ORIGINAL ARTICLE

Myocardial infarction risk and occupational categories in Kaunas 25–64 year old men

V Malinauskiene, R Grazuleviciene, M J Nieuwenhuijsen, A Azaraviciene

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See end of article for authors' affiliations

Correspondence to: Dr V Malinauskiene, Laboratory of Environmental Epidemiology, Institute of Cardiology, Kaunas University of Medicine, Str. Sukileliu 17, Kaunas LT-3007, Lithuania; aplepid@kmu.lt

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Aims: To investigate the risk of a first time myocardial infarction (MI) among different occupational categories in 25–64 year old men in Kaunas, Lithuania, a country in a transition market economy.
Methods: Case-control study among men aged 25–64 who were residents in Kaunas between 1997 and 2000. First time, non-fatal MI cases (n = 448) were identified from the MI hospital register (International Classification of Diseases, 10th revision, code I21). Controls (n = 1777) were selected and matched on age, gender, and city district of residence. Information was obtained on occupation, smoking, hypertension, psychosocial, and behavioural factors. The International Standard Classification of Occupations (ISCO) was used to code for occupational categories. The relation between MI and occupational categories was evaluated by logistic regression analysis, adjusting for a number of selected risk factors.
Results: Legislators, senior officials, and managers (1st ISCO category) had a twofold increased risk for MI compared to craft and related trades workers (7th ISCO category) after adjustment for age, district, smoking, hypertension, obesity, stress, education, and employment duration. An increased risk for professionals (2nd ISCO category) and plant and machine operators and assemblers (8th ISCO category) was also observed. Employment duration in the last occupation for 20 years and more almost doubled the risk of MI in the whole population. We also found an increased risk for other traditional IHD risk factors such as smoking and arterial hypertension.
Conclusions: Differences in first time MI risk among occupational categories were found. Legislators, senior officials, and managers (1st ISCO category), professionals (2nd ISCO category), and plant and machine operators and assemblers (8th ISCO category) were at an increased risk. Differences in psychosocial factors in transition market economy countries may contribute to observed results.

In developed countries, ischaemic heart disease (IHD) is very common. Initially rates increased in higher socioeconomic groups and later on in lower socioeconomic groups, to the extent that the social distribution changed to the now familiar pattern of an inverse social gradient: the rates increase as the social hierarchy descends.[1] Most recent studies shared the direction of the increased risk of IHD in lower socioeconomic groups.[2 3] An increased risk of IHD was found in certain occupational groups such as drivers, bakers, hotel and restaurant workers, and radio and telephone operators.[4] In Denmark the inverse association between employment status and relative risk of IHD is increasing—that is, groups with high employment status have a low and decreasing risk while groups with low employment status have a high and increasing relative risk. Managers and white collar workers have an average or low and decreasing relative risk, while male blue collar workers have a high and increasing relative risk. Thus the social inequality in IHD is rapidly increasing.[5]

Differences in the incidence of myocardial infarction (MI) among occupational categories in western populations are well known. The age standardised hospital admission ratios for MI have increased in time among male professional drivers.[6] In Sweden the decline in MI risk among male high and middle level employees started in 1976.[7] Low relative risks have been found mainly for people in occupations with a high education level, and increased risks, compared to other employed men, have been found in some occupations with a low level of education such as production and transport work.[8 9] Job category was significantly associated with MI, with a relative risk of 2.8 for blue collar workers versus white collar workers.[10] Incidence of MI was lower among senior executives and higher among employees and workers in France,[11] but a high risk of IHD incidence was found for managers, administrators, and professionals in Italy.[4]

Psychosocial factors at work have been found to be related to measures of socioeconomic status. People with better education tend to have jobs with a more favourable psychosocial environment.[10] Manual workers experience more job strain; this explained about 25–50% of the relative excess MI risk among manual workers.[12] Studies have confirmed the hypothesis that job strain may be associated with an increased risk of MI in various occupations.[13 14] MI risk differences in occupations might be a result of conditions in the work environment.[15] Psychosocial work factors have also been significantly associated with hypertension, hyperlipidaemia,[16] obesity, smoking, and alcohol consumption.[17]

The role of a socioeconomic gradient on the risk of MI in countries of central and eastern Europe and in the newly independent states of the former Soviet Union is not so clear. In Lithuania changes in MI morbidity trends in urban areas were not significant, while in rural areas morbidity rose by 6.8% per year.[18] In the Czech Republic the risk of MI was inversely related to education, and was unrelated to material conditions and parental education and occupation[19]; cardiovascular risk factors were associated with education; the correlation with occupational gradient was not studied.[20] A study of the psychosocial factors at work showed that men in passive jobs had the highest risk of MI, whereas those with jobs characterised by high demand and low control had a more modest

Abbreviations: ICD, International Classification of Diseases; IHD, ischaemic heart disease; ISCO, International Standard Classification of Occupations; MI, myocardial infarction

risk.[21] The exact risk factors that might have an effect on the incidence of MI among occupational categories in central and eastern European populations after transition have not been identified.

The aim of the present study was to investigate the risk of first time MI among different occupational categories in 25–64 year old men in Kaunas, Lithuania. Information on education, employment duration in the last occupation, smoking, arterial hypertension, obesity, and stress was also obtained in order to assess the possible influence from these factors on the relative risks.

MATERIALS AND METHODS

Kaunas is the second city of Lithuania, a former socialist country in transition market economy, with an area of 132 km^2 and a population of about 400 000. The study base population comprised all 25–64 year old men, residing in 12 districts of the city. All surviving patients with a first time MI that occurred from 1997 to 2000 were eligible for the study. The risk for MI among different occupational categories was studied using a case-control design.

Identification of cases and controls

All able bodied surviving patients with a first time MI treated in Kaunas hospitals were considered eligible for the case-control study. A case was a person with a clinical diagnosis coded I21 of the 10th revision of International Classification of Diseases (ICD-10) on the hospital registry. In total 579 male first time MI cases were registered; 470 (81.2%) of these were interviewed at the hospital during their first hospitalisation week. The control group was a random sample of men 25–64 years of age, matched on five year age categories and drawn from the population registers in 12 districts. Controls were eligible if clinical diagnosis of IHD or angina pectoris was not recorded in their medical documents, and respondents had no IHD diagnosis and did not report chest pain complaints during the interview. A total of 2755 controls were selected: 689 (25.0%) refused to participate, 95 (3.4%) had chest pain complaints and history of IHD. In total 1971 controls were included into the study (response rate 71.5%). The study was restricted to people holding the same type of the last job for at least three years, to avoid the influence from short term employed and unemployed people. Employment duration in the last occupation was classified into five year categories. After 22 cases and 194 controls with missing data on occupation, less than three years holding the same type of job, or were unemployed were excluded, 448 cases (77.4% of all registered) and 1777 controls (64.5%) with complete data remained (ratio 1:4).

Data on occupation and risk factors

Cases and controls were interviewed by trained doctors in their local hospitals, using identical standardised questionnaires, which included information on occupation, demographic, socioeconomic, and psychosocial factors, employment duration in the last occupation, and health behavioural factors. Data on history of increased arterial blood pressure, diagnosed by a doctor, was taken from records, and the subjects underwent anthropometric measurements, such as height and weight. Respondents' perceived stress was measured by a set of seven questions, adapted from the L Reeder scale.[22] The four response options for each question, scored 1–4, were used to define stress. We defined the stress measure as the sum of scores, so that potential values for stress were between 7 and 28. Values between 15–28 were assumed as "no stress" and 7–14 as "stress". Education was categorised into eight or less years of schooling, secondary and university. The International Standard Classification of Occupations (ISCO)[23] was used to classify occupations into 10 occupational categories:

Table 1 Distribution of first time myocardial infarction cases and controls by age

	Cases		Controls	
Age	n	%	n	%
25–44	65	14.5	340	19.1
45–54	158	35.3	636	35.8
55–64	225	50.2	801	45.1
25–64	448	100.0	1777	100.0

(1) *ISCO category: legislators, senior officials and managers*. Legislators and senior government officials, corporate managers, directors and chief executives, production and operations managers, managers of small enterprises, and others

(2) *ISCO category: professionals*. Physical, mathematical, and engineering science, life science and health, teaching, business, legal professionals, and others

(3) *ISCO category: technicians and associate professionals*. Physical and engineering science, life science, teaching, finance and sales, administrative associate professionals, and others

(4) *ISCO category: clerks*. Office, material recording, and transport, library, mail and related, customer services, client information clerks, and others

(5) *ISCO category: service workers and shop and market sales workers*. Travel attendants and related workers, housekeeping and restaurant, protective, fashion, and other models, shop, stall, and market salespersons and demonstrators, and others

(6) *ISCO category: skilled agricultural and fishery workers*. Market gardeners and crop growers, animal producers and related workers, forestry, fishery workers, hunters, and trappers, crop producers and others

(7) *ISCO category: craft and related trades workers*. Shotfirers, stone cutters, and carvers, building frame, metal, machinery, precision, handicraft, printing, food processing, textile, garment, and related workers, and others

(8) *ISCO category: plant and machine operators and assemblers*. Stationary plant and related operators, metal, chemical, wood products, printing, textile, leather products machine operators, mechanical, electrical equipment, composite products assemblers, drivers and mobile plant operators, and others

(9) *ISCO category: elementary occupations*. Street vendors and related workers, domestic and related helpers, cleaners and launderers, building caretakers and cleaners, messengers, porters, door keepers, and related workers, labourers in mining, construction, manufacturing, and transport, and others

(10) ISCO category: armed forces.

Statistical methods

We used SPSS 8.0 for Windows for the statistical analysis. To adjust for potential confounding effects of the selected risk factors, multiple logistic regression analysis was performed. Potential confounders included in the models were factors such as age, district, employment duration in the last occupation, education, arterial hypertension, smoking, stress, and obesity. The adjusted OR along with its 95% CI for each risk factor relative to the reference category was assessed and the effect of the risk factors on the risk of MI was evaluated. The 7th ISCO category was selected as a reference category for assessment of the odds ratios of other occupational categories.

Table 2 Characteristics of cases and controls, and age-district adjusted odds ratios for potential myocardial infarction risk factors

	Cases (448)		Controls (1777)		Age-district adjusted	
Risk factors	n	%	n	%	OR	95% CI
Marital status						
Married	394	87.9	1490	83.8		
Single	54	12.1	287	16.2	0.73	0.54 to 1.00
Education						
University	132	29.5	428	24.1		
Secondary	217	48.4	1003	56.4	0.71	0.56 to 0.91
8 years	99	22.1	346	19.5	0.89	0.66 to 1.21
Employment duration (years)						
3–4	15	3.4	91	5.1		
5–9	21	4.7	175	9.9	0.73	0.36 to 1.48
10–14	35	7.8	241	13.6	0.87	0.45 to 1.66
15–19	52	11.6	230	12.9	1.33	0.71 to 2.48
⩾20	325	72.5	1040	58.5	1.84	1.05 to 3.24
Smoking						
Non-smoker	107	23.9	609	34.3		
Current smoker	245	54.7	908	51.1	1.61	1.25 to 2.07
Former smoker	96	21.4	260	14.6	2.08	1.52 to 2.85
Blood pressure						
<140/90 mm Hg	246	54.9	1400	78.8		
⩾140/90 mm Hg	202	45.1	377	21.2	3.01	2.41 to 3.75
Body mass index						
Normal (20.1–25.0 kg/m^2)	221	49.3	928	52.2		
Increased (25.1–30.0 kg/m^2)	130	29.0	555	31.2	0.96	0.76 to 1.23
Obesity (>30.0 kg/m^2)	97	21.7	294	16.6	1.36	1.04 to 1.79
Psychological status						
No stress	294	65.6	1550	87.2		
Stress	154	34.4	227	12.8	3.63	2.85 to 4.62
Sexual disorders						
No	324	72.3	1458	82.0		
Yes	124	27.7	319	18.0	1.71	1.34 to 2.18

OR, odds ratio; 95% CI, 95% confidence interval.

RESULTS

Table 1 presents the distribution of cases and controls by age. Since controls were matched on age, the age distribution of controls is similar to cases and the age distribution reflects the age specific MI incidence. Mean age among all cases of non-fatal first time MI was 53.3 (0.37) years. Some small age differences were observed between occupational categories; for example, the average age was 52.1 (0.81) years for legislators, senior officials, and managers (1st ISCO category), and 51.8 (0.89) years for plant and machine operators and assemblers (8th ISCO category).

A greater proportion of MI patients was married (table 2). Cases and controls were similar according to education. There were more self reported current and former smokers among cases than among controls. Cases were more likely than controls to report stress and sexual disorders, and have arterial hypertension.

Table 3 shows descriptive characteristics of cases and controls in occupational categories. There were no cases of a first time MI in the ISCO occupational categories of skilled agricultural and fishery workers (6th ISCO category) and armed forces (10th ISCO category). Table 3 presents age-district adjusted and fully adjusted odds ratio estimates among ISCO categories compared to craft and related trades workers (7th ISCO category). The 1st, 2nd, and 8th ISCO categories were at increased risk for non-fatal first MI; there was also a non-significant increased risk for clerks (4th ISCO category).

Analysis of employment duration in the last occupation showed that the age-district adjusted odds ratios were 0.73

Table 3 Number of cases of first time myocardial infarction and number of controls in occupational categories, adjusted odds ratio estimates for myocardial infarction among occupational categories versus 7th category

	Cases		Controls		Age-district adjusted		Fully adjusted*	
ISCO categories	n	%	n	%	OR	95% CI	OR	95% CI
1st	79	17.6	175	9.9	2.18	1.59 to 2.99	2.18	1.50 to 3.16
2nd	61	13.6	193	10.9	1.49	1.06 to 2.09	1.50	1.01 to 2.22
3rd	28	6.3	147	8.3	0.90	0.58 to 1.40	1.09	0.68 to 1.75
4th	8	1.8	35	1.9	1.08	0.49 to 2.38	1.83	0.77 to 4.34
5th	6	1.3	47	2.6	0.63	0.26 to 1.51	0.79	0.31 to 2.00
6th	0		3	0.2	–		–	
7th	161	35.9	770	43.3	1.0		1.0	
8th	94	21.0	317	17.8	1.39	1.05 to 1.86	1.39	1.02 to 1.89
9th	11	2.5	79	4.5	0.64	0.33 to 1.24	0.71	0.36 to 1.43
10th	0		11	0.6	–		–	
All categories	448	100.0	1777	100.0				

*Age, district, smoking, hypertension, stress, obesity, education, employment duration in one model.
ISCO, International Standard Classification of Occupations; 95% CI, 95% confidence interval.

Table 4 Adjusted odds ratios for selected risk factors of first time myocardial infarction within occupational categories

Risk factors	Occupational category: All employed men OR*	95% CI	1st ISCO category OR*	95% CI	2nd ISCO category OR*	95% CI	7th ISCO category OR*	95% CI	8th ISCO category OR*	95% CI
Education										
University	1.0		1.0		1.0		1.0		1.0	
Secondary	0.74	0.57 to 0.97	0.67	0.34 to 1.34	1.43	0.50 to 4.12	2.19	0.83 to 5.75	1.21	0.25 to 5.79
8 years	0.94	0.68 to 1.29	–		–		2.65	0.98 to 7.18	2.31	0.47 to 11.32
Employment duration: ≥20 years v <20 years	1.74	1.35 to 2.24	1.44	0.74 to 2.81	2.80	1.07 to 7.34	2.04	1.32 to 3.13	1.00	0.57 to 1.74
Smoking: current smoker v non-smoker	2.12	1.60 to 2.80	2.39	1.20 to 4.78	2.64	1.24 to 5.64	2.12	1.35 to 3.64	2.61	1.34 to 5.05
Blood pressure: ≥140/90 mm Hg v <140/90 mm Hg	3.03	2.39 to 3.85	3.45	1.84 to 6.48	4.64	2.31 to 9.35	2.55	1.70 to 3.82	2.36	1.37 to 4.07
Obesity: BMI >30.0 kg/m^2 v BMI ≤30.0 kg/m^2	1.08	0.81 to 1.44	1.23	0.61 to 2.50	1.01	0.43 to 2.37	1.08	0.65 to 1.81	0.94	0.51 to 1.73
Psychological status stress: yes v no	3.42	2.65 to 4.40	2.67	1.43 to 4.97	3.93	1.89 to 8.19	4.89	3.23 to 7.39	2.02	1.08 to 3.77

*Adjusted for age, district, and all variables in the table.
ISCO, International Standard Classification of Occupations; 95% CI, 95% confidence interval.

(95% CI 0.36 to 1.48) in the 5–9 years employment group and 0.87 (95% CI 0.45 to 1.66) in the 10–14 years group compared to the 3–4 years group (table 2). The MI risk increased in the 15–19 years group (1.33; 95% CI 0.71 to 2.48) and in the employment group of 20 years and more (1.84; 95% CI 1.05 to 3.24). After including age, district, employment duration, education, smoking, hypertension, obesity, and psychological stress in the same model, the effect of obesity in the population of 25–64 year old men disappeared, but remained stable for employment duration, smoking, hypertension, and stress (table 4). A similar pattern was observed for analyses within each occupational category (table 4). It must be noted that the number of subjects in some occupational categories were small (for example, 3rd, 4th, 5th, 6th, 9th, and 10th ISCO categories); the odds ratios were therefore not included in the table.

DISCUSSION

In this case-control study of MI among men in Kaunas, Lithuania, legislators, senior officials, and managers (1st ISCO category), professionals (2nd ISCO category), and plant and machine operators and assemblers (8th ISCO category) were found to have a significantly higher risk of non-fatal first time MI compared to craft and related trades workers (7th ISCO category). A tendency for increased risk was observed for clerks (4th ISCO category), but this was not significant. We also showed increased risks for other known risk factors such as hypertension, stress, and smoking.

Socioeconomic status is one of the most powerful predictors of IHD. Recent studies showed that in developed countries IHD is more frequent among lower socioeconomic status compared to higher socioeconomic status.[2] The social pattern of IHD in the central and eastern European populations after transition has only rarely been studied.

Although the published study in the Czech Republic has concluded that MI risk was inversely related to education,[19] our results indicated that education had no significant influence on MI risk in the 25–64 year male population.

Our findings that the main risk factors of MI for managers were arterial hypertension and stress correspond with the investigations on middle managers in Germany, where they showed associations between chronic work stress and cardiovascular risk (especially manifest hypertension).[24] A cognitive group intervention programme for directors of day care centres, focusing on the psychological contribution to coping with stressful work demands, indicated that improved mobilisation of resources rather than reduced exposure to stressors had a positive impact on the director's wellbeing.[25] The psychosocial work environment of managers might be characterised by increased responsibility, work overload as a result of the need for reorganisation of the production to fit with the demands of market economy on the one hand, and the poor economic situation when many Lithuanian factories are at the level of bankruptcy on the other hand. Lithuanian factories built for the needs of the Soviet Union were gigantic, while after transition there was a requirement for small, well equipped, production factories competitive with those of Western Europe. Corporate managers comprised 88.6% of the 1st ISCO category (legislators, senior officials, and managers) and their stressful working life may have influenced their health status.

The excess MI risk among legislators, senior officials, and managers (1st ISCO category) cannot be explained by better/quicker access to health care compared with other occupational categories. The hospital admission for urgent aid in Lithuania is free and equal for all socioeconomic categories.

Our results that plant and machine operators and assemblers (8th ISCO category) were at increased risk for the development of MI correspond well with those from a study of MI risk among bus, taxi, and lorry drivers in middle Sweden.[9]

After including age, district, employment duration, education, smoking, arterial hypertension, obesity, and stress in the same model in the subgroup of plant and machine operators and assemblers (8th ISCO category), the risk estimates of smoking and hypertension were increased. Our findings that traditional IHD risk factors, such as smoking and arterial hypertension increase the risk of MI correspond to the findings in Western societies that these risk factors might explain some differences between occupational categories in MI risk.[11]

There are some limitations to the study. The results may have been influenced by the ascertainment of MI cases and misclassification of occupational categories, but the effects are likely to be minor. Misclassification of occupation could be a result of, for example, misreporting of jobs and coding errors. To avoid the influence from short term employed and unemployed people who could be expected to distort any relation between occupational factors and the rate of MI, the study was restricted to people holding the same type of job for at least three years.

The method of finding cases and case ascertainment in the present study was comparable to that of MI registers set up in accordance with principles adopted in the WHO MONICA programme.[26] Nevertheless, there were several sources of errors that may have caused a misclassification of the clinical diagnosis. These errors include diagnostic errors in silent cases, coding errors, or other clerical errors in data recording. However, this type of misclassification is likely to be unrelated to occupation but may bias the relative risk towards unity.

As we included only surviving cases of first time MI in the study, our sample was not necessarily representative of all first time episodes of MI. Only 2.4% of first time MI cases died in hospital. The pre-hospital first MI mortality of 25–64 year old men is low (82.8 per 100 000 population). Nevertheless, the study results can only be generalised to non-fatal, hospitalised first MI. Our control group represented the general population and was as a random sample, drawn from the population registers of the 12 districts of Kaunas, the second city of Lithuania. Controls were only eligible if clinical diagnosis of IHD and angina pectoris was not recorded in their medical documents and respondents had no complains of chest pain and a history of IHD during the interview; some selection or diagnostic bias could have occurred, but this was likely to be minor.

MI risk factors ascertained via interview, such as perceived stress, may have been recalled differently for cases and controls (recall bias), as persons, especially in the early stages of MI, often experience inconsistency of psychoemotional state, for example, excitement, aggression, and depression. This might affect the results and the control of confounding caused by recalled variables. There is, however, no evidence that recall bias could differ significantly among occupational categories, for example, when looking at occupation versus MI. On the other hand, we repeated the interviews six months later by telephone in a sample of 60 MI cases; answers to the questionnaire on perceived stress were similar in the majority of cases.

The age distribution among cases and controls reflected the age specific MI incidence. Small variations had no influence on crude comparisons of cases and controls with respect to their education (younger persons tend to be better educated), socioeconomic gradient (older people tend to become managers), and MI risk factors (older persons tend to be more hypertensive and obese). To avoid possible confounding effects the presented OR estimates in the article are adjusted for age and district.

Data from the international MONICA studies showed that international variations in smoking, high blood pressure, and raised plasma cholesterol account for less than half of the international variation in IHD mortality rates.[1] These factors appeared to be an inadequate explanation of social and international variation; explanations must be sought in the nature of social and economic organisation of societies. Our findings suggest that MI risk might depend not only on "classical" risk factors, such as smoking and arterial hypertension, but also on job characteristics, occupational exposures, and job strain.

In conclusion, this study has shown an increased risk of non-fatal first time MI for legislators, senior officials, and managers (1st ISCO category), professionals (2nd ISCO category), and plant and machine operators and assemblers (8th ISCO category). After adjustment the association between psychological stress and MI risk in the occupational category of legislators, senior officials, and managers (1st ISCO category) as well as other ISCO categories remained strong. The method used for stress assessment in this study was crude and may well have contributed to underestimates of actual associations between job strain and MI risk. Further studies with improved methods for the characteristics of the psychosocial work environment are needed to elicit stress effects on the course of IHD among the employed in different occupational categories.

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Authors' affiliations

V Malinauskiene, A Azaraviciene, Laboratory of Environmental Epidemiology, Institute of Cardiology, Kaunas University of Medicine, Kaunas, Lithuania
R Grazuleviciene, Department of Environmental Sciences, Vytautas Magnus University, Kaunas, Lithuania
M J Nieuwenhuijsen, Centre of Environmental Toxicology, Imperial College of Science, Technology and Medicine, London, UK

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