Is the association between low job control and coronary heart disease confounded by risk factors measured in childhood and adolescence among Swedish males 40–53 years of age?

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Objectives Low job control is associated with an increased relative risk of coronary heart disease (CHD). The increased risk seems to be most marked in men under 55 years of age. Adverse social circumstances in childhood have been related to an increased risk of CHD in adulthood. The aim of this study was to investigate the role of differences in CHD risk factors measured in childhood or late adolescence (indicators of social circumstances and negative behaviour), as well as social circumstances in adulthood, for the association between low job control and CHD among Swedish men 40–53 years of age.

Methods The study is based on a cohort of 49 323 young Swedish males, born 1949–51. For the study we have used information on childhood environment collected at the 1960 census (when the subjects were 9–11 years of age), negative behavioural factors collected at compulsory conscription for military training among young Swedish men in 1969/70 (when the subjects were 18–20 years of age), data on job control from 1990 (measured indirectly from occupational titles using a job exposure matrix, when the subjects were 39–41 years of age), and follow-up data on CHD hospitalization and mortality between the years 1991 and 2003.

Results An increased relative risk of CHD (HR = 1.55; 95% CI 1.31–1.84) was found among workers with low job control, compared with workers with high job control. Risk factors for CHD measured in different phases during the life course were strongly associated with level of job control in middle age. In multivariate analyses, taking the factors measured in childhood into consideration and also adjusting for lifestyle factors measured at age 18–20 (smoking, heavy alcohol consumption, and overweight) the increased relative risk of CHD in low control jobs was reduced by 85%. After also adjusting for adult income (according to the 1985 census) no increased relative risks remained.

Conclusion Risk factors for CHD measured already in childhood and adolescence could explain a substantial part of the of the increased risk of CHD and mortality among males 40–53 years of age associated with the measure of low work control used in this study. The results suggest that low job control, measured as in this study, is not a risk factor for CHD among men in this age group.

Keywords Low job control, coronary heart disease, childhood circumstances, early life, behaviour

Introduction

During the last decades the relation between psychosocial factors at work and health has attracted increased attention,¹–⁴ and the association between psychosocial stress at work and
coronary heart disease (CHD) has been particularly in focus.\textsuperscript{5,6} The demand-control model suggests that a high-strain job, characterized by high psychological demands in combination with low job control, may be associated with an increased relative risk of cardiovascular disease (CVD). Studies of the association between job strain and CVD outcome have generated conflicting results, while the association between low job control and CHD are shown to be strong and consistent.\textsuperscript{5–15} In Sweden, this relation has been confirmed in register-based studies with job control data based on a job exposure matrix (JEM) and with limited possibilities to adjust for confounders.\textsuperscript{7,8,13}

The effects of psychosocial factors at work on health outcomes are assumed to act through two mechanisms.\textsuperscript{14} Either psychosocial factors may increase the risk of negative health outcomes through acute or chronic pathophysiological changes or they may affect health related behaviours, such as smoking and smoking cessation, alcohol consumption, and physical activity, which in turn may influence the risk of negative health outcomes. Recently, it has been suggested that the relationship between psychosocial work-environment factors, in particular low job control, and heart disease, could be an expression of social class-related health inequalities over the life-course.\textsuperscript{16} In this view the relation between job control and heart disease could partly be due to residual confounding from, e.g., negative childhood circumstances.\textsuperscript{17} Several studies have shown a link between indicators of adverse social circumstances in childhood and CHD in adulthood.\textsuperscript{18} Such indicators include low childhood social position, poor family environment, living in crowded housing during childhood, and short stature. However, in one study the strong association between unfavourable psychosocial factors at work (job strain and effort-reward imbalance) and cardiovascular mortality was hardly affected by adjustment for indicators of early life disadvantage.\textsuperscript{19}

The aim of this study was to estimate the relative risk of CHD hospitalization and mortality associated with low job control. We will consider indicators of a poor childhood environment and behavioural risk factors established at the time of labour market entry as well as low social position in adulthood, as potential confounders of the relationship.

### Methods

#### Study population

The study was based on data from a nation-wide survey of 49,323 young Swedish males, born 1949–51, who were conscripted for compulsory military service in 1969/70. Only 2–3\% of all Swedish men are exempted from conscription, in most cases owing to severe handicaps or congenital disorders. They accounted for 97.7\% of all conscripts in 1969/70, the remaining 2.3\% were born before 1949. The data collection is described in Table 1.

#### Data on job control

Information on job control was measured indirectly by means of a JEM.\textsuperscript{20} The JEM is a job classification system based on aggregated data derived from questionnaires to representative samples of employees in the population. The JEM was originally developed for application on population-based data. For this study, the source of information was the Swedish Work Environment Surveys 1989–97 including data on almost 49,000 men and women. The surveys included questions on different aspects of the psychosocial work environment, e.g., job control. Job control, or decision latitude, is a combined measure based on two scales measuring decision authority (four items) and skill discretion (three items). This JEM is an update of an earlier Swedish JEM.\textsuperscript{21} The earlier JEM was based on another set of surveys with fewer questions on psychosocial work environment collected in 1977 and 1979. For the JEM used in this study, the source of information was the Swedish Work Environment Surveys 1989–97 including data on almost 49,000 men and women. The JEM was employed to rate all occupations on a 10 digit scale for work control. Mean scores were derived for job control by sex, age, and duration of employment for all occupations. The subjects in this study were all men in the same age and information on occupation was only used for 2 years based on the occupations reported in the 1985 and 1990 censuses. Information on occupation for each subject was obtained from the National Population and Housing Censuses of 1985 and 1990. The JEM was employed to rate all occupations on a 10 digit scale for work control. Based on this scale the population was divided into four equally large groups, i.e., with high, middle-high, middle-low, and low job control.

### Table 1 Data collection 1960–2003

<table>
<thead>
<tr>
<th>Calender year</th>
<th>Age of subject</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth years</td>
<td>1949–51</td>
<td>0</td>
</tr>
<tr>
<td>National Population and Housing Censuses of 1960</td>
<td>1960</td>
<td>9–11</td>
</tr>
<tr>
<td>Conscription examination</td>
<td>1969/70</td>
<td>18–20</td>
</tr>
<tr>
<td>National Population and Housing Censuses of 1985</td>
<td>1985</td>
<td>34–36</td>
</tr>
<tr>
<td>National Population and Housing Censuses of 1990</td>
<td>1990</td>
<td>39–41</td>
</tr>
</tbody>
</table>
Data on childhood social circumstances collected in the 1960 census

Through personal identification numbers parents and children were linked to each other between censuses. Information on father’s occupation for each conscript was obtained from the National Population and Housing Census of 1960, i.e. when the subjects were 9–11 years old. This census had a response rate of 99%. The classification into six different childhood socioeconomic groups was conducted based on information on fathers’ occupation. The following socioeconomic groups were used: (i) unskilled workers, (ii) skilled workers, (iii) assistant non-manual employees, (iv) non-manual employees at intermediate or higher level, (v) farmers, (vi) those not classified in a socioeconomic group. From the National Population and Housing Census of 1960 we also received information on childhood living circumstances through information concerning the parents. In this study we have used a measure on crowded housing (in this census >2 people per room was classified as crowded) from census information concerning the mother in 1960, i.e. when the subject was 9–11 years of age.

Information collected at the conscription examination in 1969–70

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 and tobacco smoking. All conscripts were seen by health personnel and body height and weight were measured and recorded. Five variables from the examination at conscription were selected to be included in the analyses since they previously have been associated with increased CHD risk.

The following factors from conscription were used as indicators of early disadvantage in the study

Short stature: A body height below 171 cm was considered as short.

Low education: Less than 10 years in school were considered as low education.

The following factors measured at age 18–20 were used as indicators of early established negative behaviour

Smoking: Those smoking at least 5 cigarettes per day were considered as smokers.

Risky use of alcohol: Alcohol consumption in grams 100% alcohol per 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 at least 250 g 100% alcohol per week, taken an eye-opener during hangover, been apprehended for drunkenness, or often been drunk (alternatives given in the questionnaire were ‘often’, ‘rather often’, ‘sometimes’, and ‘never’).

Body mass index (BMI): Body weight (in kilograms) divided by height (in meters) squared. A BMI ≥ 25 was considered as overweight.

Data on adult circumstances collected in the 1985 census

From the census in 1985 we collected information on income for all men. The men were divided into four groups (quartiles) based on level of income. A reason for using income instead of occupational class in this study is that occupational class, just like the measure of job control, is based on information on occupation.

Outcomes

Information on CHD diagnoses [ICD-code 9th (410-412) and 10th (I20-I25) revision] was obtained by record linkage with the National Hospital Discharge Register, covering all public inpatient care in Sweden since 1987, and with the Swedish Causes of Death register, administered by the Centre for Epidemiology at the National Board of Health and Welfare in Sweden. The study population was followed-up with regard to CHD hospitalization during the period 1991–2003. The study population was followed-up with regard to CHD mortality during the period 1991–2002.

Data analysis

For each job control group in 1990 the proportion of men with a risk factor, reported in the 1960 census, at conscription in 1969/70, or in the 1985 census, was calculated. Tests for trend over job control groups were conducted according the Cochran-Armitage trend test using the FREQ-procedure in the SAS computer package. Test for linear trend for HR over job control categories was conducted fitting a single indicator variable for job control categories with the following values: high control (0), medium high control (1), medium low control (2), and low control (3).

The association between job control in 1990 and CHD mortality or hospitalization in 1991–2003 was estimated on the basis of Cox’s proportional-hazards model (both the crude and the adjusted models) using the PHREG-procedure in the SAS computer package.

In the adjusted models the relative hazard associated with a particular level of job control in 1990 was estimated adjusting for the effect of all risk factors. Of the 48 285 men who were still alive in 1990, 47 680 (98.7%) participated in the census that year (Table 2). Based on the occupational title reported in the 1990 census 42 143 of the men who participated in the census could be classified on job control. We do not have information of the activity of those who did not report an occupation in the census. All presentations are based on those 39 160 who, based on the reported occupation in the 1990 census, could be classified on job control and for whom there was information on all the variables shown in Table 3.

Results

Early life characteristics and level of job control at age 39–41

All risk indicators measured at age 9–11 (to have originated from the lowest socioeconomic group, or crowded housing in childhood) and measured at age 18–20 (i.e. risky use of alcohol, smoking, overweight, short stature, and low education) were
In this longitudinal study we found evidence that risk factors for CHD measured in childhood and adolescence were more common among middle-aged men in low control jobs than in men with high control jobs. The increased relative risk of CHD, found in univariate analyses, disappeared completely when differences in childhood living conditions, early established behavioural factors, and adult income were taken into account. The early established risk factors could, themselves, explain a substantial part of the increased relative risk of CHD in the low job control group.

The procedure adopted for this study has several advantages over previous treatments of the subject: the study has a longitudinal design; neither work characteristics nor outcomes are based on self-reports; information is available on a number of CHD risk factors; outcome data consist of diagnoses from inpatient care and data from the cause of death register; the study population is representative of the young male working population in Sweden over the period; and a large number of occupations were represented. A weakness of the study is that only men were considered.

The job exposure matrix
Information on job control at age 39–41 was inferred from the subject’s information on occupation given in the 1990 census.

Table 2 Description of the cohort

<table>
<thead>
<tr>
<th>Description of the cohort</th>
<th>Full cohort</th>
<th>Number alive at time of census in 1990a</th>
<th>Number who participated in the census in 1990</th>
<th>Number with information on occupation in the 1990 census and who could be classified according to level of job control</th>
<th>Number with information on all variables included in Table 2 and on who all reported information are based</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>49 323</td>
<td>48 285</td>
<td>47 680 (98.7% of those who were alive at time of the 1990 census)</td>
<td>42 143 (88.4% of those who participated in the census in 1990)</td>
<td>39 160 (92.9% of those who could be classified according to level of job control based on occupational title in the census in 1990)</td>
</tr>
</tbody>
</table>

P for trend

Table 3 Prevalence of the risk indicators measured at ages 9–11, 18–20, and 34–36 (% of population and 95% CI) among those who had jobs with different levels of job control in 1990

<table>
<thead>
<tr>
<th>Job control 1990</th>
<th>High</th>
<th>Int. high</th>
<th>Int. low</th>
<th>Low</th>
<th>P for trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crowd housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14.6 (13.9–15.3)</td>
<td>20.8 (20.0–21.7)</td>
<td>21.1 (20.3–21.9)</td>
<td>27.3 (26.4–28.2)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Father unskilled worker</td>
<td>23.0 (22.2–23.8)</td>
<td>29.8 (28.8–30.7)</td>
<td>28.4 (27.5–29.3)</td>
<td>39.4 (38.4–40.4)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>37.0 (36.1–37.9)</td>
<td>47.8 (46.8–48.9)</td>
<td>45.0 (44.0–46.0)</td>
<td>54.8 (53.8–55.8)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Heavy alcohol consumption</td>
<td>7.5 (7.0–8.0)</td>
<td>11.0 (10.4–11.7)</td>
<td>13.6 (12.9–14.2)</td>
<td>16.3 (15.6–17.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Overweight (BMI &gt; 25)</td>
<td>5.2 (4.8–5.6)</td>
<td>6.4 (5.9–6.9)</td>
<td>6.3 (5.8–6.8)</td>
<td>8.6 (8.0–9.2)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Short stature (&lt;1.71)</td>
<td>7.7 (7.2–8.2)</td>
<td>10.7 (10.1–11.3)</td>
<td>10.9 (10.3–11.5)</td>
<td>13.8 (13.1–14.5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Low education (&lt;10 years)</td>
<td>27.2 (26.3–28.0)</td>
<td>46.4 (45.4–47.4)</td>
<td>54.0 (53.0–55.0)</td>
<td>70.2 (69.3–71.1)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Low income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11.0 (10.4–11.6)</td>
<td>22.7 (21.9–23.6)</td>
<td>34.2 (33.2–35.1)</td>
<td>33.0 (32.1–34.0)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Discussion
In this longitudinal study we found evidence that risk factors for CHD measured in childhood and adolescence were more common among middle-aged men in low control jobs than in men with high control jobs. The increased relative risk of CHD, found in univariate analyses, disappeared completely when differences in childhood living conditions, early established behavioural factors, and adult income were taken into account. The early established risk factors could, themselves, explain a substantial part of the increased relative risk of CHD in the low job control group.
A disadvantage of using inferred information is that some of the true variations are eliminated, which may lead to underestimation of true associations. It is often argued that the inferred information based on job title is preferable since such information is not sensitive to the influence of individual characteristics such as different kinds of health problems. However, in the Swedish SLEEP study and in the British Whitehall study associations between job control inferred from job titles and CHD, and self-reported job control and CHD were very similar. Although it was not the subject of this study we also used the JEM to classify work demands, work social support, job strain, and negative change of job control (between 1985 and 1990) but did not find any significant associations with CHD in the expected direction. Johnson and Stewart have found that JEM scores account for only 25–30% of individual variance in psychological work demands, while they account for a large proportion of individual variance in work control. Their conclusion was that control is a work characteristic, whereas demands and social support vary across individuals and also by work site within an occupation. This may explain the lack of association between job demands and work place social support and CHD in this study. Job control is a combined measure based on two scales measuring decision authority and skill discretion. In the JEM used in this study the survey questions measuring skill discretion were somewhat less satisfactory than in an older JEM used in several previous studies from Sweden. When we used the older JEM to classify the subjects in this study on job control and repeated all analyses in the same way as in this study we received very similar results to those based on the newer JEM, which is based on more recent survey information. Information on job control was based on information from only 1 year based on the occupation reported by the subjects in the 1990 census. We repeated the analyses conducted in this study based on those who were classified into the same level of job control in both the censuses of 1985 and 1990 and received the same result as those reported in Table 4.

Data collected in the 1960 census and at conscription
In this study we used information on four indicators of negative circumstances during early life and three indicators of unfavourable behavioural factors measured in late adolescence.

The risk factors were selected to test the hypothesis that social circumstances in childhood and early established health related behaviours are related to both future level of job control and risk of CHD. Most studies on early life factors and adult CHD rely on retrospective information collected at some point in 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 childhood socioeconomic circumstances was partly (childhood socioeconomic position and crowded housing) based on information from the parents given in the 1960 census and partly (low education and body height) based on information collected at the conscription in 1969/70 instead of on retrospective information in middle-age.

The indicators of negative behavioural factors measured at conscription (overweight, smoking, and heavy alcohol consumption) are likely to be more or less misclassified in terms of what would have been reported at start of follow-up when data on level of job control were collected, i.e. 20 years later. This misclassification is most likely non-differential, leading to dilution of relative risk estimates associated with the risk factors measured in early life towards unity. If anything, the explanatory power of each risk factor would have become weaker as a result of this misclassification.

**Job control and the relation to behavioural factors**
Behavioural factors, such as smoking, poor diet, and low physical activity, are important risk factors for CHD and mortality. Smoking, for example, is suggested to be a response to a stressful work environment. If this is the case it might be questionable to adjust for e.g. smoking in analyses of the association between psychosocial factors and health outcomes. However, unfavourable lifestyle factors are often established in adolescence and seem to be related to a low future social position. In this study indicators of negative behaviour, such as smoking, risky use of alcohol, and overweight, measured in late adolescence, were more prevalent in groups that later were found in jobs with a low work control. The behavioural factors also contributed to attenuate the association between low job control and CHD. The behavioural factors used in the present study are established in adolescence and are related to the same behaviours later in life, 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 e.g. smoking was collected only at one point in time and we have no information on later smoking history. Smoking and smoking cessation have been strongly related to social class in Sweden. From the 1970s and onwards there was a rapid decrease in smoking in Sweden, affecting all socioeconomic groups. Adult working conditions cannot be responsible for the health related behaviours measured in late adolescence. On the other hand, it is reasonable to believe that those exposed to low job control, due to a more stressful work environment, find it more difficult to stop smoking compared with those in other jobs. A lower rate of smoking cessation in low control jobs could also be due to other factors, such as a higher prevalence of low mental well-being. We have shown in this cohort that the 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. It may be suggested that those in low control jobs in middle-age had low control jobs already at time of conscription or even earlier and that this job situation had influences on the behavioural factors measured in this study. We believe that this is an unlikely explanation for the findings in our study. For instance, smoking is often established before the age of 16 (i.e. the age of ending compulsory schooling in Sweden at that time) and is strongly associated with later social position. It is not likely that the specific exposure of low job control has a major impact on the establishment of such negative behaviours among people in this age.

**Job control and CHD**

In this study only those in the lowest quartile showed an increased relative risk of CHD. The same finding was reported from the Swedish SHEEP study (based on 1279 male cases of myocardial infarction and controls 45–64 years of age with data on decision latitude). The cases of acute myocardial infarction and the controls in the SHEEP study were only somewhat older than the subjects in this study and data on case status were collected in the early 1990s, which is similar to this study. The subjects in the present study were followed-up for CHD and mortality between 40 and 53 years of age. It has been reported in previous studies that the increased risk of heart disease associated with low control seems to be most marked in men under 55 years of age. The association between job control (decision latitude) and myocardial infarction hospitalization in the Swedish SHEEP study was of a similar magnitude as was the association between job control and CHD hospitalization in the present study. Just as in this study the association became much weaker when indicators of current social disadvantage were adjusted for. However, in the present study we were able to show that indicators of social disadvantage measured already in childhood or at labour market entry strongly attenuated the increased risk of CHD associated with low job control. It has been suggested that the relationship between psychosocial work-environment factors, in particular low job control, and illness is an expression of social class related health inequalities that have accumulated through the life-course. Low job control is more prevalent in lower socioeconomic groups and negative social circumstances in childhood are related to an increased probability for the individual to end up in a low social position, with low job control, in adult life. If so, a stressful low control environment could actually be responsible for the increased relative risk of CHD. This is not likely to be a major effect of the risk factors measured in early life in this study since those factors strongly contributed to lower the association between job control and CHD risk many years later. In the full model (not shown for all variables) almost all risk factors showed a significantly increased association with CHD. Including information on job control in the model did not have any impact on the factors measured in early life. Risk factors for CHD measured already in childhood and adolescence could explain a major part of the of the increased risk of CHD and mortality among males 40–53 years of age associated with the measure of low work control used in this study. The results suggest that low work control, measured as in this study, reflects an accumulation of negative factors over the life-course.

**Conclusion**

To be in a situation with low work control was associated with an increased relative risk of CHD, all-cause mortality, and cardiovascular mortality. Risk factors for CHD measured in different phases during the life-course were strongly associated with level of job control in middle-age. The increased relative risk of CHD among low control workers in comparison with those 25% who had high work control diminished by 85% when controlling for the risk factors established in childhood or adolescence, and no significantly increased relative risks remained. Adjusting also for income level in adulthood reduced the risks even more. The results suggest that low work control, measured as in this study, is not a risk factor lor CHD among men in this age group.

**Acknowledgement**

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**References**


