hypothetically reflect relationships between education and change in risk factors in adulthood (which we could not study), for instance, decreased smoking.

Our findings showed that differences in social circumstances in childhood, cognitive ability and adoption of health-related behaviours in adolescence or earlier may be of major importance in explaining the association between childhood SEP and later-life CHD. SEP in adulthood, in terms of occupational class, may contribute considerably less to such an association than what has been concluded in some previous studies.

Acknowledgements

The ethics committee at Karolinska Institutet, Stockholm, approved the study. An abstract was presented at the 16th EUPHA conference in Lisbon, 6–8 November 2008.

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Conflicts of interest: None declared.

Key points

- We know from previous studies that poor social circumstances in childhood are associated with increased risk of CHD.
- Previous studies have emphasized social circumstances and risk factors measured in adulthood as explanatory factors, but most studies have had limited or no information on pre-adulthood factors.
- The present study showed that social, cognitive and behaviour-related factors evident prior to adulthood are likely to be of major importance in explaining the association, and that the importance of social position in adulthood may have been overestimated in previous studies.

References


