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Social class and self-rated health: can the gradient be explained by differences in life style or work environment?

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Abstract

The purpose of the present paper is to describe differences in work environment and life style factors between social classes in Denmark and to investigate to what extent these factors can explain social class differences with regard to changes in self-rated health (SRH) over a 5 year period. We used data from a prospective study of a random sample of 5001 Danish employees, 18–59 years of age, interviewed at baseline in 1990 and again in 1995. At baseline we found higher prevalence in the lower classes of repetitive work, low skill discretion, low influence at work, high job insecurity, and ergonomic, physical, chemical, and climatic exposures. High psychological demands and conflicts at work were more prevalent in the higher classes. With regard to life style factors, we found more obese people and more smokers among the lower classes. The proportion with poor SRH increased with decreasing social class at baseline. The follow-up analyses showed a clear association between social class and worsening of SRH: The lower the social class, the higher the proportion with deterioration of SRH. There was no social gradient with regard to improved SRH over time. Approximately two thirds of the social gradient with regard to worsening of SRH could be explained by the work environment and life style factors. The largest contribution came from the work environment factors.

Keywords: Self-rated health; Social class; Work environment; Life style; Prospective study

Introduction

One of the best established findings in the international epidemiological literature is the inverse association between health and social class: The higher the social class the lower the prevalence and/or incidence of health problems, illness, disease, and death. There are a few exceptions to this rule, but they serve to underscore the general tendency (Feinstein, 1993). In spite of the falling mortality rates in most western countries and in spite of the increasing resources spent on health care, there seems to be a tendency towards increasing social differences in health. This does not imply a deterioration of health in the lower social classes or in the population in general. (Pappas, Queen, Hadden & Fisher, 1993; Mackenbach et al., 1997). Thus, inequality in health is one of the important unsolved public health problems in the industrialised world. Epidemiological research has found systematic social class variations in psychosocial, behavioural, and biological risk factors for a number of dis-

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eases. The highest prevalence of risk factors has, generally but not always, been found in the lower classes (Kaplan & Keil, 1993; Møller, Kristensen & Hollnagel, 1991; Marmot et al., 1991; Pill, Peters & Robling, 1995; Pekkanen, Tuomilehto, Uutela, Vartainen & Nissinen, 1995). Identifying factors that explain the social gradient in health and suggesting ways in which the health gradient could be reduced are therefore important research tasks.

During the last 15 years more than 20 prospective studies have analysed the association between people's general evaluation of their own health (in the following called self-rated health, SRH) and subsequent mortality. The large majority of these studies have demonstrated that SRH is a powerful predictor for mortality, also after control for other measures of health such as medical diagnoses or functional ability (Bjorner et al., 1996; Idler & Benyamini, 1997). These clear research findings have resulted in a search for factors that influence SRH and, in particular, changes in SRH over time.

A number of studies have shown a social gradient with regard to SRH and changes in SRH over time (Power, Matthew & Manor, 1996; Power, Hertzman, Mathews & Manor, 1997; Hemingway, Nicholson, Stafford, Roberts & Marmot, 1997a; Hemingway, Stafford, Stansfield, Shipley & Marmot, 1997b), but to our knowledge only three studies have analysed to what extent these social class differences in SRH can be explained by work environment or life style factors (Marmot, 1997; Power, Matthew & Manor, 1998; Schrijvers, van de Mhen, Stronks & Mackenbach, 1998). In these three studies about half of the social gradient could be explained by differences in work environment or life style. However, the associations between social class and SRH remained statistically significant after control for both work environment and life style factors.

Many studies have elucidated differences in psychosocial work environment between occupational groups, but surprisingly few studies have analysed the associations between psychosocial work environment factors and social class (Marmot et al., 1991; Stansfeld, North White, & Marmot, 1995; Suadicani, Hein & Gyntelberg, 1993).

In earlier prospective analyses of the present cohort we have shown that several work environment factors predict changes in SRH over time (Borg, Kristensen & Burr, 2000). The purpose of the present study is to answer the following three questions:

- is social class associated with changes in SRH over time?
- can we identify social class differences with regard to work environment and life style factors?
- to what extent can work environment and life style factors explain social class differences with regard to changes in SRH over time?

Methods

Design

The Danish National Work Environment Cohort Study is an ongoing study carried out by the National Institute of Occupational Health and the National Institute of Social Research (Borg & Burr, 1997). In 1990, a random sample of 9653 persons aged between 19 and 59 years was drawn from the national registry. Of these, 8664 agreed to be interviewed by telephone (response rate 90%). According to the interviews, 5940 were working as employees in 1990. In 1995 we tried to re-interview the original cohort. Of the 5940 employees, 112 were dead or had emigrated. Of the remaining 5828, 5001 were interviewed for the second time (response rate 86%). In this article we analyse data from 4751 individuals who could be classified under one of the social classes. The remaining 250 were students or had missing data on one of the variables used for social class classification or on the health questions.

Measures of health

Global SRH was measured with one question: "*How do you rate your health in general*?". There were five response options (*very good, good, fair, poor, very poor*). In Table 1 the distribution according to SRH in 1990 and 1995 is shown. The distribution was skewed at both points in time with approx. 50% in the best category. More than half (54%) had the same SRH, while 27% had worse SRH and 19% better SRH when we compare 1995 with 1990. The extent of stability over 5 years (gamma = 0.56) was nearly the same as observed over 10 years in a somewhat younger population (gamma = 0.59) (Power et al., 1996). In the analyses of changes in SRH over time we chose to dichotomise SRH with "very good" and "good" in one group (in the following called "good") and the three remaining options in the other group (called "poor"). According to this choice a change was regarded as a change only when a person passed the line between the two new categories. After this dichotomisation, 84.5% had stable SRH, 9.9% had deteriorated SRH, and 5.6% improved SRH.

The analyses of *changes in SRH* were performed on two different parts of our sample. When analysing deterioration of SRH we used the 87.7% of the sample with "good" SRH in 1990 (the population "at risk"),

while we used the remaining proportion of the sample when analysing improvements in SRH.

The respondents were asked at both interviews if they had a disease, injury, or long lasting illness. This variable was, together with age and gender, used as potential confounder in the multivariate analyses.

Social class

The respondents were classified according to employment grade, job title, and education into five social classes at the baseline in 1990: Social class I: Executives and/or academics. Social class II: Middle managers and/or people with 3–4 years of further education. Social class III: Other white collar workers. Social class IV: Skilled blue collar workers. Social class V: Semi- or unskilled blue collar workers. We have chosen not to include changes in the social class status in the analyses.

Work environment

The interview in 1990 included 25 questions on psychosocial aspects of the work environment. The 25 items were combined into seven scales (Table 2). The items were scored with equal weights and equal intervals between response options and combined in summated rating scales. Four scales were constructed for measuring other work environment characteristics: ergonomic, chemical, climatic, and physical exposures (Table 2).

Since we expected that the associations with the outcomes would not necessarily be linear, the population was divided into quartiles for most of the scales. Due to skewed distributions there were three exceptions: The scales for conflicts and repetitive work were dichotomised, and the scale for ergonomic exposures was divided into three.

Life style factors

Two types of life style factors were included in the study: smoking and relative weight. The respondents were asked if they were current smokers, ex-smokers or had never smoked, and the smokers were divided into heavy and moderate smokers on the basis of their normal daily consumption (less than 15 cigarettes/g of tobacco per day versus 15 or more). Body mass index (BMI) was calculated on the basis of the respondents' own information on height and weight as kg/m^2. We classified the respondents into four groups: Underweight ($BMI < 20$), normal weight ($20 \leqslant BMI \leqslant 25$), moderate overweight ($25 < BMI \leqslant 30$), and obesity ($BMI > 30$).

Statistical analyses

In the bivariate analyses of the associations between SRH and work environment/life style variables we used the gamma test for linear trend (Noruskis, 1992). In the analyses of SRH in 1990 and of the changes in SRH from 1990 to 1995 multivariate logistic regression analyses were used.

In the analyses of the contribution of each factor to the explanation of the social gradient we needed an overall measure for the gradient that took the social class distribution into account. Since the social classes did not have the same size, it did not seem correct to use the ordinal values 1, 2, 3, etc. The Social Class Score Scale is an interval scale, where the sizes of the intervals depend on the sizes of the social classes. The difference between the gradient before and after control for one or more of the explanatory variables was calculated by using a method suggested by Kunst and Mackenbach (1994) and Power et al. (1997). The five social classes were ordered according to rank on a scale from 0 to 1, and the mid-point of each social class was then determined. Each person in a class was given the score of this mid-point (Table 3). Thus, the

Table 1
Distribution of self-rated health in 1990 and 1995. Percentages of the total population ($N = 4717$)[a]

	Self-rated health in 1995					
Self-rated health in 1990	Very good	Good	Fair	Poor	Very poor	Total
Very good	32.6	15.9	3.2	0.6	0.0	52.5
Good	13.0	16.2	4.6	1.1	0.3	35.2
Fair	1.6	3.7	4.8	0.7	0.2	11.0
Poor	0.0	0.2	0.4	0.3	0.1	1.1
Very poor		0.0	0.2	0.0		0.3
Total	47.3	36.1	13.2	2.7	0.6	100.0

[a] Gamma 0.56 ($p < 0.001$). Note: 34 persons did not answer the SRH question in 1995. 0.0 means less than 0.05%. A blank space indicates no observations.

Table 2
Work environment dimensions measured at baseline in 1990

Scale	No. of items	Cronbach's α	Range of inter-item correlations
Psychosocial work environment dimensions			
Psychological job demands	4	0.41	0.05–0.28
Decision authority	3	0.53	0.15–0.37
Social support	5	0.57	0.06–0.54
Skill discretion	3	0.62	0.28–0.40
Conflicts at work	4	0.42	0.09–0.24
Job insecurity	4	0.61	0.19–0.32
Repetitive work	2	0.56	0.40
Other work environment characteristics			
Ergonomic exposures	6	0.69	0.25–0.41
Chemical exposures	4	0.57	0.13–0.48
Climatic exposures	4	0.57	0.12–0.48
Physical exposures	4	0.44	0.08–0.29

slope in inequality was calculated with a logistic regression analysis by using the formula $\ln[p/(1-p)] = \alpha + \beta * \text{SCS}$, where p is the probability of change in SRH, SCS is the social class score, α is the intercept and β the regression coefficient. The gradient is presented as an OR-value, which estimates the difference between the top and the bottom in the social class hierarchy. The contribution of each work environment or life style factor to the explanation of the gradient was estimated by the change in OR after the inclusion of the variable in the model. The assumption of a linear association between social class and changes in SRH was tested by including a quadratic term in all the models. This quadratic term did not contribute significantly to any of the models. In order to test the hypothesis stated by Karasek (Karasek & Theorell, 1990) of an interaction effect of demand and skill discretion we included an interaction term in the model.

Results

Social class and work environment

Table 4 illustrates the associations between social class and the eleven work environment factors in 1990. For eight of the eleven factors we see the expected trend: the lower the social class the higher the prevalence of potentially harmful work environment factors. This trend is particularly strong with regard to repetitive work, chemical and ergonomic exposures. For two factors, psychological job demands and conflicts at work, we see significant trends in the opposite direction with higher prevalence in the higher classes. Only one factor, social support, appears to be unrelated to social class.

Social class and life style factors

The associations between social class and the two life style factors are illustrated in Table 5. As expected, there were more heavy and moderate smokers in the lower classes and more ex-smokers in the higher classes. With regard to BMI status, there was no trend for moderate overweight, but a significant trend in the expected direction for obesity.

Social class and SRH at baseline

Table 6 shows the associations between SRH at

Table 3
Computation of social class scores

	N	Proportions	Cumulative proportions	Social class score midpoints
Social class I	597	0.126		0.063
Social class II	920	0.194	0.319	0.222
Social class III	1734	0.365	0.684	0.502
Social class IV	485	0.102	0.786	0.735
Social class V	1015	0.214	1.000	0.893
Total	4751			

Table 4
Associations between social class and work environment factors in 1990 (percentages)

	Social class I	Social class II	Social class III	Social class IV	Social class V	Total	Gamma[a]	*p*-value[b]
Repetitive work	0.8	2.8	6.9	7.4	26.4	9.6	0.66	***
High psychological demands	37.1	31.3	19.3	22.9	18.0	23.9	−0.22	***
Low decision authority	6.4	14.3	22.3	24.1	42.1	23.2	0.34	***
Low social support	26.5	26.7	24.6	20.0	30.8	26.1	0.01	NS
Low skill discretion	10.2	15.2	23.7	19.4	47.0	24.5	0.37	***
High level of conflicts	50.6	52.9	37.9	37.3	27.1	40.0	−0.26	***
High job insecurity	4.2	7.5	12.8	10.9	13.9	10.7	0.15	***
High ergonomic exposures	2.0	5.5	12.6	33.4	29.1	15.5	0.48	***
High chemical exposures	1.8	2.6	5.1	29.7	17.4	9.4	0.53	***
High climatic exposures	5.5	13.8	14.8	27.2	23.3	16.5	0.21	***
High physical exposures	12.9	18.8	18.3	40.4	37.0	23.6	0.29	***
N	597	920	1734	485	1015	4751		
%	12.6	19.4	36.5	10.2	21.4	100		

[a] Gamma test for linear trend.
[b] NS non-significant, *** $p < 0.001$.

baseline and social class plus the other background factors in the study: age, gender, and health status (persons with disease, injury, or illness versus the rest). The table shows that all four variables were independently associated with SRH at baseline. Women had a higher risk of having poor SRH than men, and the risk increased with age. In social classes IV and V the risk of having poor SRH was more than twice as high as in social classes I and II. Finally, the risk of having poor SRH was substantially higher among those with disease, injury, or illness.

Social class and changes in SRH over time

We analysed two types of changes in SRH over time: Worsening and improvement. As indicated above, these two analyses were performed in different groups of respondents. The results are shown in Table 7. We found a clear association between social class and worsening of SRH. With regard to improvements in SRH, there was no clear pattern.

So far we have found that SRH at baseline and worsening of SRH over 5 years were clearly associated with social class. Furthermore, social class at baseline was significantly associated with a number of work environment and life style variables. This means that it makes good sense to continue with the analyses, since the basic requirements (associations of social class with the dependent variable as well as the explanatory variables) are fulfilled. Before we proceed to the final analyses, we will look at the third set of associations, those between the explanatory variables and changes in SRH.

Life style and changes in SRH over time

In the subgroup with good SRH in 1990 there was a clear association between smoking status and worsening of SRH. Among heavy as well as moderate smokers 13% experienced deteriorated SRH, while the proportion was 11% among ex-smokers and 8% among never smokers ($p < 0.01$). With regard to BMI status, we also found significant differences: Among those classified as obese at baseline, 26% had worsened SRH, among those with moderate overweight, it was 13%, in the group with normal weight, 9%, and among those with very low relative weight, 11% had worsened SRH ($p < 0.001$). Thus, the two life style factors were associated with worsening of SRH in the way expected.

Among the 580 persons with poor SRH in 1990, 41% of the heavy smokers, 43% of the moderate smokers, 47% of the ex-smokers, and 53% of those who had never smoked had improved SRH five years later ($p < 0.05$). However, we found no association between relative weight and improvement in SRH.

Table 5
Prevalence of smoking and overweight in 1990 in relation to social class (percentages)

	Social class I	Social class II	Social class III	Social class IV	Social class V	Total	Gamma[c]	*p*-value[d]
Smoking status[a]								
Heavy smoker	13.3	12.3	15.1	22.3	21.0	16.2	0.18	***
Moderate smoker	25.8	29.2	30.8	30.2	34.4	30.6	0.08	**
Former smoker	24.3	19.7	17.1	15.1	15.8	18.0	0.12	***
BMI status[b]								
Moderate overweight	30.0	31.7	28.1	32.0	33.6	30.6	0.03	NS
Obese	2.2	2.6	4.4	4.1	7.6	4.4	0.30	***
N	597	920	1734	485	1015	4751		
	12.6	19.4	36.5	10.2	21.4	100		

[a] Heavy smoker ⩾15 g/day, moderate smoker < 15 g/day.
[b] Moderate overweight 25–30 kg/m^2, obese > 30 kg/m^2.
[c] Gamma test for trend.
[d] NS non-significant, $^{**}p < 0.01$, $^{***}p < 0.001$.

Work environment and changes in SRH over time

The associations between work environment factors and changes in SRH have been thoroughly analysed in an earlier paper (Borg et al., 2000). In brief, we found that repetitive work, high job demands, low social support, job insecurity, and high ergonomic exposures predicted worsening of SRH, and that low ergonomic exposures and moderate skill discretion predicted improvement in SRH.

Table 6
Logistic regression of poor self-rated health in 1990 on gender, age, social class, and health status in 1990 ($N = 4751$)

	OR	95% CI	*p*-value[a]
Gender			***
Female[b]	1.36	(1.11–1.66)	
Age			***
18–29 years	1.00		
30–39 years	1.95	(1.46–2.60)	
40–49 years	2.35	(1.78–3.12)	
50–59 years	3.41	(2.54–4.59)	
Social class			***
Social class I	1.00		
Social class II	0.94	(0.64–1.38)	
Social class III	1.28	(0.91–1.80)	
Social class IV	2.18	(1.46–3.25)	
Social class V	2.27	(1.60–3.22)	
Health status			***
Disease[c]	5.16	(4.29–6.21)	

[a] The overall significance of the variable in the model, $^{***}p < 0.001$.
[b] In contrast to males.
[c] In contrast to no disease.

Explaining the social gradient in deterioration of SRH over time

In Table 8 the association between social class in 1990 and worsening of SRH over the 5 years of follow-up is analysed in detail. The first model shows that social class was a strong predictor for worsening of SRH after control for age, gender and disease status in 1990. The risk increased stepwise and was more than three times as high in social class V as in social class I. In model 2 we controlled for the two life style factors and in model 3 for the work environment factors. We found no significant interaction effects. These analyses showed that control for the work environment factors decreased the OR-values substantially (the relative changes in the OR-values are shown in the right-hand column of the table). In the last model we controlled for the life style as well as the work environment variables. This changed the OR-values by 36–59%.

In Table 9 we analysed how much the explanatory factors contributed to an explanation of the gradient in worsening of SRH. Using the model explained in the section on methods above, the overall social gradient had an OR of 4.23. Controlling for the two life style factors reduced this OR-value by 12% (BMI) and 4% (smoking). Controlling for both gave a reduction of 17%. Controlling for the eight work environment factors that were most prevalent in the lower classes yielded reductions of 4–34% in the social gradient. Control for the three remaining factors contributed in the opposite direction with increases in the gradient of 1–16%. Further analyses showed that the combination of five work environment factors gave the largest reduction in the gradient. These factors were: ergonomic exposures, repetitive work, skill discretion, climatic exposures, and job insecurity. These five factors together

Table 7
Social class and changes in SRH over time

	Persons with good SRH i 1990		Persons with poor SRH in 1990	
	N	% with deteriorated SRH in 1995	*N*	% with improved SRH in 1995
Social class I	538	6.3	53	54.7
Social class II	833	8.0	84	47.6
Social class III	1522	11.7	200	41.0
Social class IV	410	12.9	74	52.7
Social class V	834	16.1	169	44.4
Total	4137	11.3	580	45.7

explained 59% of the gradient. Finally, the two life style factors and the five work environment factors together explained 66% of the social gradient (Fig. 1).

Social class and improvement in SRH over time

In Table 10 the improvement in SRH over 5 years among those respondents who had poor SRH at baseline is analysed. The table shows that gender, age, and health status predicted improved SRH. Males, younger persons, and persons without prevalent disease had a higher "risk" of improved SRH. Social class was not a significant predictor of improved SRH. Therefore, we did not proceed with this analysis.

Discussion

This study has demonstrated a number of clear associations between social class, life style, work environment, and SRH. First, we found a clear association between social class and SRH at baseline with higher prevalence of poor SRH in the lower classes. Second, we also found that social class predicted deterioration of SRH over time in the group of respondents with good SRH at baseline. On the other hand, social class did not predict improvement in SRH in those with poor SRH at baseline. Thirdly, we found very clear associations between social class and the life style factors smoking and relative weight, and the majority of the work environment factors. Fourthly, the two life style factors and a number of the work environment factors also predicted worsening of SRH among those with good SRH at baseline. And finally, we could demonstrate that the two life style factors together with five of the work environment factors explained two thirds of the gradient with regard to worsening of SRH. The work environment factors alone explained 59% while the life style factors alone explained 17%.

To our knowledge, this is the first longitudinal study showing that work environment factors and life style factors play a significant role in the social gradient

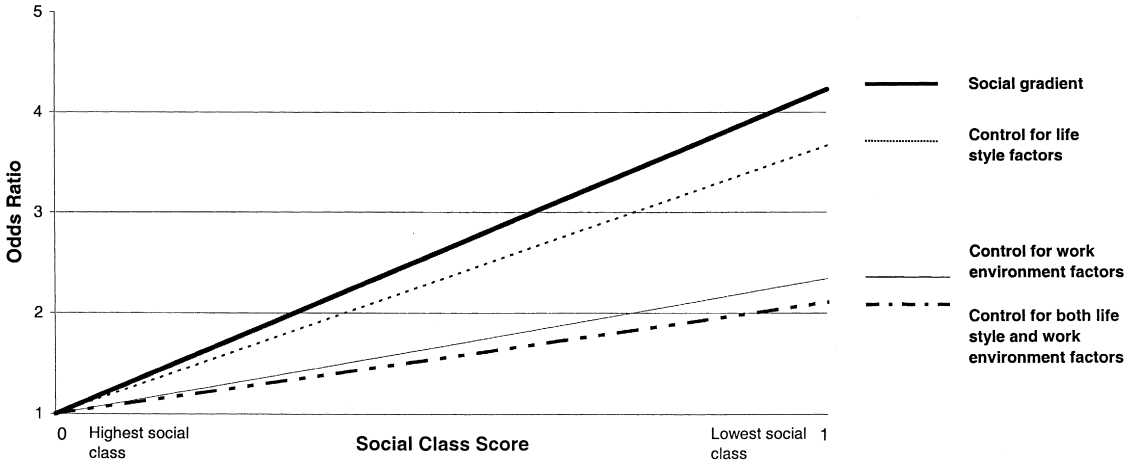

Fig. 1. Social class differences in worsening of SRH 1990–1995 explained by work environment factors, by life style factors, and by the combination of these.

Table 8
Logistic regression of worsened self-rated health in 1995 on social class, life style, and work environment in 1990 ($N = 4137$ with good SRH in 1990)

	Model 1[a]			Model 2[b]			Model 3[c]			Model 4[d]			Change in OR[e]		
	OR	95% CI	p^f	OR	95% CI	p^f	OR	CI 95%	p^f	OR	95% CI	p^f	$1 \rightarrow 2$	$1 \rightarrow 3$	$1 \rightarrow 4$
Social class			***			***			**			**			
Social class I	1.00			1.00			1.00			1.00					
Social class II	1.33	(0.86–2.08)		1.28	(0.82–1.99)		1.19	(0.75–1.87)		1.15	(0.73–1.81)		−18%	−44%	−56%
Social class III	2.10	(1.41–3.14)		1.97	(1.32–2.93)		1.80	(1.18–2.74)		1.71	(1.12–2.60)		−12%	−27%	−36%
Social class IV	2.82	(1.77–4.49)		2.68	(1.68–4.27)		2.04	(1.22–3.42)		1.99	(1.19–3.33)		−8%	−43%	−46%
Social class V	3.39	(2.25–5.12)		2.99	(1.99–4.52)		2.20	(1.39–3.50)		1.97	(1.24–3.14)		−19%	−50%	−59%

[a] Social class + confounders: age, gender, and disease.
[b] Model 1 + life style factors.
[c] Model 1 + work environment factors.
[d] Model 1 + life style factors + work environment factors.
[e] Computed with the formula $(OR_X - OR_1)/(OR_1 - 1)$.
[f] The overall significance of the variable in the model, $^{**}p < 0.01$, $^{***}p < 0.001$. Note: 30 persons did not answer the SRH question in 1995.

with regard to worsening of SRH over time. Before discussing our results in more detail, we will evaluate the methodological limitations of the study.

Methodological limitations and problems

The study has a number of potential limitations. First, the follow-up time of 5 years was relatively long. This means that changes in social class, work environment and life style may have happened during the follow-up period without being noticed. Second, we do not know anything about the duration of the explanatory factors. For example, some respondents may have been exposed to repetitive work for 20 years and others only for a few months. These two limitations will tend to result in negative bias in the estimation of relative risks. Third, there was no information in our study about social class and other factors in the individuals' early life, which may have explained some of the social differences in health or health deterioration.

A fourth potential limitation, which is often discussed in connection with studies of this type, is that all the variables are based on self-reports. Self-reporting is, of course, the only possible and valid method when we want to measure SRH, but the problem arises when we relate SRH to self reported exposures. This could result in "common method variance" (Frese, 1985; Spector, 1987; Williams, Cote & Buckley, 1985). Common method variance may lead to positive bias so that we overestimate the real associations. We do not think that the criticism has great relevance to the present study because we controlled for SRH at baseline by looking at *changes in SRH*. Also, we assume that social class is measured with very little bias since the classification is based on pieces of factual information. Fifth, the scales measuring work environment factors had Cronbach's α's between 0.41 and 0.69, which is somewhat lower than recommended in the literature. These low alphas are due to low correlations between some of the items and to the low number of items in several of the scales. We chose to use the scales in our analyses (instead of individual items) in order to give a broad coverage of different aspects within each dimension. In most cases a low alpha in a scale will result in negative bias with OR's closer to unity. Sixth, we measured SRH with only one item. In the 1995 interviews we considered using the 5-item General Health scale of the Short Form 36 questionnaire (Ware & Sherbourne, 1992). However, we decided to keep the 1990 question in order to ensure comparability. Even though a "scale" with only one item has lower reliability than a multi-item scale, the consistent associations between SRH and mortality found in many studies seem to indicate that a global question on SRH has good validity. The choice of response categories to this item was somewhat inappropriate, as it resulted in

Table 9
Proportions of the social gradient of worsened SRH explained by the different work environment factors and life style factors and by combinations of these ($N = 4137$)

	OR	95% CI	Changes in OR[c]
Social class	4.23	(2.92–6.13)	
Life style factors			
BMI status	3.85	(2.65–5.61)	−12%
Smoking status	4.10	(2.82–5.96)	−4%
Work environment factors			
Ergonomic exposures	3.13	(2.10–4.68)	−34%
Repetitive work	3.44	(2.33–5.06)	−24%
Skill discretion	3.74	(2.52–5.54)	−13%
Climatic exposures	3.88	(2.66–5.65)	−11%
Job insecurity	3.90	(2.68–5.69)	−10%
Physical exposures	3.95	(2.70–5.78)	−9%
Decision authority	4.00	(2.71–5.90)	−7%
Chemical exposures	4.10	(2.81–5.99)	−4%
Social support	4.25	(2.92–6.17)	+1%
Conflicts at work	4.46	(3.05–6.51)	+7%
Psychological demands	4.75	(3.24–6.96)	+16%
Combinations of factors			
Both life style factors	3.67	(2.51–3.36)	−17%
Five work environment factors[a]	2.34	(1.52–3.59)	−59%
Life style factors and five WE[b] factors	2.11	(1.36–3.26)	−66%

[a] The subset of work environment factors, which together explained the greatest proportion of the social gradient: ergonomic exposures, repetitive work, skill discretion, climatic exposures, and job insecurity.
[b] WE = work environment.
[c] Computed with the formula $(OR_X - OR_1)/(OR_1 - 1)$.

Table 10
Logistic regression of improved self-rated health in 1995 on gender, age, social class, and health status in 1990 ($N = 580$ with poor SRH in 1990)

Variable	OR	95% CI	p-value[a]
Gender			*
Female[b]	0.69	(0.48–1.00)	
Age			**
18–29 years	1.00		
30–39 years	0.65	(0.37–1.13)	
40–49 years	0.45	(0.26–0.77)	
50–59 years	0.41	(0.23–0.71)	
Social class			NS
Social class I	1.00		
Social class II	0.76	(0.37–1.59)	
Social class III	0.62	(0.33–1.18)	
Social class IV	0.78	(0.37–1.62)	
Social class V	0.64	(0.33–1.22)	
Health status			***
Disease[c]	0.53	(0.38–0.75)	

[a] The overall significance of the variable in the model, NS non-significant, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.
[b] In contrast to males.
[c] In contrast to no disease. Note: 4 persons did not answer the SRH question in 1995.

a ceiling effect. As a consequence, we decided to dichotomise the responses to the question. Finally, we only measured two life style factors at baseline, which probably resulted in an underestimation of the combined effect of life style factors in explanation of the social gradient. The methodological limitations discussed here will, with one possible exception, tend to bias our estimates of relative risks towards unity.

Having discussed the possible methodological problems, we would also like to mention the strengths of the study. First of all, the study population was a large national representative sample of employees. Second, the response rate was very high. Third, we included many relevant work environment factors and two life style factors, which have not been included in earlier studies of changes in SRH. Fourth, this was a prospective study over five years.

Social class differences and changes in SRH

Our analyses show considerable social class differences with regard to worsening of SRH over 5 years. Compared with social class I, persons from social class V had a relative risk of more than three for worsened SRH after control for age, gender, and prevalent disease (Table 8, model 1). This change for the worse for

the lower classes took place *on top* of the already existing social gradient in 1990. On the other hand, we could not find any social gradient with regard to improvements in SRH among those with poor SRH in 1990.

The result concerning worsening of SRH is in accordance with the two other prospective studies we have identified (Hemingway et al., 1997a, 1997b; Power et al., 1996, 1997). The result adds new evidence to the already substantial literature on social class and health (Feinstein, 1993; Marmot, Bobak & Smith, 1995). It was unexpected that we did not find any social gradient with regard to improvement in SRH. The reason may be that the analysis of improvement was restricted to the small population with poor SRH in 1990. It is a very special development *first* to develop poor SRH (1990) and *then* to develop good SRH again (1995). Such a course of events may have special causes that cannot be captured by a general study such as this.

Social class differences in work environment and life style

We also found significant social class differences with regard to work environment. In general, our findings supported the general hypothesis with a concentration of poor working conditions among the lower classes. We only found two work environment factors with a positive gradient: psychological job demands and conflicts at work. Also these results are in accordance with earlier studies.

With regard to smoking and obesity, our results are in accordance with many other studies from the industrialised world (Pocock, Sharper, Cook & Philips, 1987; Mackenbach, 1992; Kaplan & Keil, 1993; Townsend, Roderick & Cooper, 1994; Blane et al., 1996). The differences with regard to smoking are considerably smaller than those found in the UK (Marmot et al., 1991), but at the same level as those seen earlier in Finland and Denmark (Pekkanen et al., 1995, Møller et al., 1991).

How to explain the social class differences in deterioration of SRH

Our main result is that two thirds of the social class gradient with regard to worsening of SRH over time can be explained by differences in five work environment factors together with smoking and obesity. Furthermore, we found that the work environment factors (ergonomic factors and repetitive work in particular) explained a considerably larger proportion of the gradient than the two life style factors. This result is in accordance with the three analyses we have been able to identify in the literature on this issue, all of them cross-sectional. One of these studies concluded that "a combination of factors including features of the work environment (...), social circumstances outside work (...) and life style factors (...) do account for a good deal of the social gradient in overall health status" (Marmot, 1997, p. 907). In the second study, which was a cross-sectional analysis made in an otherwise longitudinal study, Power et al. (1992, 1998) concluded that psychosocial characteristics of work explained a large part of the social gradient in SRH. This cross-sectional association was notable even after adjustment for social class position and health behaviour earlier in life. The third study showed that "a substantial part of the association between occupational class and a less than good perceived general health (...) could be attributed to a differential distribution of hazardous physical working conditions and a low job control across occupational classes" (Schrijvers et al., 1998, p. 1011). It is possible that the inclusion of more life style factors in our study, e.g. exercise and alcohol consumption, would have resulted in a larger proportion of the gradient being explained by life style. But it is not likely that it would cause the work environment factors to explain a smaller part of the social gradient, since the two sets of factors had independent associations with the outcome.

Our results can be interpreted in a number of ways. The clear associations between a number of work environment factors and worsening of SRH can be explained in at least two distinctly different ways. The first, and most obvious, is that poor working conditions influence the health of a person. For instance, it is well known that repetitive work and ergonomic exposures increase the risk of a number of musculoskeletal symptoms as well as symptoms of distress and fatigue. We also know that the presence of such symptoms influences the SRH of a person (Bjorner et al., 1998). Another explanation may be that people who evaluate their work environment poorly also perceive their health as poorer. As a consequence, these individuals do less to keep healthy and therefore develop poorer health over time. Thus, low expectations concerning future health become self-fulfilling.

Our study was not able to explain the full gradient with regard to worsening of SRH. Social class differences with regard to social resources, social support, coping, personality, and material resources may also play a role. We suggest that future studies include these and other factors.

This study suggests that SRH is rather stable over time (Table 1). The majority (54%) had stable SRH, while only 8% moved more than one step on a five-point scale between 1990 and 1995. The interest in knowing more about what SRH "really is" and about the factors that influence SRH has increased significantly as a result of the literature indicating that SRH

is a strong predictor of mortality. It is a fascinating thought that a person often "knows more" than the doctor about his/her own future risk of death, and that asking a simple and straightforward question can reveal this "knowledge". We believe that SRH should be understood as a multi-dimensional phenomena which includes different elements that are synthesised by the person: (1) Medical diagnoses; (2) functional ability; (3) perceptions of well-being and capacity for coping; (4) personal attitudes and degree of optimism/pessimism; (5) intentions to act in healthy and health promoting ways (Bjorner et al., 1998; Idler & Benyamini, 1997).

The results of our study seem to suggest that social class differences in SRH could be reduced by reducing a number of work environment exposures such as repetitive work and work characterized by lifting, bending, stooping, etc. Perhaps surprisingly, prevention of obesity could have a larger effect than interventions related to smoking. Needless to say, improvement in SRH should not be the only goal of prevention and health promotion, but it is interesting to note that the Danish government launched a major campaign a few years ago with the aim of reducing repetitive work by 50% before the year 2000. Also, the national prevention program of the present Danish government emphasises social equality in health as a major goal, and points to tobacco, obesity, and work environment as some of the important targets. This means that some of the recommendations above are already part of a national strategy.

There is a need for further research on SRH. In particular, we need studies on SRH as predictor of other endpoints than mortality, on the factors that influence and determine a person's SRH, intervention studies with SRH as (one of) the endpoint(s), and qualitative studies of SRH in order to understand more about the meaning of SRH for individuals and about the differences and similarities between SRH and biomedical health.

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