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CORRELATION BETWEEN RELATIVE RATES OF HOSPITAL TREATMENT OR DEATH DUE TO ISCHAEMIC HEART DISEASE (IHD) AND OF IHD-RELATED MEDICATION AMONG SOCIO-OCCUPATIONAL AND ECONOMIC ACTIVITIES GROUPS IN DENMARK, 1996–2005

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Abstract
Objective: The aim of the present work was to establish whether or not prescribed medication is a usable risk indicator for work-related ischaemic heart disease (IHD), in Denmark. **Material and Methods:** Weighted Spearman rank correlation coefficients (rho) were used to evaluate the agreement between Standardised Hazard Ratios (SHR) for hospital treatment or death due to IHD and SHR for purchase of prescriptions for medicine that may prevent IHD from (re)occurring, among socio-occupational and economic activities groups in Denmark. The SHR were based on a 10-year prospective follow-up of 2 million people in Danish national registers 1996–2005. **Results:** We found approximately 7 times more cases of medicine usage (N = 411 651) than we did for hospital treatment or death (N = 55 684). The correlations between the 2 types of SHR were strong (rho = 0.94 for the socio-occupational groups; rho = 0.74 for the economic activities groups). We observed, however, one markedly contradictive result; the industrial group entitled 'general practitioner, dentists etc.' was associated both with significantly high rates of medicine usage (SHR = 1.15, 95% CI: 1.12–1.19) and significantly low rates of hospital treatment or death due to IHD (SHR = 0.80, 95% CI: 0.71–0.91). **Conclusion:** Apart from a few caveats, the strong correlations obtained in the present study signify that purchase of a prescription for IHD-related medication is a usable risk indicator for IHD in the working population of Denmark. The usage of medicine data in addition to or instead of the use of death or hospital data in epidemiological studies on work-related IHD risk will bring about a tremendous increase in statistical power.

Key words:
Occupational epidemiology, Heart therapeutic drugs, Anti-hypertensive drugs, Lipid modifying agents

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INTRODUCTION

Ischaemic heart disease (IHD) is the leading cause of death worldwide [1]. It is also the leading cause of years of lost life due to premature mortality [1]. Among people of working age, it has been estimated that 12% of deaths due to coronary heart disease in the United States [2], 17% of deaths due to cardiovascular disease in Denmark [3], 17% of deaths due to IHD in Finland [4] and 8% of deaths due to IHD in Korea [5] are attributable to occupational exposures. It has also been estimated that nearly 26% of the total work-related mortality in Finland is due to IHD [4].

Due to the seriousness of the disease, IHD has been an outcome of great interest to occupational epidemiologists for decades. The points of interest have been firstly, to identify and estimate the effect of potential occupational risk factors for IHD and secondly, to investigate if the effect of identified factors differs between various subpopulations of the work force. Large numbers of studies have been performed and a wide variety of occupational exposures has been tested for statistical significance. The results of the studies are, however, often remarkably uncertain.

An example of such uncertainty is given by Frost et al. (2009), who conducted a systematic search and review of studies providing information on the relative risk of IHD in relation to shift work [6]. They identified 14 relevant studies and after their evaluation, they stated that "the available evidence concerning the influence of the type and duration of shift work, as well as gender, on the risk of IHD is too limited to permit any conclusions on these issues". Another example is given by Eller et al. (2009), who performed a systematic review of studies dealing with the relationship between work-related psychosocial factors and the development of IHD [7]. They retrieved and reviewed results from 77 relevant analyses. Eighteen of the analyses focussed solely on women, yet "no conclusions could be drawn concerning women, work stress, and IHD".

The main reason for this type of uncertainty is that the statistical powers of individual studies often are too low to either dismiss or confirm a relationship, while meta-analyses of published estimates often are unfeasible due to publication bias [8].

The work-environment as a whole might have a substantial impact on the risk of IHD, but this does not necessarily mean that the effect of any individual risk factor is large. This should be kept in mind in the planning and power calculation phase of cohort studies intended to identify and estimate effects of single risk factors. It should also be kept in mind that IHD has a long latency period [9], which means that the effects we are looking for, as a function of exposure at baseline, usually are heavily diluted through transitions between job exposure categories both before and during the follow-up period. The literature suggests that we have to be prepared for rate ratios in the neighbourhood of 1.2, if we want to detect effects of work environmental exposures whose influence on the risk of IHD is of the same magnitude as e.g., job strain [8], job insecurity [10] and environmental tobacco smoke [5].

Very few studies seem to have a sufficient power to detect an effect of such size; one of them is the IPD study on the relationship between job strain and IHD [8], which obtained its power by combining follow-up data from 13 different questionnaire studies in 6 different countries. The powers to detect effects from interaction between job strain and gender, age or socioeconomic status were, however, insufficient even in that study.

With an intermediate early outcome which occurs far more frequently yet is highly associated with IHD, future studies might be able to deal with the power issues by studying this outcome instead of or in addition to IHD. The aim of the present work was to establish whether or not prescribed medication is a valid risk indicator for work-related IHD in Denmark. The aim would be obtained by comparing the standardised hazard

ratio (SHR) for use of medicine that may prevent IHD from (re)occurring with the SHR for hospital contact or death due to IHD, among socio-occupational and economic activities groups in Denmark.

MATERIAL AND METHODS

The study used a database obtained through a record-linkage between 5 national registers – the central person register [11], the hospital patient register [12], the cause of death register [13], the Danish national prescription register (DNPR) [14] and the employment classification module [15].

The central person register contains information on gender, addresses and dates of birth, death and migrations for every person who is or had been an inhabitant of Denmark sometime between 1968 and present time. DNPR covers all purchased prescriptions at pharmacies in Denmark, since 1995 [14]. All prescribed drugs are coded in the DNPR in accordance with the Anatomical Therapeutic Chemical (ATC) system. The national hospital patient register has existed since 1977 and contains data from all public hospitals in Denmark (more than 99% of all admissions). From 1977 to 1994, the register only included inpatients but since 1995 it also covers outpatient and emergency ward visits. The national cause of death register covers all deaths among Danish residents in Denmark. It has existed since 1875 and was computerised in 1970. The diagnoses in both the hospital patient register and the cause of death register are coded according to ICD-10, since 1994.

A person's occupation, economic activities group and employment status are, since 1975, registered annually in the employment classification module. Since 1994, the occupations are coded according to DISCO-88 [16], which is a national version of ISCO-88 (the International Standard Classification of Occupations), while the economic activities are coded according to a national version of the European Industrial Classification of All Economic Activities [17]. In the present project, we used the industrial classification of the National Research Centre for the Working Environment, AT49X, which aggregates the original economic activities into 57 different economic activities groups [18]. The socio-occupational status was determined by the first digit in the DISCO-88 code in accordance with SOCIO (Statistics Denmark's socioeconomic classification) [19].

Ethics approval

The study complies with The Act on Processing of Personal Data (Act No. 429) [20], which implements the European Union Directive 95/46/EC on the protection of individuals. The data usage was approved by the Danish Data Protection Agency, file number: 2001-54-0180.

Statistical analysis

The SHR to be analysed were obtained through prospective cohort studies, which cover the time interval 1 January 1996 – 31 December 2005. The study population consisted of all employees (employment status code 3–4) who lived in Denmark and were 21–59 years old at baseline (1 January 1996).

The following clinical endpoints were considered:

1. Hospital treatment or death with IHD as principal diagnosis/cause of death. The case definition includes the following ICD-10 codes: I20 angina pectoris, I21 acute myocardial infarction, I22 subsequent myocardial infarction, I23 certain current complications following acute myocardial infarction, I24 other acute ischaemic heart diseases, I25 chronic ischaemic heart disease.
2. Purchase of a prescription for medications that may prevent IHD from (re)occurring. The case definition includes these ATC-codes: C01A Cardiac glycosides, C01D Vasodilators used in cardiac diseases, C02 Antihypertensiva, C03 Diuretics, C07 Alpha- and

beta-blockers, C08 Calcium channel blockers, C09 ACE-inhibitors and angiotensin-II antagonists and C10 Lipid-modifying agents.

3. Purchase of a prescription for heart therapeutic drugs (C01A, C01D).
4. Purchase of a prescription for antihypertensive drugs (C02, C03, C07, C08, C09).
5. Purchase of a prescription for lipid-modifying agents (C10).

The endpoints 3, 4 and 5 are proper subsets of endpoint 2. The study population was followed, first for death or hospital treatment due to IHD and then for purchase of prescriptions. Only those who were free from the clinical endpoint of the respective follow-ups, throughout the calendar year preceding baseline, were included in the analyses.

For each endpoint, each of the included individuals was followed until any of the following events occurred: (s)he reached the clinical endpoint of the follow-up, (s)he emigrated, (s)he died, the study period ended. Person years at risk (PYRS) were calculated for each individual.

We calculated i) age and gender standardised hazard ratios by socio-occupational group for each of the 5 endpoints, and ii) age, gender and social group standardised hazard ratios by economic activities groups, for each of the 1st 2 endpoints. 'All included individuals' were used as standard populations. A person's socio-occupational status and economic activities groups refer to the ones that were determined at baseline.

A standardised hazard ratio is denoted SHR1 if it is based on death or hospital visits, SHR2 if it is based on purchase of medications that may prevent IHD from (re)occurring (the 2nd endpoint), SHR3 if it is based on purchase of heart therapeutic drugs, SHR4 if it is based on purchase of antihypertensive drugs, and SHR5 if it is based on purchase of lipid-modifying agents. If the age and gender standardised rate of death or hospitalisation due to IHD (the 1st endpoint), in a given socio-occupational group, is 20% higher than it is in the standard population at large then SHR1 for this socio-occupational group = 1.20; if the rate is equal to that in the standard population then SHR1 = 1.00, etc.

We tested whether or not SHR1 is statistically independent of socio-occupational/economic activities group, and we calculated a weighted Spearman correlation coefficient between SHR1, SHR2, SHR3, SHR4 and SHR5. Numbers of persons at baseline were used as weights.

The Spearman correlation coefficient (rho) measures the statistical correlation between ranked variables. It can take values between –1 and +1. If the observation with the highest value of x also has the highest value of y, the observation with the next highest value of x also has the next highest value of y and so on then rho equals 1.

Each resident of Denmark has a unique identification number. This number appears in all of the involved registers and was used as the key in the data linkage. The linkage and the analyses were performed by use of SAS version 9.3.

RESULTS

In total, there were 1 073 154 male and 963 700 female employees who fulfilled the age criteria for inclusion into the study. The socio-occupational code was, however, missing for 22 507 of the men and 944 of the women, who were excluded from the analyses. For the outcome "hospital treatment or death due to IHD", an additional 3185 men and 878 women were excluded as prevalent cases, while the remaining 1 047 462 men and 961 878 women were included in the analysis. The corresponding numbers (of included men and women respectively) were 1 045 407 and 960 979 for the outcome heart therapeutic drugs, 1 005 103 and 889 339 for antihypertensive drugs, 1 045 809 and 960 930 for lipid-modifying agents.

By the end of the 10-year follow-up period, 31.2% of the study population had changed to another occupational group, 2.5% had died, 3% had emigrated, 10.3% had retired, and 6.9% were studying, unemployed, on long-term sickness absence or otherwise economically inactive. The remaining 46% belonged to the same occupational category as they did in the beginning of the follow-up period.

The hazard ratios for ischaemic heart disease depended on socio-occupational group ($p < 0.0001$) and economic activities group ($p < 0.0001$).

With respect to the hazard ratios by occupational group, we found a strong positive correlation between ratios based on hospital contacts and ratios based on purchase of medication (Spearman's correlation coefficient = 0.94) as well as between ratios based on the different types of cardiovascular medicine (Spearman's correlation coefficient = 1).

We also found a strong positive correlation among the hazard ratios of the economic activities groups (Spearman's correlation coefficient = 0.74). We observed, however, one markedly contradictive result; the economic activities group entitled 'general practitioner, dentists etc.' was associated both with significantly high rates of medicine users (SHR2 = 1.15, 95% CI: 1.12–1.19) and significantly low rates of hospital treatment due to IHD (SHR1 = 0.80, 95% CI: 0.71–0.91).

The SHR by socio-occupational group are presented in Table 1–4, while the SHR by economic activities group are presented in Table 5. Cases per 1000 person years at risk are given in Table 6.

A *post hoc* gender-stratified version of Table 1 is given in Table 7.

Table 1. Death or hospital treatment due to IHD (SHR1) and purchase of medications that may prevent IHD from occurring (SHR2), in Denmark 1996–2005, by baseline socio-occupational group

Socio-occupational group	Persons (n)	SHR1	95% CI	SHR2	95% CI	SHR2 vs. SHR1	95% CI
Legislators, senior officials and managers	56 999	0.88	0.85–0.92	0.99	0.97–1.01	1.12	1.10–1.15
Professionals	257 919	0.72	0.70–0.73	0.83	0.82–0.83	1.15	1.14–1.17
Technicians and associate professionals	352 729	0.91	0.89–0.93	0.93	0.92–0.93	1.02	1.00–1.03
Workers in occupations that require skills at a basic level	1 015 316	1.08	1.07–1.10	1.06	1.05–1.06	0.97	0.97–0.98
Workers in elementary occupations	326 377	1.20	1.17–1.22	1.10	1.09–1.10	0.92	0.91–0.93

IHD – ischaemic heart disease; SHR – age and gender standardised hazard ratio; CI – confidence interval.

Table 2. Death or hospital treatment due to IHD (SHR1) and purchase of heart therapeutic drugs (SHR3), in Denmark 1996–2005, by baseline socio-occupational group

Socio-occupational group	SHR1	95% CI	SHR3	95% CI	SHR3 vs. SHR1	95% CI
Legislators, senior officials and managers	0.88	0.85–0.92	0.88	0.85–0.91	1.00	0.99–1.00
Professionals	0.72	0.70–0.73	0.72	0.70–0.73	1.00	1.00–1.00
Technicians and associate professionals	0.91	0.89–0.93	0.86	0.84–0.88	0.95	0.94–0.95
Workers in occupations that require skills at a basic level	1.08	1.07–1.10	1.09	1.08–1.11	1.01	1.01–1.01
Workers in elementary occupations	1.20	1.17–1.22	1.22	1.20–1.25	1.02	1.02–1.02

Abbreviations as in Table 1.

Table 3. Death or hospital treatment due to IHD (SHR1) and purchase of antihypertensive drugs (SHR4), in Denmark 1996–2005, by baseline socio-occupational group

Socio-occupational group	SHR1	95% CI	SHR4	95% CI	SHR4 vs. SHR1	95% CI
Legislators, senior officials and managers	0.88	0.85–0.92	0.97	0.95–0.98	1.10	1.07–1.12
Professionals	0.72	0.70–0.73	0.83	0.82–0.83	1.15	1.13–1.17
Technicians and associate professionals	0.91	0.89–0.93	0.92	0.92–0.93	1.02	1.00–1.03
Workers in occupations that require skills at a basic level	1.08	1.07–1.10	1.06	1.05–1.06	0.98	0.97–0.98
Workers in elementary occupations	1.20	1.17–1.22	1.10	1.09–1.11	0.92	0.91–0.93

Abbreviations as in Table 1.

Table 4. Death or hospital treatment due to IHD (SHR1) and purchase of lipid-modifying agents (SHR5), in Denmark 1996–2005, by baseline socio-occupational group

Socio-occupational group	SHR1	95% CI	SHR5	95% CI	SHR5 vs. SHR1	95% CI
Legislators, senior officials and managers	0.88	0.85–0.92	1.02	1.00–1.05	1.16	1.14–1.18
Professionals	0.72	0.70–0.73	0.79	0.78–0.80	1.10	1.09–1.11
Technicians and associate professionals	0.91	0.89–0.93	0.94	0.93–0.95	1.04	1.03–1.05
Workers in occupations that require skills at a basic level	1.08	1.07–1.10	1.05	1.05–1.06	0.97	0.97–0.98
Workers in elementary occupations	1.20	1.17–1.22	1.12	1.10–1.13	0.93	0.93–0.94

Abbreviations as in Table 1.

Table 5. Death or hospital treatment due to IHD (SHR1) and purchase of medications that may prevent IHD from occurring (SHR2), in Denmark 1996–2005, by baseline economic activities group according to the industrial classification AT49X [18]

Economic activities group	Person (n)	SHR1	95% CI	SHR2	95% CI	SHR2 vs. SHR1	95% CI
010 Metal and steelworks, and foundries	4 673	1.05	0.91–1.22	0.97	0.91–1.04	0.93	0.83–1.03
020 Manufacture of transport equipment	12 243	1.08	0.98–1.18	0.99	0.95–1.03	0.92	0.86–0.98
030 Shipyards	10 104	1.04	0.95–1.15	1.05	1.00–1.09	1.00	0.94–1.07
040 Electricity and heat supply	11 331	0.91	0.83–0.99	0.98	0.94–1.01	1.08	1.01–1.15
050 Iron and metal industries	44 677	1.04	0.99–1.10	1.05	1.03–1.07	1.00	0.97–1.04
060 Engineering industry	59 338	0.98	0.94–1.03	0.99	0.98–1.01	1.01	0.98–1.05
070 Electricity and electronics industry	28 182	0.95	0.88–1.02	1.00	0.98–1.03	1.06	1.00–1.12
080 Car industry	14 828	0.94	0.86–1.04	0.97	0.94–1.01	1.03	0.96–1.10
090 Road contractors	41 902	0.95	0.91–1.00	0.94	0.92–0.96	0.99	0.96–1.03
100 Bricklayer, joiner, and carpentry work	27 689	0.83	0.78–0.89	0.87	0.85–0.90	1.05	1.00–1.10
110 Finishing	11 106	0.90	0.81–1.00	0.95	0.91–0.99	1.05	0.97–1.14
120 Insulation and installation businesses	33 529	0.95	0.90–1.02	0.95	0.92–0.97	0.99	0.95–1.04

Table 5. Death or hospital treatment due to IHD (SHR1) and purchase of medications that may prevent IHD from occurring (SHR2), in Denmark 1996–2005, by baseline economic activities group according to the industrial classification AT49X [18] – cont.

Economic activities group	Person (n)	SHR1	95% CI	SHR2	95% CI	SHR2 vs. SHR1	95% CI
130 Printing works and publishing	26 908	0.99	0.93–1.06	0.99	0.96–1.01	1.00	0.95–1.05
140 Paper, cardboard and bookbinding industries	8 832	1.13	1.02–1.25	1.00	0.96–1.05	0.89	0.82–0.96
150 Wholesale trade	119 930	0.97	0.94–1.00	0.98	0.97–0.99	1.01	0.99–1.04
160 Transport of goods	81 423	1.04	1.01–1.08	1.03	1.02–1.05	0.99	0.96–1.01
170 Transport of passengers	46 250	1.26	1.21–1.31	1.14	1.12–1.16	0.91	0.88–0.93
180 Fire service, lighthouse and salvage corps	7 223	1.07	0.96–1.19	1.05	1.00–1.10	0.98	0.91–1.06
190 Textile, clothing, and leather industry	16 593	0.98	0.89–1.07	0.95	0.92–0.98	0.97	0.90–1.04
200 Manufacture of wood and wood products	32 851	0.98	0.92–1.04	0.95	0.92–0.97	0.97	0.92–1.01
210 Mineral, oil, rubber and plastic products	19 967	1.11	1.03–1.19	1.02	0.99–1.05	0.92	0.87–0.97
220 Stone-works, pottery, and glass industry	13 339	1.00	0.91–1.09	0.97	0.93–1.00	0.97	0.91–1.03
230 Medical equipment / toys / cameras / etc.	13 181	1.02	0.92–1.13	1.00	0.97–1.04	0.98	0.91–1.07
240 Manufacture of industrial chemicals	13 470	1.01	0.92–1.10	1.03	0.99–1.07	1.02	0.95–1.10
250 Heavy raw material and semi-manufacture	6 207	1.03	0.91–1.16	1.06	1.00–1.11	1.03	0.94–1.12
260 Pharmaceutical industry	10 748	0.89	0.78–1.01	1.02	0.98–1.07	1.15	1.04–1.28
271 Office and administration (transport and wholesale)	13 144	1.09	0.98–1.20	1.00	0.96–1.04	0.92	0.86–1.00
272 Office and administration (service)	11 302	1.09	1.01–1.18	1.09	1.06–1.13	1.00	0.94–1.06
273 Finance / Public office and administration	166 406	0.93	0.90–0.96	1.00	0.99–1.01	1.07	1.05–1.10
274 Private office and administration	119 183	0.94	0.90–0.97	0.96	0.94–0.97	1.02	0.99–1.05
281 Car dealers	15 115	0.87	0.78–0.96	0.98	0.94–1.02	1.13	1.05–1.22
282 Garage	3 526	0.95	0.72–1.25	1.03	0.95–1.12	1.08	0.87–1.35
283 Shops	41 463	0.99	0.92–1.06	0.95	0.93–0.97	0.96	0.91–1.01
290 Supermarkets, department stores, etc.	46 388	0.92	0.86–0.99	0.93	0.91–0.96	1.01	0.96–1.07
300 Sewers, water- and gas supply	4 444	1.06	0.94–1.20	1.03	0.97–1.09	0.97	0.89–1.06
310 Personal care and other services	9 231	1.01	0.88–1.15	0.98	0.93–1.03	0.97	0.87–1.08
320 Cleaning, laundries, and dry cleaners	22 953	1.09	1.00–1.18	1.05	1.02–1.08	0.97	0.91–1.03
330 Telecommunication	13 131	0.93	0.85–1.02	1.02	0.99–1.06	1.10	1.03–1.17
340 Surveillance, armed forces, police etc.	26 659	0.99	0.93–1.05	1.03	1.00–1.05	1.04	1.00–1.09
350 Hotels and restaurants	34 778	1.13	1.05–1.22	1.03	1.00–1.05	0.91	0.86–0.96
361 Photographers / film and video production	2 531	0.75	0.54–1.02	0.86	0.78–0.95	1.14	0.89–1.48
362 Entertainment, culture and sport	21 577	1.01	0.93–1.09	0.96	0.93–0.99	0.95	0.90–1.01
363 Libraries and archives	7 155	0.73	0.63–0.85	0.93	0.89–0.97	1.27	1.12–1.43
370 Slaughterhouse industry	18 072	1.05	0.97–1.13	0.99	0.96–1.03	0.95	0.90–1.00
380 Poultry slaughtering and fish products	9 815	1.10	0.98–1.24	1.04	1.00–1.08	0.95	0.86–1.03
390 Beverage industry	12 072	1.02	0.93–1.11	1.00	0.97–1.04	0.99	0.92–1.05

Table 5. Death or hospital treatment due to IHD (SHR1) and purchase of medications that may prevent IHD from occurring (SHR2), in Denmark 1996–2005, by baseline economic activities group according to the industrial classification AT49X [18] – cont.

Economic activities group	Person (n)	SHR1	95% CI	SHR2	95% CI	SHR2 vs. SHR1	95% CI
400 Manufacture of bread, chocolate, tobacco etc.	18 768	1.03	0.95–1.13	1.01	0.98–1.04	0.98	0.91–1.04
410 Manufacture of dairy products	11 063	0.98	0.89–1.09	0.93	0.89–0.97	0.94	0.87–1.02
420 Agriculture	15 529	0.78	0.69–0.87	0.80	0.76–0.84	1.03	0.94–1.13
430 Horticulture and forestry	11 276	0.83	0.74–0.94	0.86	0.82–0.90	1.03	0.94–1.13
440 Hospitals	90 053	1.09	1.05–1.14	1.05	1.04–1.06	0.96	0.93–0.99
450 Nursing homes, home care, etc.	128 377	1.18	1.14–1.22	1.08	1.07–1.09	0.92	0.89–0.94
460 Child care etc.	104 110	0.96	0.92–1.01	1.01	1.00–1.02	1.05	1.01–1.09
471 General practitioners, dentists etc.	15 092	0.80	0.71–0.91	1.15	1.12–1.19	1.43	1.29–1.58
472 Health care not elsewhere classified	23 780	0.93	0.86–1.01	1.02	0.99–1.04	1.09	1.02–1.16
480 Education and research	151 289	0.95	0.92–0.98	0.94	0.93–0.95	0.99	0.97–1.01
490 Fishing	2 637	1.10	0.91–1.32	1.06	0.97–1.15	0.96	0.84–1.10
990 Unstated	1 912	1.00	0.78–1.26	1.03	0.94–1.13	1.04	0.86–1.24

Abbreviations as in Table 1.

Table 6. Endpoint specific numbers of cases per 1000 person years at risk

Endpoint	Person years (n)	Cases (n)	Cases per 1000 person years (n)
Hospital contact or death due to IHD	19 291 045	55 684	2.9
Heart therapeutic drugs (C01A, C01D)	19 262 259	54 656	2.8
Antihypertensive drugs (C02, C03, C07, C08, C09)	16 707 579	374 029	22.4
Lipid-modifying agents (C10)	19 112 089	136 577	7.1
Any of the above drugs	16 531 772	411 651	24.9

IHD – ischaemic heart disease.

Table 7. Death or hospital treatment due to IHD (SHR1) and purchase of medications that may prevent IHD from occurring (SHR2), in Denmark 1996–2005, by gender and baseline socio-occupational group

Socio-occupational group	Persons (n)	SHR1	95% CI	SHR2	95% CI	SHR2 vs. SHR1	95% CI
Men							
legislators, senior officials and managers	47 513	0.88	0.85–0.91	1.00	0.99–1.02	1.14	1.12–1.17
professionals	145 944	0.72	0.70–0.74	0.87	0.86–0.88	1.21	1.19–1.23
technicians and associate professionals	142 110	0.95	0.92–0.97	0.98	0.97–0.99	1.03	1.02–1.05
workers in occupations requiring skills at a basic level	529 815	1.08	1.06–1.09	1.03	1.02–1.03	0.95	0.95–0.96
workers in elementary occupations	182 080	1.20	1.17–1.23	1.08	1.07–1.10	0.90	0.89–0.92

Table 7. Death or hospital treatment due to IHD (SHR1) and purchase of medications that may prevent IHD from occurring (SHR2), in Denmark 1996–2005, by gender and baseline socio-occupational group – cont.

Socio-occupational group	Persons (n)	SHR1	95% CI	SHR2	95% CI	SHR2 vs. SHR1	95% CI
Women							
legislators, senior officials and managers	9 486	0.94	0.82–1.08	0.92	0.89–0.96	0.98	0.89–1.09
professionals	111 975	0.70	0.67–0.74	0.78	0.77–0.79	1.11	1.07–1.15
technicians and associate professionals	210 619	0.84	0.81–0.87	0.90	0.89–0.91	1.07	1.04–1.10
workers in occupations requiring skills at a basic level	485 501	1.10	1.07–1.12	1.08	1.07–1.09	0.99	0.97–1.00
workers in elementary occupations	144 297	1.18	1.14–1.23	1.10	1.09–1.12	0.94	0.91–0.96

Abbreviations as in Table 1.

DISCUSSION

The present study compared hazard ratios of IHD related medication with corresponding ratios based on hospital treatment or death due to IHD, and found a strong correlation between these outcomes, among socio-occupational and economic activities groups in Denmark.

The strength of the study is that the risk estimates were obtained through a prospective follow-up study which was large enough to obtain reasonably narrow confidence intervals for most of the examined socio-occupational and economic activities groups. The registries involved enabled us to censor for emigration and death. Another advantage of the study is that we were able to exclude prevalent cases from the analysis.

The strong correlations in the present study indicate that prescribed medication is a useful risk indicator for work-related IHD in Denmark. There are, however, a few caveats. We showed that the relative rates of medicine purchase between groups of people from the same nation, who were observed during the same calendar period, were strongly correlated with relative rates of IHD morbidity. This does not necessarily mean that relative rates of medicine purchase in one time period versus an earlier time period can be used to measure the relative increase or decrease in morbidity rates over time. Nor does it mean that the absolute incidence of purchase of cardiovascular medicine can be used as a proxy for the absolute incidence of cardiovascular problems. It has, for example, been estimated that approximately only 1/4 of the people with hypertension in Denmark during 1991–1992, received treatment for their condition [21].

The occupational data we used in the present study are not detailed enough to attribute the found morbidity differences between the groups to any particular occupational exposure. This was, however, not the purpose of the study. We merely wanted to know if groups of workers with increased/decreased rates of hospitalisation or death due to IHD also were likely to have increased/decreased rates of IHD-related medication usage, and to what degree these outcomes were correlated on a group level.

Our results imply that the usage of data on prescribed IHD-related medication combined with individual-level exposure data may help us to establish whether or not a certain occupational exposure is a predictor of IHD. They also indicate that the estimated effect of a predictor based on prescribed medication is likely to point in the same direction as would a predictor based on hospitalisation or death due to IHD. The obtained SHR for socio-occupational groups suggest, however, that estimates based on the purchase of medication aimed at preventing IHD as a proxy measure may lead to a slight bias towards unity as compared to estimates based on

hospitalisation or death. They also suggest that part of the social inequalities in IHD incidence may be explained by differences in the propensity to seek medical treatment when needed; the higher the educational requirements of the job, the greater the propensity to check for and handle IHD-related health problems when they arise.

Previous studies have shown that workers in the health care sector differ from the rest of the work force in the propensity to utilize health care services [15,22]. The present study detected that work in dentist's and general practitioner's clinics was associated with prescription bias. Hence, it reinforces previous conclusions which state that one should beware of bias whenever health care workers are included in analyses where health care utilization is used as a proxy for morbidity.

Another caveat is that some of the prescriptions for diuretics (C03) are due to chronic kidney disease [23].

CONCLUSION

Apart from a few caveats, the strong correlations obtained in the present study signify that prescribed medication is a usable risk indicator for ischaemic heart disease, in the working population of Denmark.

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