Low control beliefs, classical coronary risk factors, and socio-economic differences in heart disease in older persons


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Abstract

The objective of this study was to examine whether it is through their low control beliefs that low socio-economic status groups have higher risks of heart disease, and to examine whether this mechanism is more substantial than and independent of the mechanism via classical coronary risk factors. In a population-based prospective cohort study, participants were selected from 27 general practices in the north-eastern part of The Netherlands. In 1993, there were 3888 men and women, 57 years and older, who were without prevalent heart disease. During the 5-year follow-up period, 287 cases of incident heart disease (acute myocardial infarction and/or congestive heart failure) were registered (7%). Persons with a low socio-economic status had higher risks of heart disease (RR = 1.45 (95% CI: 1.06 – 1.99)) compared with their high status counterparts. On average, 4 percent of the socio-economic differences were accounted for by the classical coronary risk factors (e.g. smoking, hypertension) compared with 30 percent by the control beliefs. The contribution of the latter was largely independent of the former. Our findings support the hypothesis that socio-economic inequalities in heart disease—at least in middle-aged and older persons—may be based upon differences in control beliefs, more than upon differences in smoking rates and other classical risk factors.

Keywords: Social class; Heart disease; Coronary risk factors; Perceived control; The Netherlands

Introduction

It is well established that the higher risks of coronary heart disease in persons with a low socio-economic status can be explained only partially by a higher prevalence of smoking, hypertension, and other coronary risk factors in these persons (Lynch, Kaplan, Cohen, Tuomilehto, & Salonen, 1996; Marmot, Shipley, & Rose, 1984). Recent attempts at the explanation of socio-economic differences in coronary heart disease have therefore addressed alternative risk factors for coronary heart disease, such as low job control and depression (Lynch et al., 1996; Bosma, Schrijvers, & Mackenbach, 1999a; Marmot, Bosma, Hemingway, Brunner, & Stansfeld, 1997). It has cogently been argued that low perceived control may be the key factor underlying the association between low socio-economic status and poor health and that many of the alternative risk factors, such as life events and hostility, may actually be based upon beliefs of low control (Syme, 1989).

Control beliefs refer to individuals’ beliefs regarding the extent to which they can control or influence outcomes (e.g. staying healthy, getting a job promotion) (Skinner, 1996). Low control beliefs are thought to affect health outcomes through direct stress-induced
physiological activation or unhealthy behaviours (Baillis, Segall, Mahon, Chipperfield, & Dunn, 2001; Brunner, 1997). There is some evidence for an important contribution of low control beliefs to socio-economic differences in heart disease and their roots in adverse socio-economic conditions during upbringing and adulthood (Baillis et al., 2001; Bobak, Pikhart, Rose, Hertzman, & Marmot, 2000; Bosma et al., 1999a; Bosma, Van de Mheen, & Mackenbach, 1999b; Skinner, 1996). The extent to which this contribution is independent of and larger than the contribution of the classical coronary risk factors, including unhealthy behaviours, has not yet been examined (Fig. 1).

Using longitudinal data from 3888 Dutch men and women, 57 years old and older, the present study examines socio-economic differences in heart disease incidence and examines whether the underlying mechanism via control beliefs is more substantial than and independent of the mechanism via classical coronary risk factors.

Methods

This study is part of the Groningen Longitudinal Aging Study (GLAS) in the north eastern part of The Netherlands. The study population comprised all men and women who were 57 years old and older on January 1, 1993 and who were registered as patients in 27 general practices that participated in a morbidity registration network. In 1993, 5279 persons completed the baseline assessments (62% of the eligible population); 4792 were interviewed at home and filled out a self-report questionnaire, and 487 answered a shorter version of the questionnaire by telephone. Although older persons and persons with cancer participated somewhat less in the study, there was no evidence of differential response rates according to whether or not persons had ischemic heart disease, congestive heart failure, chronic respiratory disease, or chronic diseases of the locomotor apparatus (Kempen, Jelicic, & Ormel, 1997; Ormel et al., 1998). The group who was questioned by telephone was excluded in the current study, because necessary information on income and occupational level was lacking. Furthermore, in the remaining group of 4792 persons, there were 904 persons (19%) who reported a heart condition at baseline. To allow examination of the incidence of new heart disease, prevalent cases were excluded, leaving 3888 persons for the analyses.

Follow-up measurements

After the GLAS-baseline phases, the collaborating general practitioners registered diagnoses of congestive heart failure (CHF) and acute myocardial infarction (AMI) in participating patients. AMI was diagnosed if two of the following three conditions were present: chest pain characteristic of myocardial ischemia and lasting more than 15 min, abnormal ST–T changes or Q waves on an electrocardiogram, or elevation of blood cardiac enzymes (code K75 of the International Classification of Primary Care (ICPC) scheme) (Lambers & Wood, 1987). CHF was diagnosed if three of the following conditions were present: dependent edema, raised jugular venous pressure of hepatomegaly in the absence of liver disease, signs of pulmonary congestion or pleural effusion, enlarged heart, and dyspnea in the absence of pulmonary disease (code K77 of ICPC) (Lambers & Wood, 1987). In the 5-year follow-up period (until January 1, 1998), 129 incident AMIs (3%) and 170 incident CHFs (4%) were recorded. Twelve persons had both events, resulting in 287 incident cases with heart disease (7%). In this incident group, 40 persons died on the same day and an additional three on the day after.

Socio-economic status

Baseline reports of the educational, occupational, and income level were used to define socio-economic status. Educational level was measured with the International Standard Classification of Education and had six categories ranging from no elementary school (1) to graduate degree (6) (sample mean = 3.07; standard deviation = 1.09) (Unesco, 1976). Occupational level was measured with the International Socio-economic Index of Occupational Status and ranges from 0 (low prestige) to 100 (high prestige) (sample mean = 44.22; standard deviation = 15.30) (Ganzeboom, De Graaf, & Treiman, 1992). Income level was measured by asking

Fig. 1. Socio-economic differences in heart disease. Mediation of control beliefs is hypothesised to be stronger than and independent of the classical coronary risk factors.
the respondent to indicate their net monthly household income. This report was recoded to an individual-level income, using different weights for households with one person and households with two or more persons (sample mean = 1656.26 Dutch guilders; standard deviation = 343.04). To compute an overall index of socio-economic status, all three scores were standardised and subsequently averaged. All indicators were divided in approximate thirds using tertiles. The tertile cut-off score for education corresponded to: 1: no or elementary education; 2: lower general secondary education, and 3: higher general secondary education and higher. Separate categories were included to define persons with missing values (except for eight persons with missing scores on educational level; these persons were excluded in the analyses for educational level).

Classical coronary risk factors

Baseline self-reports were used to define hypertension (no, yes), diabetes (no, yes), smoking (pack-years: (mean number of cigarettes smoked during the life-course / 25) * number of years that the respondent smoked), heavy alcohol consumption (drinking more than 13 alcoholic beverages per week (upper tenth of distribution)), no alcohol consumption, obesity (body mass index >= 30), underweight (body mass index < 18.5), strenuous exercise (mean number of hours per day that respondents participated in bicycling, gymnastics, active sports, and gardening), and healthy diet. Hypertension and diabetes were scored as present, only when the participants consulted a general practitioner or specialist for these conditions or when they used medication for the particular conditions during the past 12 months. Healthy diet was computed by summing eight healthy habits (0: no, 1: yes). This score then ranges from 0 (unhealthy diet) to 8 (healthy diet). The healthy dietary habits included were having a warm meal each day of the week, starting with breakfast each day of the week, eating sweet in-between-meals-snacks less than six times per week, eating savoury in-between-meals-snacks less than three times per week, trying to avoid food rich in fat/cholesterol, actually avoiding more than one high-fat product group, trying to eat fibrous food, actually eating more than one fibrous product group. The original questionnaire to determine coronary risk factors can be obtained from the authors.

Control beliefs

Both general self-efficacy and mastery were measured at the baseline phase. Both cover different facets of control beliefs (Skinner, 1996). General self-efficacy, i.e. the extent to which people believe that they can perform a certain behaviour, was measured with Sherer’s General Self-Efficacy Scale (Sherer et al., 1982). It theoretically ranges from 16 to 80 with higher scores indicating more self-efficacy (Cronbach’s alpha = 0.84 at baseline) (sample mean = 60.22; standard deviation = 11.07). One of the items is: “When trying to learn something new, I soon give up if I am not initially successful”. Pearlin and Schooler’s Mastery scale was used to measure mastery, i.e. the extent to which people believe that their behaviour matters for the events that occur in their environment (Pearlin & Schooler, 1978). This scale theoretically ranges from 7 (low mastery) to 35 (high mastery) (Cronbach’s alpha = 0.79 at baseline) (sample mean = 24.87; standard deviation = 5.13). One of the items is: “Sometimes I feel that I am being pushed around in life”. In a previous paper, using the same data set, both scales were strongly correlated (r = 0.55; p < 0.001) and factor analysis indicated the presence of one dominant factor underlying the items of the two scales (Kempen et al., 2003). Therefore, both scales were standardised and subsequently averaged to construct one measure of control beliefs (Cronbach’s alpha = 0.88). The measure was further divided in thirds using tertiles.

Statistical analyses

For the separate categories of socio-economic status, logistic regression analyses (for categorical risk factors) and analyses of variance (for continuous risk factors) were used to compute the sex and age-adjusted probabilities and means, respectively. Cox proportional hazards analyses were used to compute hazard ratios of heart disease for persons with a medium and low socio-economic status compared with persons with a high socio-economic status (mortality was censored). Three models were estimated with the following predictors of heart disease: (1) age, sex, and socio-economic status, (2) age, sex, socio-economic status, classical coronary risk factors, and (3) age, sex, socio-economic status, classical coronary risk factors, and control beliefs. The hazards ratios for medium and low socio-economic status were compared between these models. The percent decrease of these hazard ratios between models 2 and 1 estimates the contribution of the classical risk factors. The percent decrease between models 2 and 3 estimates the extent to which the contribution of the control beliefs is independent of (and larger or smaller than) the contribution of the classical coronary risk factors. The percent decrease of the hazard ratios is computed as follows: \( \text{HR}_{\text{restricted model}} / \text{HR}_{\text{extended model}} \). As associations were not different between men and women and between young and old (tested by including interaction terms), all data were combined and sex and age were controlled for. Sex and age-adjusted hazard ratios for low socio-economic status (combined measure) were 1.62 (95% CI: 1.02, 2.59) and 1.46 (95% CI: 0.97, 2.21) for the AMI and CHF outcome, respectively.
(not tabulated). To increase power, both outcomes have been combined as was done in a previous study (Kempen, Van Jaarsveld, Van Sonderen, Sanderman, & Ormel, 2001). This decision was also dictated by the evidence that both outcomes probably share similar risk factors (Dei Cas, Metra, Nodari, Dei Cas, & Gheorghiaide, 2003).

**Results**

Ten percent of the persons with a low socio-economic status developed heart disease during follow-up compared with six percent in their higher status counterparts (not tabulated). Table 1, model 1 presents the corresponding sex and age-adjusted hazard ratios of heart disease. According to the combined measure of socio-economic status, persons in the low socio-economic status group have a 45 percent higher rate of heart disease compared with their higher status counterparts (HR = 1.45; 95% CI: 1.06, 1.99). Low educational level and low income level were also significantly related to higher rates of heart disease, although hazards ratios were somewhat smaller (1.38 (95% CI: 1.03, 1.85) and 1.35 (95% CI: 1.00, 1.82), respectively). Low occupational level was not significantly related to heart disease incidence (HR = 1.15 (95% CI: 0.86, 1.56)).

Lower socio-economic status groups smoked more cigarettes during their lives than higher socio-economic status groups (almost two pack-years) (Table 2). They also drank much less alcohol. Prevalence of heavy consumption was much lower (6 versus 13 percent) and prevalent abstinence was much higher (72 versus 49 percent). Obesity and diabetes were more common in lower socio-economic status groups compared with their higher status counterparts (15 versus 7 and 7 versus 5 percent, respectively). They also had a somewhat less healthy diet (5 versus 6 healthy dietary habits). Low control beliefs were much more common among the lower socio-economic status groups (47 percent) compared with the high socio-economic status groups (24 percent). Socio-economic groups did not significantly differ in strenuous exercise, underweight, and hypertension.

<table>
<thead>
<tr>
<th>Socio-economic status (combined measure)</th>
<th>N</th>
<th>Model 1: Sex and age-adjusted</th>
<th>Model 2: Model 1, additionally adjusted for classical risk factors</th>
<th>Model 3: Model 2, additionally adjusted for control beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1,128</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Medium</td>
<td>1,107</td>
<td>1.19 (0.86, 1.65)</td>
<td>1.22 (0.88, 1.69) [—]</td>
<td>1.15 (0.83, 1.60) [32]</td>
</tr>
<tr>
<td>Low</td>
<td>1,125</td>
<td>1.45 (1.06, 1.99)</td>
<td>1.42 (1.03, 1.97) [07]</td>
<td>1.30 (0.93, 1.80) [29]</td>
</tr>
<tr>
<td>Missing</td>
<td>528</td>
<td>1.00 (0.66, 1.53)</td>
<td>1.00 (0.66, 1.53) [00]</td>
<td>0.95 (0.62, 1.46) [—]</td>
</tr>
<tr>
<td>Educational level^b^</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1,385</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Medium</td>
<td>1,062</td>
<td>1.20 (0.88, 1.63)</td>
<td>1.20 (0.88, 1.64) [00]</td>
<td>1.15 (0.84, 1.57) [25]</td>
</tr>
<tr>
<td>Low</td>
<td>1,433</td>
<td>1.38 (1.03, 1.85)</td>
<td>1.36 (1.01, 1.83) [05]</td>
<td>1.24 (0.92, 1.68) [33]</td>
</tr>
<tr>
<td>Occupational level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1,128</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Medium</td>
<td>1,324</td>
<td>1.26 (0.93, 1.70)</td>
<td>1.24 (0.92, 1.68) [08]</td>
<td>1.19 (0.88, 1.61) [21]</td>
</tr>
<tr>
<td>Low</td>
<td>1,327</td>
<td>1.15 (0.86, 1.56)</td>
<td>1.16 (0.85, 1.57) [—]</td>
<td>1.09 (0.80, 1.48) [44]</td>
</tr>
<tr>
<td>Missing</td>
<td>109</td>
<td>0.65 (0.24, 1.78)</td>
<td>0.60 (0.22, 1.66) [—]</td>
<td>0.58 (0.21, 1.59) [—]</td>
</tr>
<tr>
<td>Income level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1,543</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Medium</td>
<td>790</td>
<td>1.37 (1.00, 1.88)</td>
<td>1.38 (1.00, 1.89) [—]</td>
<td>1.30 (0.94, 1.79) [21]</td>
</tr>
<tr>
<td>Low</td>
<td>1,123</td>
<td>1.35 (1.00, 1.82)</td>
<td>1.31 (0.97, 1.77) [11]</td>
<td>1.21 (0.89, 1.64) [32]</td>
</tr>
<tr>
<td>Missing</td>
<td>432</td>
<td>1.04 (0.68, 1.82)</td>
<td>1.04 (0.68, 1.59) [00]</td>
<td>1.00 (0.66, 1.53) [100]</td>
</tr>
</tbody>
</table>

^aThe percentage reduction of the hazard ratios is computed as: 100 * (HR_restricted model—HR_extended model) / (HR_restricted model−1).

^bEight persons with missing education scores were excluded.
Table 2
Sex and age-adjusted association of socio-economic status (combined measure) with classical coronary risk factors and control beliefs; expressed in terms of adjusted means and percentages

<table>
<thead>
<tr>
<th></th>
<th>High SES</th>
<th>Medium SES</th>
<th>Low SES</th>
<th>Missing SES Score</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (mean)</td>
<td>67.6</td>
<td>68.7a</td>
<td>72.3a,b</td>
<td>70.7a,b,c</td>
<td>*</td>
</tr>
<tr>
<td>Women (%)</td>
<td>47.6</td>
<td>54.8a</td>
<td>69.3a,b</td>
<td>65.0a,b</td>
<td>*</td>
</tr>
<tr>
<td>Classical risk factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pack-years smoking (mean)</td>
<td>11.1</td>
<td>12.0</td>
<td>12.9a</td>
<td>12.8</td>
<td>*</td>
</tr>
<tr>
<td>Much alcohol (%)</td>
<td>12.6</td>
<td>8.2a</td>
<td>5.6a</td>
<td>9.0</td>
<td>*</td>
</tr>
<tr>
<td>No alcohol (%)</td>
<td>48.9</td>
<td>60.4a</td>
<td>71.6a,b</td>
<td>59.6a,c</td>
<td>*</td>
</tr>
<tr>
<td>Strenuous exercise (mean)</td>
<td>0.9</td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Obesity (%)</td>
<td>6.9</td>
<td>9.8</td>
<td>15.0a,b</td>
<td>11.2a</td>
<td>*</td>
</tr>
<tr>
<td>Underweight (%)</td>
<td>2.7</td>
<td>2.4</td>
<td>1.9</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>20.0</td>
<td>19.9</td>
<td>20.9</td>
<td>21.1</td>
<td></td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>4.7</td>
<td>4.8</td>
<td>7.1</td>
<td>4.7</td>
<td>*</td>
</tr>
<tr>
<td>Healthy diet (mean)</td>
<td>5.5</td>
<td>5.3</td>
<td>5.2a</td>
<td>5.2a</td>
<td>*</td>
</tr>
<tr>
<td>Low control beliefs (%)</td>
<td>23.7</td>
<td>35.8a</td>
<td>47.3a,b</td>
<td>41.1a,c</td>
<td>*</td>
</tr>
</tbody>
</table>

* P ≤ 0.05 for overall test of differences between socio-economic categories. Corrected for multiple tests (P ≤ 0.01): test of differences compared with

a high
b medium, and
c low socio-economic status.

Table 1 (models 1–3) shows that seven percent of the increased rate of heart disease for the lower socio-economic groups (combined measure) was taken into account by the classical coronary risk factors ((1.45–1.42) / (1.45–1)) The socio-economic differences in heart disease rates subsequently decreased by 29 percent, when control beliefs were additionally introduced into the model. The hazard ratio of heart disease for lower socio-economic groups decreased from a statistically significant 1.42 to a statistically non-significant 1.30. Results for the separate indicators of socio-economic status also show that the classical coronary risk factors only marginally contributed to the socio-economic differences in heart disease and that the control beliefs had a substantial independent contribution. On average, hazard ratios of the intermediate and low socio-economic status groups decreased by 4 percent, when the classical risk factors were introduced and by 30 percent, when the control beliefs were additionally introduced. In the model with control beliefs, all socio-economic effects lost their statistical significance.

When the classical coronary risk factors and the control beliefs were simultaneously controlled (model 3), the hazards ratios of both groups of variables only slightly decreased compared with the model without such simultaneous control (not tabulated). For example, the hazard ratio for low control beliefs decreased from 1.54 (95% CI: 1.14, 2.09) to 1.50 (95% CI: 1.10, 2.04) after control for the classical coronary risk factors. This indicates that control beliefs were not strongly related to the classical risk factors. In the final model for the combined measure of socio-economic status, statistically significant and adverse effects on heart disease were found for being older (HR = 1.06; 95% CI: 1.05, 1.08), being male (HR = 0.51; 95% CI: 0.38, 0.68), absence of strenuous exercise (HR = 0.85; 95% CI: 0.75, 0.96), smoking one extra pack-year (HR = 1.01; 95% CI: 1.01, 1.02), and low control beliefs (HR = 1.50; 95% CI: 1.10, 2.04). Similar patterns were found across all measures of socio-economic status.

Discussion

In middle-aged and older Dutch men and women, a higher prevalence of low control beliefs in the lower socio-economic status groups appears to be more important for the explanation of the higher heart disease rates in these groups than a higher prevalence of smoking, obesity, and unhealthy dietary habits. Although occupational level was not significantly related to heart disease incidence, a similar pattern of the relative contribution of classical coronary risk factors and control beliefs was observed across different indicators of socio-economic status and for an overall, combined socio-economic indicator. On average, 4 percent of the socio-economic differences in incident
heart disease were accounted for by the classical coronary risk factors compared with 30 percent by the control beliefs. This confirms other studies indicating the importance of control beliefs for varying health outcomes (Mendes de Leon, Seeman, Baker, Richardson, & Tinetti, 1996; Ryan & Deci, 2000; Seeman & Lewis, 1995), including heart disease (Chandola, Kuper, Singh-Manoux, Bartley, & Marmot, 2004) and for socio-economic differences in health (Adler et al., 1994; Bosma et al., 1999a,b; Mackenbach, Borsboom, Nusselder, Looman, & Schrijvers, 2001; Marmot, 2003).

The contribution of the control beliefs, being largely independent of the classical coronary risk factors, indicates that low control beliefs may affect heart disease through other than classical coronary risk factors. This is in contrast with models of behavioural change, where control beliefs (self-efficacy in particular) generally are considered important predictors of behaviours (Ajzen, 1991). It is also in contrast with a recent study that found important mediation of health behaviours in the association between control beliefs and mortality (Mackenbach, Simon, Looman, & Joung, 2001). It is unclear how to explain these diverging patterns, but the older men and women in our study may be one reason. Similar to our study, others found only weak associations between control beliefs and health behaviours (Baillis et al., 2001; Perlman, Bobak, Steptoe, Rose, & Marmot, 2003). There is evidence, although scant, that stress-induced physiological pathways may be implicated, e.g. via an excessive production of glucocorticoids and its adverse effects on the immune system (Brunner, 1997; Haidt & Rodin, 1999; Kop, 1999; Krantz & McCeney, 2002; Kristenson, Eriksen, Sluiter, Starke, & Ursin, 2004; Skinner, 1996; Walker, 2001).

The findings strongly suggest that, at least in older men and women, low control beliefs may be a more important mechanism in the association between low socio-economic status and heart disease than the mechanism via the classical coronary risk factors. Low control beliefs do not originate in a vacuum, but have important socio-economic roots in early and adult life (Bosma et al., 1999a,b). Previously, Wheaton (1980) discussed the concept of “socialised fatalism” which is similar to our low control beliefs concept, but the terminology perhaps better reflects that psychological factors should be contextualised. Low control beliefs may be based on environmental conditions that are ‘objectively’ without control. Adverse neighbourhoods or working conditions may be examples (Bosma, Marmot, Hemingway, Nicholson, Brunner, & Stansfeld, 1997; Bosma, Van de Mheen, Borsboom, & Mackenbach, 2001). This contextualisation indicates, firstly, that low control beliefs are not only an individual, psychological characteristic or trait, but may also be a cultural phenomenon, characteristic of lower social classes and, secondly, that the socio-economic roots of the unhealthy belief systems should be the target of intervention and prevention efforts, rather than the beliefs themselves (Forbes & Wainwright, 2001; Link & Phelan, 1995; Muntaner & Lynch, 1999).

Methodological issues

Several considerations should be taken into account. Firstly, one could object that diabetes, obesity, and hypertension were based on self-reports, possibly leading to underestimated effects of these important risk factors. It should be mentioned that biases due to social desirability, negative affectivity, and not knowing or remembering may be differentially related to socio-economic status. Moreover, the latter type of bias may differ between conditions (Mackenbach, Looman, & Van der Meer, 1996; Goldman, Lin, Weinstein, & Lin, 2003; Kriegsman, Penninx, Van Eijk, Boeke, & Deeg, 1996). For example, Goldman and colleagues find misreporting for diabetes, but not for hypertension (Goldman et al., 2003). The socio-economic patterns in the misreporting may lead to differential misclassification of the risk factors, rather than to non-differential misclassification. Given the unclear pattern of socio-economic misclassification, it is also unclear how this may have affected the associations of risk factors with heart disease and particularly the small contribution of the classical coronary risk factors to the socio-economic differences in heart disease. We further think that our questionnaire on the health behaviours is extensive and compares well with other studies asking for health behaviours and coronary risk factors. However, for some risk factors, such as excessive alcohol consumption and unhealthy dietary habits, arbitrary cut-offs may have been used. Their influence may thus not have been validly determined in all cases (Droomers, Schrijver, Stronks, Van de Mheen, & Mackenbach, 1999). Moreover, further studies should preferably include more recent risk factors, such as HDL and LDL cholesterol, and baseline exclusions based on ECG-abnormalities.

Secondly, the adverse effects of the classical coronary risk factors may already have taken their toll by having affected the pre-baseline incidence of heart disease. The exclusion of prevalent cases of heart disease may thus also have resulted in an underestimated contribution of the classical coronary risk factors. However, to exclude the possibility that heart disease resulted in mobility to less prestigious jobs, prevailing cases were left out of the analyses. This healthy survivors phenomenon may thus point to genuinely weaker effects of the classical coronary risk factors in elderly persons and corresponds to findings of other researchers (Abbott et al., 2002; Langer et al., 1989; Manolio et al., 1992), but not all (Benfante, Reed, & Frank, 1992; Castelli, Anderson, Wilson, & Levy, 1992; Frost et al., 1996).
Thirdly, the possibility of selection effects due to control beliefs cannot be excluded, as socio-economic status and control beliefs were simultaneously measured at the baseline phase. The causal direction of the association between socio-economic status and control beliefs could therefore not be determined. Given that control beliefs—indeed of background socio-economic status—may also affect where people end up in the socio-economic hierarchy (Wang, Kick, Fraser, & Burns, 1999), further research should examine this possibility in more depth. The presence of such a selection effect would have important implications for the methodology of research on socio-economic differences in (heart) disease and for setting up interventions.

Finally, our occupational prestige score, based on the Socio-economic Index of Occupational Status, was not related to heart disease. The absence of an effect was not specific to the prestige score, as another occupational scaling method, i.e. the Erikson–Goldhorpe–Portecarero (EGP) scale, neither was related to heart disease (not tabulated). The latter scale is more difficult to recode into three groups than the prestige score. It is unclear how this negative finding for occupation can be explained, but it may point to different socio-economic indicators telling us different things about groups differing in age or other characteristics.

Conclusion

Our findings support the hypothesis that socio-economic inequalities in heart disease—at least in middle-aged and older persons—may be based upon differences in control beliefs, more than upon differences in smoking rates and other classical risk factors. More information is needed on the specific socio-economic correlates (e.g. work characteristics, living in deprived areas) that induce beliefs of low control, because these may be easier to modify than the beliefs themselves and because interventions on control beliefs per se may do little to the structural determinants which generate these beliefs.

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