How far are socioeconomic differences in coronary heart disease hospitalization, all-cause mortality and cardiovascular mortality among adult Swedish males attributable to negative childhood circumstances and behaviour in adolescence?

Tomas Hemmingsson and Ingvar Lundberg

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Objectives Coronary heart disease (CHD) and mortality are unevenly distributed between social classes, the lower being disadvantaged compared with the higher. Adverse social circumstances in childhood have been related to an increased risk of CHD and mortality in adulthood. The present purpose was to investigate the effect of differences in social disadvantage in early life on later differences in risk of CHD, all-cause mortality, and cardiovascular mortality between socioeconomic groups among Swedish men aged 40–50.

Methods Data on circumstances in childhood and adolescence, e.g. crowded housing and low social position of the father, measured at age 9–11, was collected among 49,323 men, born in 1949–51, and conscripted for compulsory military training in 1969/70. Data on adult socioeconomic position was obtained from the 1990 census, data on CHD from the Swedish In-patient Care register 1991–2000, and data on mortality from the Causes of Death register 1991–2000.

Results A social gradient was found for all health outcomes. The relative risk of CHD, all-cause mortality, and cardiovascular mortality among unskilled workers compared with that among high-level non-manual employees was 1.82 (95% CI: 1.36, 2.44), 2.24 (95% CI: 1.72, 2.93), and 2.38 (95% CI: 1.47, 3.86) respectively. The early life risk indicators, such as crowded housing and low childhood social position (measured at age 9–11), short stature (measured at age 18–20), and low education (reported at age 18–20), were more common among those who in 1990 (i.e. at age 39–41) were manual workers than among those who were in non-manual occupations. In multivariate analyses, considering the indicators of childhood social disadvantage and adjusting for lifestyle factors established at age 18–20, (smoking, alcohol consumption, overweight) the increased relative risk of CHD hospitalization and cardiovascular mortality in the four categories of employed workers was reduced by 72–100%.

Conclusion Predictors of CHD measured in childhood and adolescence may explain a substantial part of the social gradient in CHD, cardiovascular mortality, and all-cause mortality among the 40–50 year old males studied.

Keywords Socioeconomic group, coronary heart disease, mortality, childhood circumstances, early life
The association between social position and coronary heart disease (CHD) and mortality is well documented in several industrialized countries.\(^1,2\) During the past few decades the incidence of CHD has decreased in Sweden, while social differences in heart disease seem to have increased.\(^3\)

Several studies show a link between indicators of adverse social circumstances in childhood and CHD and mortality in adulthood.\(^4\)\(^-\)\(^10\) Some findings indicate that childhood circumstances are more important for cardiovascular death than for other mortality.\(^9\)\(^,\)\(^10\) Previous studies from Scandinavia have used register-based routine statistics, including census information, to collect individual information on social position in childhood and in adulthood. They found independent associations between early social disadvantage and adult mortality.\(^7\)\(^,\)\(^10\) However, those studies lacked information on other particulars of the people studied.

Behavioural factors such as smoking, poor diet, and low physical activity are important risk factors in shaping socioeconomic differences in CHD risk.\(^11\) However, it is not clear why people in lower social positions more often adopt a negative lifestyle.\(^12\)\(^,\)\(^13\) Unfavourable lifestyle factors are often established in childhood and adolescence and are related to a low future social position.\(^14\)\(^-\)\(^17\) Conventional CHD risk factors such as blood pressure, obesity, and blood cholesterol measured in adolescents and young adults predict CHD risk many decades later.\(^18\)

The present purpose was to investigate how far indicators of childhood social circumstances, and negative behavioural factors present when entering adult working life, may explain differences in CHD and mortality between socioeconomic groups in adulthood. The study is based on a cohort of 49,323 young Swedish males, born in 1949–1951. We used information on childhood circumstances collected from the 1960 census (when the subjects were aged 9–11) and from compulsory military conscription in 1969/70. At conscription, all men were asked to complete two examinations. Information collected at the 1969–1970 conscription was used as indicators of early disadvantage in the study:

1. Are indicators of social disadvantage in childhood and negative behavioural factors established in adolescence more common in lower socioeconomic groups of middle-aged Swedish men than among higher groups?

2. How far may socioeconomic differences in CHD, all-cause mortality, and cardiovascular mortality among men 40–50 years of age be explained by differential exposure to social disadvantage in childhood and youth?

### Methods

#### Study population

The study was based on data from a nationwide survey of 49,323 Swedish males, born 1949–1951, who were conscripted for compulsory military service in 1969/70. The background of the Swedish conscription surveys and the variables included has been presented in detail elsewhere.\(^21\)\(^,\)\(^22\) Only 2–3% of all Swedish men are exempted from conscription, in most cases due to severe handicaps or congenital disorders. Those included in this study accounted for 97.7% of all conscripts in 1969/70, the remaining 2.3% were born before 1949.

#### Census data on adulthood socioeconomic position and childhood social circumstances

Information on socioeconomic group for each conscript was obtained by record linkage with the National Population and Housing Census of 1990 held by Statistics Sweden. This census had a response rate of over 98%. The record linkage was possible because of the unique personal identification number of every citizen in Sweden.

The classification into the following eight socioeconomic groups in 1990 was conducted at Statistics Sweden and is based on information on occupation and the educational level required: (1) unskilled workers, (2) skilled workers, (3) assistant non-manual employees, (4) non-manual employees at intermediate level, (5) non-manual employees at higher level, (6) farmers, (7) self-employed people (in this age group mostly skilled workers or drivers), (8) those for whom no occupation was reported (e.g. unemployed, early retired, or disabled). Through their personal identification numbers, parents and children were linked to each other between censuses. Information on ‘father’s socioeconomic position’ was obtained from the National Population and Housing Census of 1960 (response rate 99%), i.e. when the subjects were 9–11 years old. A second classification, into the following six socioeconomic groups, was based on information on fathers’ occupation: (1) unskilled workers, (2) skilled workers, (3) assistant non-manual employees, (4) non-manual employees at intermediate or higher level, (5) farmers, (6) those not classified in a socioeconomic group. It was not possible to identify self-employed people in the 1960 census and they were classified according to occupation.

From the National Population and Housing Census of 1960 we also received information on childhood living circumstances through information concerning the parents. We here use a measure of ‘crowded housing’ (in this census >2 people/room was classified as crowded) from census information concerning the mother in 1960, i.e. when the subjects were 9–11 years of age.

#### Information collected at the 1969–1970 conscription examination

At conscription, all men were asked to complete two questionnaires. The first concerned social background, behaviour and adjustment, psychological factors, and health. The second dealt specifically with substance use, e.g. alcohol consumption and tobacco smoking. All conscripts were seen by health personnel and body height and weight were measured and recorded. The following factors from conscription were used as indicators of early disadvantage in the study:
Short stature
Height <171 cm was considered as short. This cut-off has previously been used in studies of this population\(^2\) and included almost 11% of the men.

Low education
Those who attended ≤9 years of schooling were considered as having a low education.
The following factors from conscription were used as indicators of negative behaviour established in adolescence:

Smoking
Those smoking ≥5 cigarettes/day were considered as smokers.

Risky use of alcohol
Alcohol consumption in grams 100%/alcohol/week was calculated on the basis of the answers to the questions on frequency and average consumed volume of beer, wine, and strong spirits. A composite variable, risky use of alcohol, included at least one of the following indicators of problem drinking: consumption of ≥250 g 100% alcohol/week, to have taken a ‘hair-of-the-dog’ during a hangover, to have been apprehended for drunkenness, or to have often been drunk (aluminium given in the questionnaire were ‘often’, ‘rather often’, ‘sometimes’, and ‘never’).

Overweight
Body mass index (BMI) was calculated using bodyweight (kg) divided by height (m) squared. A BMI ≥25.0 was considered overweight.

Outcomes
Information on CHD diagnoses was obtained by record linkage with the National Hospital Discharge Register, administered by the Centre for Epidemiology at the National Board of Health and Welfare in Sweden. This covers all public inpatient care in Sweden since 1987. The study population was followed with regard to CHD (International Classification of Diseases [ICD code], 9th Revision [ICD-9: 410–412] and 10th Revision [ICD-10: 120–125]) between 1991 and 2000. With personal identification numbers we also linked records with the National Cause of Death Register 1991–2000, National Board of Health and Welfare. The study population was followed with regard to all-cause mortality and to cardiovascular disease mortality (ICD-9: [390–459] and ICD-10: [I00–I99]).

Data analysis
For each socioeconomic group in 1990 (i.e. at age 39–41) the proportion of men with an indicator of social disadvantage during early life was calculated. The association between socioeconomic position in 1990 and mortality 1991–2000 was calculated in univariate and multivariate models using the SAS logistic-procedure. Odds ratios were used as approximations of relative risks. In the multivariate models the relative risk associated with being in a particular socioeconomic group in 1990 was estimated, controlling for the effect of the indicators of social disadvantage in childhood and for behavioural factors measured in late adolescence (i.e. at conscription in 1969/70).

The relative risks presented for the socioeconomic groups were calculated for those 44 207 conscripts who contributed full information concerning all the variables included in Table 2.

Results
Of the 48 285 men who were still alive in 1990, 47 680 (98.7%) participated in the census that year (Table 1). All presentations are based on those 44 207 men (92.7%) for whom there was information on all the variables shown in Table 2.

Prevalence of indicators of social disadvantage in childhood, and of negative behaviour, in the socioeconomic groups in 1990
To have originated from the lowest socioeconomic groups and to have lived in crowded housing, as measured at age 9–11, as well as having short stature and low education as measured at age 18–20, were more common among manual workers than among non-manual employees at age 39–41 (Table 2).

Negative behaviour measured at age 18–20 (risky use of alcohol, smoking, and overweight) were also more common among those who were to become manual workers than among those who were to become non-manual employees at age 39–41 (Table 2).

Socioeconomic differences in coronary heart disease, all-cause mortality, and cardiovascular mortality
In the cohort, 610 men received a hospital diagnosis of CHD and 900 died, 257 from cardiovascular disease, between 1991–2000. The social gradient based on childhood position is more marked for CHD hospitalization and for cardiovascular mortality than for all-cause mortality (Table 3).

In Table 4 analyses based on adult social position are presented. In the univariate analyses, considerable differences in risks were found between socioeconomic groups, with the highest relative risks for those not classified in SEI, followed by unskilled workers. The social gradient was somewhat more marked for all-cause and cardiovascular mortality than for CHD hospitalization (Table 4).

In the first multivariate model, including indicators on material and cultural conditions in childhood, the increased relative risks for the lower socioeconomic groups were lower (for each of the four groups of employed workers the reduction was around 30% for all-cause mortality, and over 50% for cardiovascular mortality and for CHD). In the second multivariate analysis, also including indicators on behavioural factors established in late adolescence, the increased relative risks for the lower socioeconomic groups were considerably lowered (for each of the four groups of employed workers the

<table>
<thead>
<tr>
<th>Table 1 Description of the cohort</th>
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<tbody>
<tr>
<td>Full cohort</td>
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<tr>
<td>No. alive at time of census in 1990(^a)</td>
</tr>
<tr>
<td>No. who participated in the census in 1990</td>
</tr>
<tr>
<td>No. with information on all variables included in Table 2 and on who all reported information are based</td>
</tr>
</tbody>
</table>

\(^a\) The census was held in November 1990 and included information on socioeconomic position.
reduction was around 50% for all-cause mortality, 77–100% for CHD, and 72–91% for cardiovascular mortality).

**Discussion**

In this longitudinal study the social gradient in CHD, all-cause mortality, and cardiovascular mortality was strongly attenuated by simultaneous adjustment for markers of childhood living conditions. Behavioural factors established at labour market entry were strong predictors of CHD between the ages of 40 to 50. Those early-established risk factors explained a substantial part of the increased relative risks of CHD, cardiovascular mortality, and all-cause mortality in all the main socioeconomic groups studied. A weakness of the study is that only men were considered.

**Data collected at conscription and information on socioeconomic position**

We used information on four indicators of negative circumstances during childhood and three indicators of unfavourable behavioural factors established at labour market entry. The risk factors were selected to test the hypothesis that social circumstances in childhood and health-related behaviour established in adolescence are related to adult socioeconomic position and CHD. Most studies on early-life factors and health outcomes in adult life rely on retrospective information collected at some point of the subject’s adult life. In this study information on risk factors from childhood and adolescence were collected at age 9–11 and at age 18–20, respectively.

Information on crowded housing at age 9–11 was based on information from the mother given in the 1960 census, not on retrospective information. Information on adult socioeconomic position came from the subject’s own information given in the 1990 census. This procedure probably minimizes misclassification concerning socioeconomic position and crowding housing.
Is coronary heart disease risk, or all-cause mortality risk, determined in early life or in adulthood?

In 1934 Kermack et al. suggested that the decline in death rates during the preceding decades could largely be attributed to improved child health. They suggested that health potential is strongly determined during the first 15 years of life. Increasing interest is being shown in early-life determinants of adult disease. In a representative sample of the Swedish population born between 1906–1951, childhood social circumstances were associated with adult mortality risk. An investigation of men born in Scotland in the 1920s suggested that mortality from some diseases in adulthood was affected by socioeconomic conditions in childhood. Kuh et al showed in the British 1946 birth cohort that poor childhood circumstances were related to an increased risk of mortality in adulthood independently of adult social circumstances. Longitudinal studies of younger populations, e.g. the British 1958 birth cohort and the Dunedin study from New Zealand, with participants born 1972–1973, show strong relations between adverse childhood circumstances and indicators of poor health in early adult life.

The present focus was to estimate the impact of early life circumstances on adult socioeconomic differences in health in all-cause mortality and cardiovascular mortality in socioeconomic groups among men aged 40–50. Univariate and multivariate analysis (logistic regression analysis) with 95% CI. In multivariate model 1, the risk indicators of adverse childhood social circumstances (as reported in Table 1) are controlled for. In multivariate model 2, in addition, behavioural factors measured in late adolescence are controlled for.

### Table 4

<table>
<thead>
<tr>
<th></th>
<th>Univariate</th>
<th>Multivariate 1a</th>
<th>Multivariate 2b</th>
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<tbody>
<tr>
<td></td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
</tr>
<tr>
<td>a. Coronary heart disease (610 cases) SEI—1990</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Non-manual high</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Non-manual intermediate</td>
<td>1.11</td>
<td>0.81, 1.53</td>
<td>0.73, 1.39</td>
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<tr>
<td>Non-manual low</td>
<td>1.27</td>
<td>0.88, 1.84</td>
<td>0.74, 1.57</td>
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<tr>
<td>Skilled worker</td>
<td>1.57</td>
<td>1.17, 2.11</td>
<td>0.87, 1.62</td>
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<tr>
<td>Unskilled worker</td>
<td>1.82</td>
<td>1.36, 2.44</td>
<td>1.00, 1.85</td>
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<td>Self-employed</td>
<td>1.57</td>
<td>1.06, 2.33</td>
<td>0.83, 1.90</td>
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<tr>
<td>Farmers</td>
<td>0.63</td>
<td>0.27, 1.46</td>
<td>0.54</td>
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<tr>
<td>Not classified in SEI</td>
<td>2.07</td>
<td>1.52, 2.82</td>
<td>1.68</td>
</tr>
<tr>
<td>b. All-cause mortality (900 cases) SEI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-manual high</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Non-manual intermediate</td>
<td>1.19</td>
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<td>0.84, 1.52</td>
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<td>1.02, 2.00</td>
<td>0.92, 1.81</td>
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<td>1.38, 2.38</td>
<td>1.15, 2.03</td>
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<tr>
<td>Unskilled worker</td>
<td>2.24</td>
<td>1.72, 2.93</td>
<td>1.88</td>
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<tr>
<td>Self-employed</td>
<td>1.53</td>
<td>1.05, 2.23</td>
<td>0.91, 1.95</td>
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<tr>
<td>Farmers</td>
<td>1.41</td>
<td>0.81, 2.46</td>
<td>0.75, 2.39</td>
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<tr>
<td>Not classified in SEI</td>
<td>4.68</td>
<td>3.62, 6.05</td>
<td>4.11</td>
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<td>c. Cardiovascular disease mortality (257 cases) SEI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-manual high</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Non-manual intermediate</td>
<td>1.20</td>
<td>0.70, 2.06</td>
<td>0.62, 1.84</td>
</tr>
<tr>
<td>Non-manual low</td>
<td>1.56</td>
<td>0.85, 2.84</td>
<td>0.67, 2.28</td>
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<tr>
<td>Skilled worker</td>
<td>1.77</td>
<td>1.07, 2.92</td>
<td>0.72, 2.06</td>
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<tr>
<td>Unskilled worker</td>
<td>2.38</td>
<td>1.47, 3.86</td>
<td>0.98, 2.70</td>
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<tr>
<td>Self-employed</td>
<td>1.20</td>
<td>0.57, 2.53</td>
<td>0.89</td>
</tr>
<tr>
<td>Farmers</td>
<td>0.95</td>
<td>0.29, 3.18</td>
<td>0.88</td>
</tr>
<tr>
<td>Not classified in SEI</td>
<td>3.94</td>
<td>2.44, 6.36</td>
<td>2.97</td>
</tr>
</tbody>
</table>

a Socioeconomic position of father, crowded housing in childhood, short stature, low education.

b Socioeconomic position of father, crowded housing in childhood, short stature, low education, smoking, overweight, risky use of alcohol.

c Socioeconomic index.
adulthood. When the analyses included indicators of childhood poverty and negative behavioural factors measured in adolescence, i.e. before entering adult working life, as explanatory factors, the contribution from early life proved substantial. Other relevant studies have shown that adult social position is more strongly associated with mortality than childhood social position is. Such studies most often rely on information on father’s occupation (retrospectively reported) as a proxy for childhood circumstances and lack information on other indicators of early disadvantage. In our study, childhood social position (based on father’s occupation) was only one of four indicators of social circumstances in childhood previously shown to be associated with increased mortality risk. Adjusting for only father’s social class in the present study contributed to a smaller reduction of the increased relative risks (e.g. ca 20% for cardiovascular disease mortality) than adjusting for all four indicators of social circumstances in childhood data (not shown).

A study from Finland concluded that social differences in mortality among men 30–34 years of age could be entirely explained by simultaneously controlling for educational level achieved. Perhaps ability to reach a certain level of education depends on experience in early life and educational level to a high degree captures those early-life exposures. Indeed, other studies from Finland show a strong association between living circumstances, including behavioural factors, in childhood and subsequent educational level.

As in the present study, other studies have shown a stronger impact of childhood circumstances on cardiovascular mortality than on all-cause mortality. It has previously been argued that such a finding highlights the inadequacy of considering socioeconomic differences in health to reflect an increased general susceptibility to all diseases among those in adverse social circumstances.

It might, however, be suggested that some of the childhood circumstances reported in this study are not related to adult health in a direct sense. Rather they could act as determinants of adult social circumstances, for example labour market conditions, circumstances which may influence disease risk. School attendance (in this study <10 years versus >9 years of schooling) is a strong predictor of adult social position but at the same time a measure of the cultural environment in the family of upbringing. Unfavourable behavioural factors established in adolescence, such as smoking, alcohol consumption, and low physical activity, are related to, and cluster in, low future social position.

Glendinning et al. also found that those with a negative attitude towards school at the age of 16, and most probably ending up as manual workers, drank more alcohol at the age of 18. The behavioural factors used in the present study are established in adolescence but are expected to assert their influence on health in relation to ‘total dose’, i.e. those who continue to smoke, or continue to be overweight, during adult life will be at increased risk of disease. Present data on, for instance, smoking was collected only at one point in time and we have no information on later smoking history. From the 1970s and onwards there was a rapid decrease in smoking in Sweden, affecting all socioeconomic groups.

Blane et al. concluded that some behavioural factors, such as smoking and heavy alcohol consumption, were more strongly associated with adult social position than with childhood social position, while overweight was more strongly associated with childhood social position. The present study suggests that the socioeconomic distribution of the behavioural factors is established already on labour market entry. Such a pattern is also seen in other studies. In the present study risk indicators measured in late adolescence had a strong effect on socioeconomic health differences 30 to 40 years later. There is, however, evidence that behavioural factors at one point in time can be regarded as outcomes of previous circumstances. Childhood adversities are strongly related to negative social, behavioural, and health outcomes in adult life. Since the negative behavioural factors in this study (smoking, overweight, and heavy alcohol consumption) were measured in adolescence, it is likely that they may be regarded partly as outcomes of previous childhood circumstances. Smoking in adulthood relates to childhood experiences such as emotional, physical and sexual abuse, parental divorce, and parental substance abuse. We have shown in this cohort that number of cigarettes smoked at age 18–20 was strongly related to prevalence of low mental health (psychiatric diagnosis, low emotional control, and self-reported use of drugs for nervous problems), other substance abuse (alcohol and drugs), as well as parental divorce. Other studies have shown a relation between factors of psychological distress in childhood and adult morbidity and mortality, and that such factors contribute to explaining socioeconomic differences in adult health.

In this study we present evidence suggesting that childhood circumstances influence adult disease and mortality. In a study of middle-aged Finnish men, the strong relation between social class (based on income quintiles) and all-cause, and cardiovascular, mortality was eliminated by adjustment for a large number of biological, behavioural, psychological, and social risk factors collected in adulthood. As the authors themselves point out, these risk factors appeared to constitute the mechanism of how social position and mortality was related. However, it remained unknown why all those risk factors were differently distributed by social position. In a life-course perspective on adult disease, risk factors for adult disease measured at one point in time could reflect earlier negative circumstances. The distribution of the behavioural risk factors emanates from the early life phase, at the time when young people also seem to choose their future social position (or earlier). It is still unknown why those two mechanisms are related. Based on the present results, we suggest that the distribution of risk factors in socioeconomic groups already happens largely in childhood. In this study such factors were associated with mortality 30–50 years later.

**Conclusion**

A pronounced socioeconomic gradient in CHD, all-cause mortality, and cardiovascular mortality was found. The increased relative risk of CHD and of cardiovascular mortality among other socioeconomic groups than higher non-manual employees diminished by 72% or more when controlling for the indicators of social disadvantage in early life, and no significantly increased relative risks remained. The results suggest that a substantial part of socioeconomic differences in cardiovascular disease among middle-aged men can be
attributed to circumstances in early life, i.e. characteristics established in childhood or late adolescence.

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