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Socioeconomic status and cardiovascular risk factors in the Czech Republic

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Background In western countries, prevalence of cardiovascular diseases and most risk factors is higher in lower socioeconomic groups. The social gradients in the former communist societies are less well known. Because in western countries different indicators of socioeconomic status (SES) are correlated, this gradient is found with a number of different measures of SES. We have analysed the presence and magnitude of the socioeconomic gradient in cardiovascular risk factors in a former communist country. As the relationship between material conditions and education has been much weaker than in the west, we have also attempted to separate their effects.

Methods A cross-sectional survey examined a random sample of men and women resident in six Czech districts participating in the MONICA study in 1992. Participants completed a questionnaire, underwent anthropometric and blood pressure measurements, and provided a blood sample. Two indicators of SES were used: education and material conditions, the indicator constructed from car ownership and crowding. Linear regression was employed to analyse the relation between SES and total and high-density lipoprotein (HDL) cholesterol, body mass index (BMI), waist-hip ratio (WHR) and height. Logistic regression was used to assess the association between SES and smoking and hypertension.

Results A total of 1141 men and 1212 women (overall response rate 75%) participated in the study. After controlling for age, all risk factors were associated with education, except HDL cholesterol in women and BMI in men; only smoking in both sexes and WHR in women and height in men were significantly related to material conditions. In mutually adjusted analyses, educational gradients persisted but associations with material conditions disappeared or became substantially weaker. The magnitude of the educational differences was similar to those found in western countries.

Conclusions Socioeconomic differences in cardiovascular risk factors in Czech Republic in 1992 had the same direction and similar magnitude as in Western Europe, and were strongly related to education rather than material conditions. Materialist explanations for the social differences seem unlikely in this population.

Keywords Cardiovascular diseases, socioeconomic factors, risk factors, epidemiology, Eastern Europe

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Socioeconomic status is one of the most powerful predictors of cardiovascular disease (CVD) and its risk factors, although the direction of the relationship between SES and CVD is not stable.[1–4] The available evidence suggests that CVD and its risk factors were originally more common in upper socioeconomic groups (hence the name 'disease of affluence'[5]) and the direction of the association has gradually changed in western populations throughout the middle of this century so that currently CVD is more common in lower socioeconomic groups.[2–4,6] The positive socioeconomic gradient still persists in some of the less industrialized countries.[7–10] Until recently, the social pattern of CVD and its risk factors in the former communist countries was not known.

There has been some debate as to which component(s) of SES are the most important for the socioeconomic gradient in CVD and its risk factors. Some have argued that material conditions (that might relate, for example, to affordability of a healthy diet)

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are more important;[11] others have suggested that education (and therefore the ability to make an informed choice) influence health behaviours and lifestyle;[11] it has also been suggested that the perception of control over life and health, also related to SES, underlies the gradient.[12]

In western societies, different measures of SES are closely correlated: better educated people have higher income and live in better material circumstances.[11] Because of this close correlation between different indicators of SES, they are all inversely associated with CVD and its risk factors;[13–15] this also makes it difficult to separate their effects and to identify the component of SES most important for CVD risk status.

The situation is different in the former socialist countries of Central and Eastern Europe. Over the last few decades, education was not rewarded by higher income or other material privileges, and the distribution of income was more equitable than in western countries.[16] The Gini coefficient, a measure of income inequality, in the Czech Republic in 1987–1988 was about 0.19, compared to 0.35 in OECD countries.[17] The best paid groups were usually manual workers in preferred sectors of industry, such as construction and energy.[16] Professions with university education were not among the best paid. Theoretically, this lack of correlation between individual components of SES should allow investigators to disaggregate their effects on CVD risk status.

The association between SES and CVD or its risk factors in these countries was not examined until the collapse of communism in 1989. Since then, several papers on this issue have been published, most of them showing higher mortality from CVD in lower socioeconomic groups ('western pattern').[18–23] However, the best measure of SES in Central and Eastern Europe has not been established,[24,25] and only one published analysis has, to our knowledge, examined more than one measure of SES.[26,27] It has been suggested that indicators of SES may have different meanings in Central and Eastern Europe compared to the west, which may also influence their associations with health-related factors.[25] In this paper, we examine whether CVD risk factors are predicted by education and material conditions, and which of these two components of SES is a better determinant of CVD risk status.

Methods

This was a cross-sectional study, based on the Czech WHO MONICA population sample.[28] A 1% random sample of population of the six districts aged 25–64 stratified by sex and 10-year age group was drawn from the Central Population Register of the Czech Ministry of Interior. The population register has been updated for preceding elections and is considered to be virtually complete. A total of 3140 subjects (1560 men and 1580 women) were randomly selected and invited for an examination in a local hospital or health centre. Non-responders were invited repeatedly, and those who did not attend after three reminders were sent a short mail questionnaire to assess whether they differed from participants. From the 1142 men and 1212 women (overall response rate 75%) who participated in the study, information on all factors was available on 1133 men and 1205 women on whom these analyses are based.

Information on subjects was collected by questionnaire, physical examination and analysis of blood samples taken during the examination.[28] The questionnaire collected data on demographics, SES, tobacco and alcohol consumption, personal and family health history, medication and dieting, self-rated health in the last 12 months and other aspects. Physical examination followed the interview.

Socioeconomic status (SES)

Two dimensions of SES were measured: education and material conditions. Education was assessed by the highest achieved education and by years spent at school. In this paper, subjects are classified into four categories according to highest achieved education: primary (8–9 years of primary school), apprenticeship (primary school plus completed apprenticeship), secondary (completed secondary school with final examination 'maturita'), and university (completed degree). Material conditions were measured by *crowded housing* conditions (more than one person per room) and *car ownership* in the household. Three categories of material conditions were calculated: poor (crowding and no car), medium, and good (no crowding plus car).

Anthropometric measurements

Subjects undressed to their underwear and removed shoes for the physical examination. Weight was measured using a mechanical scale with precision to the nearest half kilogram, and height was measured by a steel stadiometer to the nearest half centimetre. Waist circumference was measured by a plastic tape at the mid point between the iliac crest and lowest rib margin and hip circumference was measured at the greater trochanter, both to the nearest half centimetre.

Blood pressure

Blood pressure was measured twice, after at least 5 minutes rest, in a sitting position, on the left arm by one type of mercury sphygmomanometer with a scale divided by 2 mmHg. Mean of the two measurements was calculated; hypertension was defined as either blood pressure over 140/90 mmHg and/or treatment for hypertension.

Blood samples

10 ml of venous blood were taken after overnight fasting in a single venepuncture without tourniquet or after short-term ligation of the arm. Serum was separated within 4 hours of venepuncture, and in the portions designated for HDL cholesterol analysis, ApoB containing lipoproteins were immediately precipitated by phosphotungstate (phosphowolframic acid) in the local laboratory. Serum was stored at 4°C, and samples were transported on ice to the central laboratory. Total and HDL cholesterol in serum were measured by the WHO Lipid Reference Centre, Institute of Clinical and Experimental Medicine, Prague, by enzymatic CHOD-PAP method (Boehringer, Mannheim).

Statistical analysis

Means of continuous risk factors by socioeconomic category were calculated by linear regression (Proc GLM in SAS), and odds ratios for presence of the risk factor were estimated by logistic regression for dichotomized risk factors. Odds ratios and means were first estimated controlling for age and district; in the second step, both material conditions and education were entered in one model to estimate their independent effects.

Table 1 Distribution of the population sample by education and economic circumstances

	Men N (%)	Women N (%)
Education		
Primary	132 (12)	366 (30)
Apprenticeship	572 (50)	342 (28)
Secondary	305 (27)	428 (35)
University	129 (11)	72 (6)
Material conditions[a]		
Poor	133 (12)	147 (12)
Middle	533 (47)	591 (49)
Good	467 (41)	467 (39)
Car ownership		
No	283 (25)	373 (31)
Yes	850 (75)	832 (69)
Crowding		
No	617 (54)	694 (58)
Yes	520 (46)	512 (43)
Total	1133 (100)	1205 (100)

[a] Material conditions: combination of car ownership in the household and crowding.

Results

Table 1 shows the distribution of the population sample by education, car ownership and crowding. There are substantial differences in educational attainment between men and women. Eleven per cent of men but only 6% of women had university education; 12% of men and 30% women had only primary education. Perhaps the most striking is the sex difference in apprenticeship (50% of men compared to 28% of women) but the proportion of men and women with less than secondary education was similar.

Gender differences in car ownership and crowding were smaller: 46% of men and 43% of women lived in 'crowded' (more than one person per room) conditions, and 75% of men and 69% of women owned a car in their household. If car ownership and crowding are combined, 41% of men and 39% of women had good material conditions while 12% had low status by this measure.

Education and material conditions of both men and women are positively associated, although the association seems to be somewhat stronger for men than women (Table 2). While 29% of primary educated men have good economic status, 47% of university educated men both owned a car and did not live in crowded conditions. Correlation between education and material conditions was significant but weak: correlation coefficients were 0.1 for both genders. Education was strongly related to age: older men and women were more than four times more likely to have had only primary education, and conversely, the youngest age group had the highest proportion who were university educated. Material conditions were similar in men and women, and in both increased with age, mainly due to less crowding while car ownership was similar in different age groups. Nevertheless, age did not substantially affect the relation of the two socioeconomic indicators.

Age-district-adjusted associations between SES and risk factors

Tables 3 and 4 show sex-specific means and odds ratios adjusted for age and district calculated for each level of education and material conditions. There was a strong inverse association between education and cholesterol in both genders: the difference between primary and university educated subjects was about 0.5 mmol, with a monotonic decrease with each educational category, and highly significant trend (Table 3). The ratio of HDL to total cholesterol increased with education in women (P for trend 0.001) but not in men, and was not related to material conditions. There was no clear pattern of body mass index (BMI) in men, but BMI in women and waist-hip ratio (WHR) in both genders decreased with education. Height also increased with education; university educated men and women, respectively, were 4.5 cm and 4.0 cm taller than those with only primary education. Smoking was strongly related to education: university educated men and women smoked four times and five times less, respectively, than primary educated. Similar, although less pronounced, was the association between education and hypertension.

The relation of material conditions to mean levels of examined factors was much weaker: only WHR in women and height in both genders showed significant trends (Table 4). Prevalence of smoking falls sharply with increasing material conditions but there was only a weak positive association with prevalence of hypertension.

Multivariate analyses

Mutual adjustment for education and material conditions confirmed the pattern found in the previous two tables. All associations between education and risk factors persisted after adjustment without substantial reduction (Table 5) but no factor seems to be significantly related to material conditions. Men

Table 2 Relationship between education and material conditions in the population sample. Percentage of subjects with given level of material conditions by educational group

	Good material conditions		Car ownership		Crowding	
Education	Men	Women	Men	Women	Men	Women
Primary	29%	36%	56%	58%	48%	39%
Apprenticeship	42%	36%	75%	69%	44%	45%
Secondary	43%	43%	82%	77%	50%	44%
University	47%	44%	81%	82%	43%	44%
Overall	41%	39%	75%	69%	46%	42%
P for linear trend	<0.001	<0.001	<0.001	<0.001	0.874	0.156

Table 3 Means and odds ratios for risk factors by education adjusted for age and district

		Education				
Risk factor	**Sex**	Primary	Apprent.	Secondary	University	***P* for trend**
Cholesterol (mmol/l)	M	6.19	6.02	5.90	5.69	<0.001
	F	6.04	6.00	5.88	5.60	0.002
HDL/total cholesterol	M	0.23	0.23	0.23	0.23	0.758
	F	0.26	0.26	0.27	0.28	0.006
Systolic BP (mmHg)	M	136.2	135.2	133.8	132.2	0.036
	F	132.4	131.8	128.9	126.6	0.002
Diastolic BP (mmHg)	M	85.4	86.4	86.6	86.4	0.479
	F	83.2	83.5	82.4	81.5	0.133
BMI (kg/m^2)	M	27.0	27.3	27.1	27.1	0.743
	F	27.8	27.4	25.9	25.3	<0.001
WHR	M	0.94	0.93	0.92	0.92	0.003
	F	0.82	0.81	0.80	0.80	<0.001
Height (cm)	M	172.0	174.3	176.0	176.5	<0.001
	F	160.9	162.1	163.5	164.9	<0.001
Hypertension (Odds ratio)	M	1.0	0.87	0.81	0.65	0.098
	F	1.0	0.99	0.54***	0.54	<0.001
Smoking (Odds ratio)	M	1.0	0.63*	0.47***	0.21***	<0.001
	F	1.0	0.87	0.52***	0.26***	<0.001

P-value for difference of odds ratio from baseline category: *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

Table 4 Means and odds ratios for risk factors by material conditions adjusted for age and district

		Material conditions			
Risk factor	**Sex**	Poor	Middle	Good	***P* for trend**
Cholesterol (mmol/l)	M	5.87	5.96	6.02	0.213
	F	6.19	5.92	5.93	0.102
HDL/total cholesterol	M	0.24	0.23	0.23	0.197
	F	0.25	0.27	0.26	0.257
Systolic BP (mmHg)	M	134.2	135.4	134.1	0.617
	F	129.3	131.1	130.7	0.639
Diastolic BP (mmHg)	M	84.7	86.7	86.5	0.252
	F	82.2	83.1	82.9	0.718
BMI (kg/m^2)	M	26.9	27.2	27.2	0.445
	F	27.3	26.8	26.7	0.310
WHR	M	0.93	0.93	0.92	0.129
	F	0.82	0.81	0.80	0.016
Height (cm)	M	172.8	174.8	175.2	0.004
	F	161.7	162.4	162.7	0.075
Hypertension (Odds ratio)	M	1.0	1.26	1.09	0.860
	F	1.0	1.32	1.20	0.782
Smoking (Odds ratio)	M	1.0	0.57**	0.54**	0.010
	F	1.0	0.62*	0.57**	0.022

P-value for difference of odds ratio from baseline category: *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

in the highest category of material conditions were 1.9 cm taller than those in the lowest category; and smoking was less common in men and women who lived in better material conditions (data not shown). This strengthens the impression created by Tables 3 and 4: education seems to be a stronger determinant of cardiovascular risk factors than material conditions.

Discussion

This paper shows that, both in age-adjusted and multivariate analyses, education was strongly related to CVD risk factors while material conditions were weakly and inconsistently associated with them. These results provide information on the presence and magnitude of socioeconomic gradients in

Table 5 Means and odds ratios for risk factors by education adjusted for age, district and material conditions

		Education				
Risk factor	**Sex**	Primary	Apprent.	Secondary	University	***P* for trend**
Cholesterol (mmol/l)	M	6.20	5.98	5.87	5.65	<0.001
	F	6.09	6.06	5.94	5.67	0.003
HDL/total cholesterol	M	0.24	0.23	0.22	0.23	0.883
	F	0.26	0.26	0.27	0.30	0.009
Systolic BP (mmHg)	M	136.2	135.1	133.6	132.1	0.029
	F	132.3	131.4	128.4	126.0	<0.001
Diastolic BP (mmHg)	M	85.2	86.1	86.1	85.9	0.656
	F	83.1	83.3	82.2	81.3	0.106
BMI (kg/m^2)	M	27.0	27.2	27.0	26.9	0.451
	F	27.8	27.5	25.9	25.4	<0.001
WHR	M	0.94	0.93	0.92	0.92	0.003
	F	0.82	0.81	0.80	0.80	<0.001
Height (cm)	M	171.8	173.9	175.6	176.0	<0.001
	F	160.9	162.0	163.5	164.8	<0.001
Hypertension (Odds ratio)	M	1.0	0.85	0.78	0.62	0.074
	F	1.0	0.97	0.53***	0.51	<0.001
Smoking (Odds ratio)	M	1.0	0.69	0.51**	0.23***	<0.001
	F	1.0	0.88	0.55***	0.27***	<0.001

P-value for difference of odds ratio from baseline category: *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

health in a former communist country, and offer some insight regarding the dimensions of SES which function as determinants of health.

Limitations of the design

The cross-sectional nature of these data could potentially affect our findings. While education is a relatively stable indicator, economic position, and particularly car ownership, may change over time, and this change may be related to health status (health selection). Such health selection, however, would strengthen the association between material conditions and health, and cannot explain the lack of such association.

Official data are not available to support the reliability of our indicator of material conditions. Crowding and car ownership were used as indicators of material conditions instead of income for two reasons. First, our Czech collaborators strongly opposed asking about income, arguing that questions on income would jeopardize the response rate. Second, it is uncertain whether income would be a better measure of economic circumstances of Czech citizens in 1992. Distribution of official income has been egalitarian[16] and, anecdotally, most of the differences in the pre-1989 era originated not in occupational (official) income but in the black economy, such as bribes (civil servants, doctors), illegal overpricing due to shortages of more luxurious goods (shop assistants) and weekend work (manual workers). Although important for people's material circumstances, these sources of income had largely ceased by the time of our study,[16] and would not be reported anyway. In addition, the 'restitution' programme, returning property 'nationalized' by the communist government in 1948, made a considerable impact on material circumstances of hundreds of thousands of people. Again, self-reported income would not reflect this phenomenon.

For these reasons, car ownership and housing conditions seem to be valid as measures of long-term economic status similar to income, although their meanings are not identical. Crowding probably reflects the economic situation of families less well than car ownership. Residential mobility in the Czech Republic was low, mainly due to the absence of an official housing market. Although there was an unofficial market with properties, and the allocation of flats owned by the state (or a factory) could in some instances be influenced by 'under-the-table payments', the scale of such a 'market' was probably limited. On the other hand, there was a car market in Czechoslovakia prior to 1989 (although the variety of cars was limited). Because car ownership was generally considered as both desirable and a symbol of better material position,[16] it is likely that its relation to economic circumstances is relatively close. Both car ownership and crowding were (weakly) related to risk factors in the same direction; their aggregation into one variable (material conditions) therefore concentrated, rather than diluted, their effects. Although the importance of education for income increased after 1990, the relationship in 1992 was still very similar to the pre-1990 situation.[16] The divergence in income distribution in the Czech Republic also occurred mainly after 1993.[16,29] Our data, collected in 1992, reflect largely the pre-1990 context of socioeconomic variables.

Participants' occupation was also recorded, but was not used in these analyses as it is not related to SES. The 'Standard classification of occupations', developed in the early 1960s, and still used in the Czech Republic in 1992, grouped occupations according to sector of economy (e.g. transport, agriculture, mining industry, etc.) regardless of income, qualification requirements or prestige. Moreover, in parallel to income differences by education, income differentials between occupations in the Czech Republic were still small in 1992.[16]

Educational gradient

International data show remarkably homogeneous distribution of income in the former socialist countries until 1990.[17,30] This could lead to the assumption that social variation in health in these countries would be much smaller than in the west. Our results suggest the contrary. Socioeconomic differences in health existed in Central European countries, although income distribution was narrow and absolute poverty was virtually eradicated. Moreover, the differences between educational groups are as large, or larger than in the west. Compared with recently published data from Finland with similar educational categories,[31] both the direction and the magnitude of the educational differences were similar. The magnitude of the differences between socioeconomic groups also corresponds to that found in Germany and Switzerland.[32,33] The relatively large differences in cholesterol by education in our data are interesting, as they are not found uniformly. In British civil servants, for example, cholesterol levels were similar in different occupational grades.[34] In contrast to 1992, there was only a small and insignificant gradient in cholesterol in the Czech MONICA in 1988.[35] As suggested above, this may be a consequence of a differential impact of social changes after 1989 on different social groups.

So far, few reports exist on socioeconomic gradients in risk factors in Central and Eastern Europe. In age-adjusted analyses, education was related to most classical risk factors in MONICA centres in Poland and Lithuania and in Kalocsa town in Hungary (unpublished). The Warsaw MONICA Project found that dietary risk factors were more favourable in people with higher education.[26] The findings in the Russian Lipid Research Clinic population were inconsistent.[18]

Consistency with reports on socioeconomic differences in mortality

More has been published on mortality in Central and Eastern Europe. Our findings are consistent with the educational gradients in mortality reported from Poland,[23] the Czech Republic,[36] Hungary,[22,37] Russia,[18,19,38] Estonia[37] and Lithuania.[39] A case-control study, based on the Czech MONICA Project, also demonstrated a steep educational gradient in non-fatal myocardial infarction. Age-sex-adjusted odds ratios for university educated versus primary educated people was 0.44.[40] Comparing directly Eastern and Western European countries, Kunst has found that the educational gradient in all-cause mortality in the Czech Republic, Hungary and Estonia was steeper than in Finland, Norway, France or the US.[37] When specific causes of death were examined, gradients for cancers, respiratory diseases and external causes were more pronounced in post-communist countries; gradients in cardiovascular and ischaemic heart disease were about the same in Eastern and Western Europe. Reported gradients in Poland[23] and Russia[38] were also as large as, or larger than in Western Europe.

Which measure of SES?

Education was a powerful determinant of cardiovascular risk status in our study population while material conditions were a poor predictor. This is consistent with Polish data on dietary intake, the only study so far to our knowledge which assessed the contribution of both income and education, where education predicted dietary intakes better than income.[26,27] Although further multivariate analyses from other post-communist populations are not available, existing evidence suggests that education is an appropriate indicator of SES to be used in epidemiological studies in post-communist countries of Central Europe, both to study health inequalities and to control for SES in multivariate analyses.

These observations may also provide some hints as to the origins of socioeconomic differences. It suggests that, in societies where basic material needs have been met, the psychosocial aspects of SES are likely to be more important to health than purely material factors. The psychosocial aspects include a sense of control over life and work, perceived status in the social hierarchy, access to information on healthy behaviours and lifestyles; and a greater sense of personal control over health-related behaviours. We have previously shown that the educational gradient in most risk factors increased after 1989, and that, except for smoking in women, this was due to an improvement among the better educated, rather than worsening among the less educated.[35] Although our data largely reflect the pre-1990 situation, a part of the observed gradient might be due to post-1990 changes. This is also consistent with the view that in this population the socioeconomic gradient in cardiovascular risk factors was determined more by psychosocial aspects and the health choices that go with them than by access to material goods *per se*. For example, better educated people may have felt more in control and may have expected to improve their lives after the fall of communism (psychosocial mechanisms). At the same time, they would benefit more from a wider choice of foods and health-related information. While the data do not allow us to identify the precise mechanisms of the link between education and risk factors, they suggest that materialistic explanations for the social differences in this population are unlikely.

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