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### **Multi-wave cohort study of sedentary work and risk of ischemic heart disease**

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This is a study with high validity, several exposure measures and high statistical power that rejects the hypotheses that occupational sitting time is a distinct risk factor for ischemic heart disease when the effect of occupational sitting is disentangled from that of occupational physical activity, which is a weakness of the majority of prior studies within this field.

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## Multi-wave cohort study of sedentary work and risk of ischemic heart disease

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**Objectives** This study aimed to investigate whether sedentary work is a distinct risk factor for ischemic heart disease (IHD) when the effect of occupational sitting is disentangled from that of occupational physical activity.

**Methods** Data on occupational sitting time and several covariates were derived from the Danish Work Environment Cohort Study (DWECS) conducted every five years from 1990–2005 among the active Danish population. This study was designed as a multi-wave longitudinal study including participants employed at entry. Respondents were followed in national registers, first for death or hospital treatment due to IHD and second for purchase of medication that may prevent IHD from (re)occurring serving as a proxy for IHD.

**Results** During 145 850 person-years of follow-up, 510 cases of fatal and non-fatal IHD occurred. After adjustment for age, sex, body mass index (BMI), and socioeconomic status, no difference in risk of IHD was observed between sedentary and non-sedentary employees [hazard ratio (HR) 0.95, 95% confidence interval (95% CI) 0.78–1.16]. During 44 949 and 42 456 person-years of follow-up among men and women, respectively, 1263 men and 1364 women purchased IHD-related medication. No differences in risk were observed between sedentary and non-sedentary participants, either for men or women. A dose–response relationship between occupational sitting time and the risk of IHD was also not detected.

**Conclusions** This study could not confirm the hypothesis that sedentary work is a distinct risk factor for IHD. Future studies may further investigate the association with objective measures of occupational sitting time.

**Key terms** DAG; directed acyclic graph; IHD; ischemic heart disease medication; occupational sitting; sedentarism; sedentary behavior; sedentary lifestyle.

Over the past decade, research within the physical activity and public health field has increasingly focused on sedentary behaviors, defined as any waking behavior characterized by an energy expenditure  $\leq 1.5$  metabolic equivalent of task (MET) while in sitting or reclining posture (1). Several studies have demonstrated the deleterious effects that sedentary behaviors have on a number of health outcomes, such as cardiovascular disease, diabetes, and mortality (2–6). These effects have been shown to be different from those attributed to the lack of moderate-to-vigorous-intensity physical activity (7, 8). Hence, sedentary behavior is suggested to be an independent health risk factor rather than simply one extreme on the physical activity continuum (8).

In particular, the link between leisure-time sedentary behaviors, such as TV viewing, and the risk of cardiovascular disease has been established in the literature (9–12). However, not all domains of sedentary behavior seem to have the same impact on cardiovascular outcomes. Two cross-sectional studies found the associations between occupational sitting time and cardio-metabolic risk factors to be fewer and weaker compared to leisure-time sitting (13, 14). Also in van Uffelen and colleagues' systematic review (15), only limited evidence was found to support a relationship between occupational sitting and health risks in general, and the identified papers investigating cardiovascular disease even revealed conflicting results. Most of these

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studies used a categorical self-report measure of occupational physical activity with sedentary, mainly sitting, or physically-very-easy sitting office work as the response variable representing sedentary work. As noted by Yates et al (16) these ordinal scales of occupational physical activity are not necessarily ordinal scales of occupational sitting, as high levels of sedentary behavior at work can co-exist with high levels of occupational physical activity. Considering the different effects of these behaviors, the use of estimates of occupational physical activity to make inferences about the impact of sedentary work is likely to introduce substantial misclassification bias.

Taking into account the weekly hours of occupational sitting, the aim of the present study was to test the hypotheses that (i) employees engaged in sedentary work have a higher risk of ischemic heart disease (IHD) compared to employees not engaged in sedentary work, and (ii) a positive dose-response relationship exists between occupational sitting time and the risk of IHD.

## Methods

### Study design

We conducted a multi-wave follow-up study within the Danish Work Environment Cohort Study (DWECS) by linking data on sitting time and covariates from the four waves 1990, 1995, 2000, and 2005 to national registers via the participants' unique civil registration number. Purchase of prescription for IHD-related medication has been shown to be a good risk indicator of IHD in the working population in Denmark (17). IHD-related medication was included in the study as a second endpoint in addition to IHD-related hospital admission, in order to increase the statistical power of the analyses.

The follow-up period for death or hospitalization due to IHD ran from 1 January 1991 to 31 December 2010 and included all four waves. The follow-up period for purchases of prescribed IHD-related medication, serving as a proxy for IHD, ran from 1 January 1996 to 31 December 2010, and included the waves 1995, 2000, and 2005.

For each endpoint, all participants were followed until any of the following events occurred: he/she reached the clinical endpoint of the follow-up, he/she emigrated from Denmark, he/she died from primary causes other than IHD, or the study period ended.

### Study cohort

DWECS was an open dynamic cohort with a split panel design drawn from a representative sample of

the active Danish population (18). A main panel and additional age and migration panels were drawn from the Civil Registration System. The main panel consisted of a random sample of people aged 18–59 years as of 1 October 1990, who were invited for a telephone interview in October–November 1990. An additional panel was randomly drawn from a population of people aged 18–59 years in 2005. At each wave, the population was supplemented with age (18–22 years) and migration (immigrated within the last five years prior to cohort entry) panels to remain representative of the Danish workforce. Once a subject was drawn for a certain panel and invited for the study, he/she was re-invited at all subsequent waves, irrespective of participation at previous waves. Interviews were conducted by telephone in 1990, 1995, and 2000 and by a combination of postal questionnaire (90%) and telephone interviews (10%) in 2005. Response rates in the study were high, but decreased continuously from 90% in 1990 to 63% in 2005. Feveile et al (18) have published details of DWECS.

Respondents to the DWECS, who were categorized as employees according to the interview in 1990, entered the cohort on 1 January 1991 if on that date they: (i) lived in Denmark, were  $\geq 21$  years old, and were free from the respective clinical endpoints throughout the calendar year preceding baseline (ie, in order to pursue a design where the exposure is measured before the outcome is developed). The same principle was used for new entries among respondents interviewed during the 1995, 2000, and 2005 waves.

### National registers

Information on IHD was obtained from the Danish Occupational Hospitalisation Register (OHR) and information on IHD-related medication from the Danish National Prescription Registry.

OHR is a database obtained through record-linkage between the Civil Registration System, the Danish National Patient Register, the Cause of Death Register, and the Employment Classification Module. OHR includes every person who at some point since 1980 has been living and working in Denmark. The Danish National Patient Register has existed since 1977 and contains data from all public hospitals in Denmark (>99% of all admissions). Diagnoses were coded according to the International Classification of Disease, 8<sup>th</sup> revision (ICD-8) before 1994, after which the ICD-10 was used (19).

The Danish National Prescription Registry contains all purchases of prescription drugs at pharmacies in Denmark since 1995 (20).

## Occupational sitting time

Occupational sitting was measured at all four waves of DWECS with the item “Does your job involve sitting?” and the following six response categories: (i) almost all of the time; (ii) approximately  $\frac{3}{4}$  of the time; (iii) approximately  $\frac{1}{2}$  of the time; (iv) approximately  $\frac{1}{4}$  of the time; (v) rarely; and (vi) never. Since this operationalization of occupational sitting does not provide absolute values of sitting hours, the categories of sitting time were converted into corresponding constants (0.875, 0.75, 0.5, 0.25, 0.125, and 0) and combined with self-reported information on actual weekly working hours in main and second jobs. Eriksen et al (21) have published a similar measure of occupational sitting time.

Moreover the weekly occupational sitting time was defined on an ordinal scale with five categories (0, >0–<10, 10–<20, 20–<30, and  $\geq 30$  hours).

## Sedentary work

In previous studies, employees are considered to be exposed to sedentary work if they report a minimum of  $\frac{3}{4}$  of their working time is spent sitting due to a particular health risk when exceeding this threshold (22). In the present study, participants are categorized as sedentary at work if they spend  $\geq 25$  hours sitting at work per week, accounting for participants having varying number of working hours. When applying this cut point, part-time employees (usually working 30 hours per week) who have stated they sit almost all of the time are included in the exposed category.

## Ischemic heart disease and IHD-related medication

The following two endpoints were considered separately, in accordance with Hannerz et al (23): (i) IHD: hospital treatment or death with IHD as principal diagnosis/cause of death. The case definitions include the following ICD codes: 410-414 (ICD-8) and I20-I25 (ICD-10); (ii) IHD-related medication: purchase of prescription for medications that may prevent IHD from (re)occurring. The case definitions 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.

## Potential confounders and modifiers

Potential confounders and mediators of the association between sedentary work and IHD were identified in the existing scientific literature on general sedentary behavior and cardiovascular disease. Decisions on which

confounders to include in the analyses were taken in accordance with the theory of directed acyclic graphs (DAG) (24), see figure 1.

Information on age and gender was obtained from the Civil Registration System. Socioeconomic status (SES) was provided by Statistics Denmark and is defined according to the respondents' term of employment and classified into three groups of white-collar and two groups of blue-collar workers (25).

At all four DWECS waves, the respondents have indicated their smoking status as current, former, or never smoker. BMI is calculated at each wave using respondents' self-reported height and weight.

Only at the waves 2000 and 2005 were respondents asked about their diet, alcohol consumption, and level of leisure-time physical activity. The questions and response categories regarding leisure-time physical activity did not have the exact same wording at the waves 2000 and 2005. However, it was possible to dichotomize the two variables so that they both indicate whether or not respondents are physically inactive ( $>2$  hours of moderate physical activity per week). In 2000, alcohol consumption was measured as the number of unit wine, beers and spirits consumed per day. In 2005 alcohol consumption was measured as average units consumed per week days and per days in the weekend. The variables have been dichotomized indicating high risk consumers, which is consumption  $>14$  units per week for women and  $\geq 21$  units per week for men, according to the threshold set by the Danish Health and Medicines Authority (26).

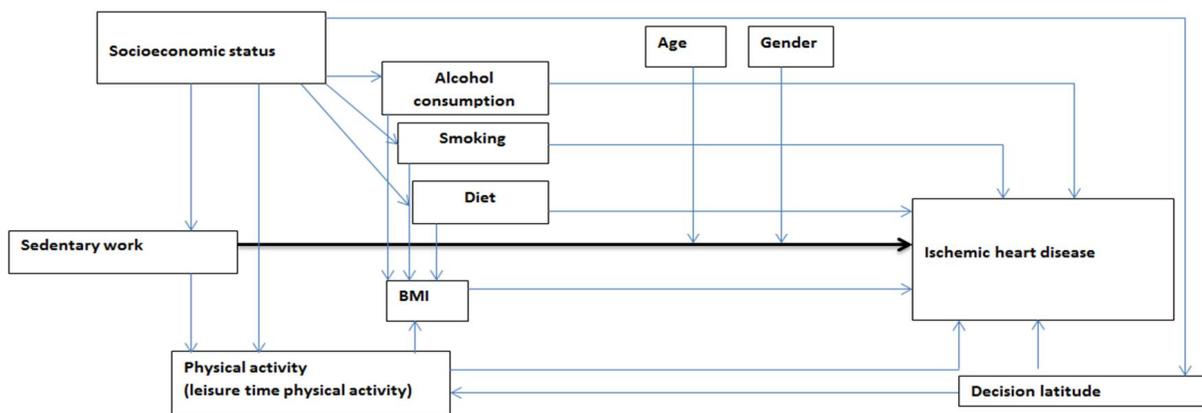
Decision latitude, a dimension of job control found to influence risk of myocardial infarction (27), was measured at all DWECS waves with the item “Do you have great influence over decisions regarding your work?” and the response categories: always; usually; usually not; never.

## Statistical analysis

The association between sedentary work, occupational sitting time, and relative rate (RR) of IHD was analyzed using multiple Poisson regressions. A chi<sup>2</sup> goodness-of-fit test was performed using the ordinal scale of occupational sitting time in order to determine a possible dose–response relationship.

Person-years at risk were calculated for each individual, first for test of IHD and then IHD-related medication.

Since the exposure variable is measured at four waves, the exposure status can change over time. In case of a missing data point of an exposure or confounder variable at a certain wave, the most recent available information was carried forward. Carry backward was avoided to reduce the risk of reverse causality, that is, the onset disease affecting the level of occupational sitting time or the confounders. Thus, variables only avail-



**Figure 1.** A directed acyclic graph (DAG) representing the theoretical framework of the relationship between sedentary work and ischemic heart disease

able at the 2000 and 2005 waves could not be included in the main analyses with follow-up beginning in 1991. Instead, they were included in sensitivity analyses with a follow-up period beginning in 2001.

According to the theory of DAG, it would be sufficient to adjust the analyses for SES and wave, and stratify on age, gender and physical activity. Confounding effects of other health behaviors and BMI are already taken into account when adjusting for SES. However, due to low statistical power some deviations from this optimal design were made. Age was instead treated as a confounder in all analyses and gender was treated as a confounder when studying IHD. Because physical activity is not available before the 2000 wave, BMI was treated as a confounder in the main analyses as a proxy of physical activity. Sensitivity analyses included physical activity and were further adjusted for smoking status, alcohol consumption and decision latitude.

The hypothesis and the statistical models were completely defined in a detailed study protocol before any relation between the concerned exposure and response variables in the data material were studied. Statistical analyses were performed with the software SAS, version 9.3 (SAS Institute, Cary, NC, USA).

## Results

Table 1 presents the characteristics of DWECs participants included in the analyses when followed for IHD from 1991–to 2010 (1990, 1995, 2000, and 2005 waves). Table 2 presents the participants included in the corresponding sensitivity analysis when followed from 2001–2010 (2000 and 2005 waves).

Throughout the study period from 1991–2010, a total of 11 996 participants contributed with 145 850 person-

years of follow-up (mean 12.16 years). In this period, 510 IHD cases occurred. When participants were followed for IHD-related medication from 2001–2010, a total of 5095 men contributed with 44 949 person-years of follow-up (mean 7.5 years) and 5218 women contributed with 42 456 person-years of follow-up (mean 8.14 years). In this period, 1263 men and 1364 women purchased prescribed IHD-related medication during follow-up.

Table 3 presents the Poisson proportional hazards regression analyses for associations between sedentary work, occupational sitting time and incidence of IHD. No differences in the RR of IHD were found between sedentary and non-sedentary participants when adjusting for gender, age, BMI and SES: RR=0.95 (95% CI 0.78–1.16). Results were consistent when further adjusting for health behaviors and decision latitude: RR=0.94 (95% CI 0.71–1.27). For every 10 hours increase in occupational sitting time, the RR for IHD was 0.99 (95% CI 0.92–1.06).

Results from the analyses of associations between sedentary work, occupational sitting time, and purchase of prescribed IHD-related medication are presented in table 4. No differences could be observed in the RR of purchasing IHD-related medication when comparing sedentary and non-sedentary participants, either among men (RR=1.00, 95% CI 0.88–1.13) or women (RR=0.93, 95% CI 0.82–1.06).

The goodness-of-fit tests yielded similar results and found no association between occupational sitting time and IHD as well as purchase of IHD-related medication (data not shown).

Due to SES being strongly correlated with occupational sitting, inclusion of SES as a confounder may lead to an overcorrection of the effect sizes. Therefore, additional post-hoc sensitivity analyses for IHD were performed without adjustment for SES and stratified on SES, respectively. When adjusting for gender, age and

**Table 1.** Characteristics of participants in the dynamic Danish Work Environment Cohort Study (DWECS) cohort followed from 1991–2010 for ischemic heart disease.

	Wave							
	1990		1995		2000		2005	
	N	%	N	%	N	%	N	%
Total	5420	100	6423	100	7139	100	10 821	100
Sedentary work ( $\geq 25$ hours spent sitting at work per week)								
Yes	1707	31.5	2009	31.3	2273	31.8	3620	33.5
No	3713	68.5	4414	68.7	4866	68.2	7201	66.5
Age (years)								
21–39	2737	50.5	2706	42.1	2514	35.2	3001	27.7
40–49	1597	29.5	1815	28.3	1864	26.1	3133	29.0
50–59	1004	18.5	1405	21.9	1735	24.3	2865	26.5
60–69	82	1.5	497	7.7	959	13.4	1441	13.3
$\geq 70$	0	0.0	0	0.0	67	0.9	381	3.5
Gender								
Women	2594	47.9	3167	49.3	3606	50.5	5622	52.0
Men	2826	52.1	3256	50.7	3533	49.5	5199	48.0
Socioeconomic status								
Social class I (highest)	713	13.2	868	13.5	1023	14.3	1703	15.7
Social class II	1041	19.2	1009	15.7	1257	17.6	2358	21.8
Social class III	1986	36.6	2465	38.4	2471	34.6	3074	28.4
Social class IV	555	10.2	700	10.9	815	11.4	1591	14.7
Social class V (lowest)	1125	20.8	1381	21.5	1573	22.0	2095	19.4
BMI ( $\text{kg}/\text{m}^2$ )								
Normal/underweight ( $< 25$ )	3868	71.4	4305	67.0	4303	60.3	6144	56.8
Overweight ( $25 < 30$ )	1295	23.9	1745	27.2	2271	31.8	3600	33.3
Obese ( $\geq 30$ )	257	4.7	373	5.8	565	7.9	1077	9.9
Year of cohort entry								
1991	5420	100	5320	82.8	5155	72.2	4909	45.4
1996	.	.	1103	17.2	1110	15.5	1104	10.2
2001	.	.	.	.	874	12.2	897	8.3
2006	.	.	.	.	.	.	3911	36.1

BMI only, sedentary participants had a RR=0.89 (95% CI 0.74–1.08) of IHD incidences compared to non-sedentary participants. Likewise, the stratified analyses showed no differences in RR of IHD between sedentary and non-sedentary participants, neither among participants with SES (SES groups I–III: RR=0.97, 95% CI 0.76–1.23) nor among participants with low SES (SES group IV and V: RR=0.90, 95% CI 0.37–1.32).

In response to a comment by the reviewer, we performed two post hoc sensitivity analyses, one with hospital contacts due to IHD and one with IHD-related medications as outcome. For the IHD, we only included people who lived in Denmark and were free from hospital contacts due to IHD throughout the time period between 1 January 1991 and entry into the cohort (N=6202). For IHD-related medications, we only included people who lived in Denmark and who did not redeem any prescription for IHD-related medication between 1 January 1995 and entry into the cohort (4309 men and 4255 women). The obtained rate ratios were 0.96 (95% CI 0.77–1.20) for hospital contacts due to IHD, 1.00 (95% CI 0.88–1.14) for IHD-related medications among men,

and 0.96 (95% CI 0.84–1.09) for IHD-related medications among women.

## Discussion

We hypothesized that employees engaged in sedentary work are exposed to an increased risk of IHD compared to employees not engaged in sedentary work. This hypothesis could not be confirmed. When adjusting for age, gender, SES, BMI and wave, no difference in risk of IHD was observed between sedentary and non-sedentary employees. Also, when studying purchase of IHD-related medication as a proxy for risk of IHD, no differences were observed between the two groups, either for men or women. Furthermore, we hypothesized that a dose–response relationship exists between time spent sitting at work and the risk of IHD. In the study protocol, we planned to test this with the goodness-of-fit test. However, since no linear relations could be observed in the regression analyses, the goodness-of-fit

**Table 2.** Characteristics of participants in the dynamic Danish Work Environment Cohort Study (DWECS) cohort followed from 2001–2010 for ischemic heart disease.

	Wave			
	2000		2005	
	N	%	N	%
Total	5229	100	9717	100
Sedentary work ( $\geq 25$ hours spent sitting at work per week)				
Yes	1749	33.5	3365	34.6
No	3480	66.5	6352	64.4
Age (years)				
21–39	2359	45.1	3394	34.9
40–49	1398	26.7	2833	29.2
50–59	1202	23.0	2533	26.1
60–69	267	5.1	919	9.5
$\geq 70$	3	0.1	38	0.4
Gender				
Women	2584	49.4	5048	52.0
Men	2645	50.6	4669	48.0
Socioeconomic status				
Social class I (highest)	811	15.5	1614	16.6
Social class II	826	15.8	2095	21.6
Social class III	1785	34.1	2656	27.3
Social class IV	710	13.6	1572	16.1
Social class V (lowest)	1097	21.0	1780	18.3
Smoking				
Never smoker	1937	37.0	2995	30.8
Former smoker	1190	22.8	2564	26.4
Current smoker	2102	40.2	4158	42.8
Leisure-time physical activity				
$\geq 2$ hr/wk of light intensity	4480	85.7	8221	84.6
$< 2$ hr/wk of light intensity	749	14.3	1496	15.4
High alcohol consumer (>14/21 units per week for women/men)				
No	4946	94.6	8463	87.1
Yes	283	5.4	1254	12.9
Decision latitude				
Always	3026	57.9	4594	47.3
Usually	1601	30.6	3717	38.3
Usually not	283	5.4	875	9.0
Never	319	6.1	531	5.5
Year of cohort entry				
2001	5229	100	5155	53.0
2006	.	.	4562	47.0

test served to check whether any non-linear relationship could be observed, which was not the case. Finally, we performed additional sensitivity tests for the two hypotheses including adjustments for health behaviors and decision latitude, which generated results that were consistent with the main analyses.

There may be several explanations that no associations between sedentary work and IHD could be observed in this study, despite moderate evidence for an existing association between general sedentary behavior and risk of heart disease in previous studies (2, 28). First, it is possible that sedentary work results in higher energy expenditure and includes more muscle contractions due to moderate arm movements compared to other sedentary behaviors, such as watching TV. This is

**Table 3.** Relative rate (RR) with 95% confidence interval (95% CI) for ischemic heart disease as a function of sedentary work and occupational sitting time, respectively, among employees in the Danish Work Environment Cohort Study (DWECS), 1991–2010 & 2001–2010. [Ref=reference.]

	Ischemic heart disease (IHD)			
	Person-years	Cases	RR	95% CI
Sedentary work <sup>a</sup> ( $\geq 25$ hr/wk spent sitting)	47 007	152	0.95	0.78–1.16
Non-sedentary work	98 843	358	Ref	..
Sedentary work <sup>b</sup> ( $\geq 25$ hr/wk spent sitting)	23 323	64	0.94	0.71–1.27
Non-sedentary work	45 336	152	Ref	..
Occupational sitting time <sup>a</sup> (Per 10 hr/wk increase)	145 850	510	0.99	0.92–1.06
Occupational sitting time <sup>b</sup> (Per 10 hr/wk increase)	68 659	216	0.98	0.88–1.09

<sup>a</sup> Adjusted for gender, age, BMI, socioeconomic status and calendar year. Follow-up period 1991–2010, waves 1990, 1995, 2000 and 2005.

<sup>b</sup> Sensitivity analyses adjusted for gender, age, socioeconomic status, smoking status, alcohol consumption, leisure time physical activity, decision latitude and calendar year. Follow-up period: 2001–2010, waves 2000 and 2005.

to some extent indicated in a study by Matthews et al (3), where time spent watching TV was associated with cardiovascular mortality, which was not the case for overall daily sitting time. Also, in a study investigating sedentary leisure-time behavior and the risk of cardiovascular disease, only 1.0 MET activities were included (10). Sedentary computer or desk work was set to 1.5 MET reflecting the authors' hypothesis that the health effects of sedentary work are distinct from that of general sedentary behavior. Second, Healy et al's research (29) demonstrated that not only the total amount of time spent sitting but also the manner in which it is accumulated is important for the effect on metabolic biomarkers. In general, sedentary work might very well involve more frequent interruptions than certain sedentary behaviors during leisure time, such as watching TV. Variations in the number and lengths of interruptions in sedentary work as well as the years of accumulated exposure should be considered in future studies investigating the potential adverse health effects of sedentary work.

This multi-wave cohort design has several strengths. Data on occupational sitting was collected before onset of IHD and purchase of IHD-related medication, and only respondents free from these clinical endpoints during the calendar year preceding baseline were included. The multiple measurements also reduce misclassification due to changes in exposure and confounder status during follow-up. However, since workers might seek more sedentary jobs as symptoms increase prior to the endpoint, it is possible that the effect has been overestimated.

By measuring occupational sitting as absolute sitting time, it was possible to disentangle its effect on risk of cardiovascular disease from that of occupational physi-

**Table 4.** Relative rate (RR) with 95% confidence interval (95% CI) for purchase of ischemic heart disease (IHD)-related medication as a function of sedentary work and occupational sitting time, respectively, among employees in the Danish Work Environment Cohort Study, (DWECS) 1996–2010 and 2001–2010. [BMI=body mass index.]

	IHD-related medication							
	Men				Women			
	Person-years	Cases	RR	95% CI	Person-years	Cases	RR	95% CI
Sedentary work <sup>a</sup> ( $\geq 25$ hours per week spent sitting)	16 188	455	1.00	0.88–1.13	13 032	373	0.93	0.82–1.06
Non-sedentary work	28 761	808	Ref.	..	29 424	991	Ref.	..
Sedentary work <sup>b</sup> ( $\geq 25$ hours per week spent sitting)	10 402	318	1.03	0.89–1.19	8799	269	0.92	0.80–1.07
Non-sedentary work	17 459	538	Ref.	..	19 375	673	Ref.	..
Occupational sitting time <sup>a</sup> (Per 10 hr/wk increase)	44 949	1263	1.01	0.96–1.05	42 456	1364	0.98	0.93–1.03
Occupational sitting time <sup>b</sup> (Per 10 hr/wk increase)	27 861	856	1.03	0.98–1.08	28 174	942	0.97	0.91–1.02

<sup>a</sup> Adjusted for age, BMI, socioeconomic status and calendar year. Follow-up period 1996–2010, waves 1995, 2000 and 2005.

<sup>b</sup> Sensitivity analyses adjusted for age, socioeconomic status, smoking status, alcohol consumption, leisure time physical activity, decision latitude and calendar year. Follow-up period: 2001–2010, waves 2000 and 2005.

cal activity. Several previous studies have been challenged by using a measure of occupational sitting level that was included in a categorical scale of occupational physical activity (15, 30–35), which is not in line with the two behaviors being distinct risk factors.

Literature on general sedentary behavior suggests a strong dose–response relationship with cardiovascular disease (11). Yet, high physical demands at work are also shown to be associated with increased risk of cardiovascular morbidity and mortality (33). High physical demands are likely to be present among employees with low levels of occupational sitting time, which could have led to the alternative hypothesis of a u-shaped relationship between occupational sitting and IHD. However, the results of the present study did not confirm any non-linear relationship.

Information on the two outcome measures – IHD and IHD-related medication – are derived from national registers considered to be of high validity (20). However, prescription and detection biases related to IHD might be present. Health staff must take into account the number of risk factors of cardiovascular disease present in a patient when deciding whether or not to prescribe drug treatment for hypertension and high cholesterol levels (36). Since people engaged in sedentary work tend to represent socioeconomic groups, where these risk factors are less prevailing, an underestimation of the detrimental effect of sedentary work may be expected when studying IHD-related medication as a proxy for IHD. In contrast, these biases may be reversed by detection bias as people engaged in sedentary work might be more prone to make an unsolicited appointment for a health check-up (17).

A limitation of the study is the use of the self-reported measure of occupational sitting, which has not been validated. Though imprecise, other workplace

sitting measures have been shown to have acceptable properties for use in observational studies (37, 38).

This study could not confirm the hypothesis that sedentary work is a distinct risk factor for IHD. Neither was it confirmed that a dose–response relationship exists between occupational sitting time and the risk of IHD. Future studies should further investigate associations between objectively measured occupational sitting time and IHD.

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