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ORIGINAL ARTICLE

Heavy lifting at work and risk of retinal detachment: a population-based register study in Denmark

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ABSTRACT

Objectives To investigate the relationship between rhegmatogenous retinal detachment (RRD) and frequent heavy lifting in a Danish working population through national register data.

Methods A dynamic cohort of all men aged 20–59 years in Denmark was followed through the Danish Occupational Hospitalisation Register from 1995 to 2010 for diagnosed RRD. Occupational categories were classified according to their potential for heavy lifting in 4 main groups: heavy lifters, manual workers unlikely to be heavy lifters, other manual workers and non-manual workers unlikely to be heavy lifters. The age-standardised rate of diagnosed RRD for heavy lifting occupations was compared with that experienced by the other 3 occupational categories. Rate ratios (RRs) and 95% CIs were estimated through a Poisson regression model adjusted for calendar period and age group.

Results The highest age-standardised rate of diagnosed RRD was recorded among non-manual workers performing occupational activities unlikely to be associated with heavy lifting (18.0 cases per 100 000 person-years). The RR for workers in jobs expected to entail a high frequency of heavy lifting compared with manual workers whose occupation was unlikely to be associated with heavy lifting was 0.91 (95% CI 0.73 to 1.14), while in comparison with other manual workers, it was 0.93 (95% CI 0.78 to 1.11). The RR compared with non-manual workers in occupations unlikely to entail heavy lifting was 0.51 (95% CI 0.43 to 0.60).

Conclusions These findings do not support an association of occupational heavy lifting with diagnosed RRD. The epidemiological evidence for this association is still inconclusive. Future studies should use a more specific measure of exposure to resolve the outstanding uncertainties.

What this paper adds

- Previous studies have suggested a positive association between heavy manual handling at work and risk of retinal detachment, but other epidemiological evidence is indirect and conflicting.
- To explore this possible association, a population-based register study was carried out in a Danish working population, but the association was not supported.
- Further research using a more specific measure of exposure would be needed to rule out a relationship with confidence.

INTRODUCTION

Retinal detachment (RD) is a serious ophthalmic emergency that can lead to irreversible loss of vision. Rhegmatogenous RD (RRD), which is the most common form of the disorder, has an annual incidence of 6.3–18.2 per 100 000 person-years with a male-to-female ratio ranging from 1.3:1 to 2.3:1.[1 2]

The major known risk factors for RD are age, severe myopia, cataract surgery and ocular trauma.[3–5] Apart from avoidance of acute ocular trauma,[6] no effective primary prevention is currently available. Moreover, other than through injuries, RD is not generally considered to be work related.

However, in 2008, an exploratory case–control study by Mattioli *et al*[7] found a strong association between occupational exposure to heavy lifting and risk of surgically treated RD in people with myopia. Then, in a supplementary case–case analysis, the same authors found no difference in the prevalence of heavy lifting between myopic and emmetropic cases with surgically treated RD,[8] leading them to propose that occupational lifting might be a risk factor for RD even in the absence of myopia. This hypothesis was supported by an extended case–control analysis including non-myopic cases.[9]

An association with heavy lifting might occur because such tasks involve the Valsalva manoeuvre (forceful attempted exhalation against a closed glottis), leading to a sudden increase in intraocular pressure.[10] The Valsalva manoeuvre affects arterial as well as intra-abdominal pressures, and it is plausible that intraocular pressure could also be affected. Thus, Vieira *et al*[11] reported an important increase in intraocular pressure while lifting at 80% of one-repetition maximum (ie, 80% of the maximum load a person can lift at 1 attempt).

Other epidemiological evidence for an association of RD with heavy lifting is indirect and conflicting. A Scottish study found that incidence of diagnosed RRD among people living in more affluent areas was twice that among those living in areas of deprivation.[12] On the other hand, a large population-based study in Tuscany, using hospital discharge records, found a twofold higher incidence of surgically treated RRD among manual as compared to non-manual workers.[13]

To explore further the relationship between RRD and occupational lifting, we carried out a study in a

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Danish general working population, in which we compared rates of diagnosed RRD among manual workers in occupations associated with heavy lifting with those in manual workers performing occupational activities in which heavy lifting was less likely to occur, and in non-manual workers among whom heavy lifting was unlikely to be experienced.

METHODS

Study design

The study used the Danish Occupational Hospitalisation Register (OHR), a database compiled through record linkage between three national registers—the central person register,[14] its employment classification module, and the hospital patient register.[15] Currently, the OHR includes every person who has been economically active and an inhabitant of Denmark at some time after 1980. The central person register contains information on gender, address and dates of birth, death and migration (in and out of the country) for every person who is or has been an inhabitant of Denmark at any time since 1968. Since 1975, people's occupation and industry have been registered annually in the employment classification module, and, since 1994, the occupations have been coded according to Statistics Denmark's Standard Classification of Occupations (DISCO-88),[16] which is a national version of ISCO-88 (ie, the International Standard Classification of Occupations). The national hospital register has existed since 1977 and contains data from all public hospitals in Denmark (to which more than 99% of all hospital admissions occur). From 1977 to 1994, the register included data only on inpatients, but after 1995, it also covered outpatient and emergency ward visits. Since 1994, diagnoses have been coded according to the 2010 version of the International Classification of Diseases, Tenth Revision (ICD-10).[17]

A dynamic cohort (open for entry and exit) of all men aged 20–59 years in Denmark was followed through the OHR, from 1 January 1995 to 31 December 2010, for hospital attendance (including inpatients, outpatients and emergency ward visits) with RRD (RD with retinal break, ICD-10=H33.0) as the principal diagnosis. Each man was followed until any of the following events had occurred: he reached the clinical end point of the study, he attended a hospital with 'injury of eye and orbit' (ICD-10=S05) as the principal diagnosis, he emigrated, he died, he became 60 years old, or the study period ended.

Classification of occupational categories

Occupational categories were classified according to their potential for heavy lifting by three experts in the development of job-exposure matrices with extensive experience in the evaluation of job title and heavy lifting at work (Andreas Holtermann, Karen Søgaard and DC). Andreas Holtermann and Karen Søgaard identified occupations associated with heavy lifting, while DC identified occupations in which heavy lifting was unlikely to occur. Thus, together they distinguished four main groups of occupations: (1) manual jobs in which frequent heavy lifting was highly likely; (2) manual jobs in which frequent heavy lifting was unlikely; (3) other manual jobs (not included in the previous 2 categories) and (4) non-manual jobs in which frequent heavy lifting was unlikely to occur. The DISCO-88 codes assigned to each of these groups are presented in table 1. In addition, three other categories of employment were defined: workers with other DISCO-88 codes; those economically active but with missing DISCO-88 codes; and those not economically active.

Data from the Danish Work Environment Cohort Study (DWECS; a national study that collects information about working conditions, health and lifestyle among Danish employees and self-employed earners[18]) in the calendar year 2000 were used to check that the prevalence of heavy lifting in the jobs classed as entailing frequent heavy lifting was importantly higher than that in the other three main occupational groups. This analysis confirmed that the classification of the occupational categories performed by the experts was plausible (see online supplementary table S1). In particular, the proportion of workers who reported that they carried or lifted objects approximately 1/4 of the time or more with a typical weight of 30 kg or more was higher among the heavy lifting group (16.5%) than in the other three main occupational categories (2.5–10.9%).

Statistical analysis

Time-dependent dummy variables (which were updated at the beginning of each calendar year) were used to indicate whether or not a person belonged to a specific occupational category.

Age-standardised rates (per 100 000 person-years) of diagnosed RRD by occupational category were calculated with the distribution of person-years (in 10-year strata of age) across the entire population as the standard. The main analysis focused on the four main occupational groups that had been distinguished. We compared the rate of diagnosed RRD for men currently in heavy lifting occupations with that experienced by the other three occupational categories (ie, manual workers unlikely to be heavy lifters, other manual workers and non-manual workers unlikely to be heavy lifters)—taking each in turn as the reference category. Rate ratios (RRs) and 95% CIs were estimated through a Poisson regression model adjusted for calendar period (4-year intervals) and age (10-year age groups). Finally, we performed a post hoc sensitivity analysis in which we restricted our measure of outcome to cases treated as inpatients.

Proc genmod in SAS V.9.3 was used to implement the analysis.

RESULTS

A flow chart for the study cohort is set out in table 2. Table 3 shows the age-standardised rates (per 100 000 person-years) of diagnosed RRD, together with numbers of cases and person-years at risk, by occupational category. Men in heavy lifting occupations experienced a rate of 9.2 cases per 100 000 person-years. Manual workers whose occupation was unlikely to be associated with heavy lifting had a rate of diagnosed RRD of 10.1 cases per 100 000 person-years; and other manual workers experienced a similar rate. The highest rate of diagnosed RRD was recorded among non-manual workers performing occupational activities unlikely to be associated with heavy lifting.

The RR (adjusted for calendar period and age) for workers in jobs expected to entail a high frequency of heavy lifting compared with manual workers whose occupation was unlikely to be associated with heavy lifting was 0.91 (95% CI 0.73 to 1.14), while in comparison with other manual workers, it was 0.93 (95% CI 0.78 to 1.11). The RR compared with non-manual workers in occupations unlikely to entail heavy lifting was 0.51 (95% CI 0.43 to 0.60).

Of the 2384 diagnosed cases of RRD who were included in the main analysis, 81% were treated as inpatients. In the *post hoc* sensitivity analysis based only on inpatient cases, the RR (adjusted for calendar period and age) for heavy lifters compared with manual workers unlikely to be heavy lifters was 0.88 (95% CI 0.69 to 1.13). In comparison with other manual workers, the RR was 0.93 (95% CI 0.76 to 1.13), while with

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Table 1 Classification of occupational categories by association with heavy lifting coded according to DISCO-88

Occupational category	DISCO-88
Heavy lifters (occupations in which frequent heavy lifting is highly likely)	712. Building frame and related trades workers 921. Agricultural, forestry and fishery labourers 931. Construction labourers 933. Transport and storage labourers
Manual workers unlikely to be heavy lifters (occupations in which frequent heavy lifting is unlikely to occur)	731. Precision workers in metal and related materials 733. Handicraft workers in wood, textile, leather and related material 734. Printing and related trades workers 741. Food processing and related trades workers 743. Textile, garment and related trades workers 744. Pelt, leather and shoemaking trades workers 815. Chemical-processing-plant operators 816. Power-production and related plant operators 817. Automated-assembly-line and industrial-robot operators 822. Chemical-products machine operators 825. Printing, binding and paper products machine operators 826. Textile, fur and leather products machine operators 827. Food and related products machine operators 828. Assemblers 829. Other machine operators and assemblers 831. Locomotive engine drivers and related workers 912. Shoe cleaning and other street services elementary occupations 913. Domestic and related helpers, cleaners and launderers 914. Building caretakers, window and related cleaners
Other manual workers (not included in the previous 2 categories)	All workers with a first digit DISCO-code equal to 6 (agricultural trades workers), 7 (craft and related trades workers), 8 (plant and machine operators and assemblers) or 9 (elementary occupations). Except those who belong to either heavy lifters' group or manual workers unlikely to be heavy lifters' group
Non-manual workers unlikely to be heavy lifters (occupations in which frequent heavy lifting is unlikely to occur)	All workers with a first digit DISCO-code equal to 1 (legislators, senior officials and managers), 2 (professionals), 3 (technicians and associate professionals) or 4 (clerks), except those who belong to the following occupations: 223. Nursing and midwifery professionals 323. Nursing and midwifery associate professionals 347. Artistic, entertainment and sports associate professionals

DISCO-88, Statistics Denmark's Standard Classification of Occupations.

respect to non-manual workers unlikely to be heavy lifters, it was 0.48 (95% CI 0.40 to 0.58).

DISCUSSION

This study suggests that, in Denmark, at least among men, occupational heavy lifting compared with other manual work is not more often associated with diagnosed RRD. Rather, the highest risk of diagnosed RRD was observed in non-manual workers unlikely to perform heavy lifting, who experienced a rate of diagnosed RRD about twice that in men whose jobs were likely to involve frequent heavy lifting.

These findings contrast with those reported previously from two Italian studies,[7 13] which suggested a positive association between heavy manual handling at work and risk of surgically treated RD. Rather, they accord with the results of an incidence study performed in Scotland, which found an association of diagnosed RRD with affluence—likely to be a proxy for lower exposure to heavy lifting.[12 19]

Two other case–control investigations have explored the association of RD with level of education and physical activity.[4 20] A study by Austin *et al*[20] found an adjusted OR of 0.6 (95% CI 0.3 to 1.1) for high educational level and idiopathic RD. On the other hand, a second study found no significant association with 'vigorous physical activity', 'subjective impression of physical activity' or 'indoor/outdoor place of work'.[4] However, no quantitative information was presented on the risk of RD in relation to these factors.

An important limitation of the current study was the lack of direct information about lifting. Lifting, and more generally manual material handling, is a widespread occupational exposure, especially among manual workers. The lack of direct data about occupational manual handling or lifting (including the intensity and duration of exposure) precluded more detailed analyses, and even among the workers in jobs classed as unlikely to involve heavy lifting, it is possible that a few were in fact exposed to such tasks. To the extent that this occurred, it will have tended to obscure true associations with RD, although it would not explain an inverse relationship to risk. Furthermore, no information was available about exposure to manual handling during leisure-time activities (sports or hobbies), which might be confounders. Additionally, the study provides no information regarding exposure to heavy lifting and risk of RD among women, and gives no indication of possible differences in risk by ethnicity (incidence of RRD is reported to be lower in Asians and Blacks than in Caucasians[1]).

We were also unable to collect data on myopia, which, in the absence of previous eye surgery, may account for almost 55% of non-traumatic RD.[4] The prevalence of myopia increases with educational level and tends to be associated with higher socioeconomic status.[21 22] Moreover, the relationship between education and myopia appears to hold for myopia of all degrees, and not only for people with mild myopia.[23] Indeed, some studies indicate that the relationship is even stronger for severe myopia,[24 25] although, in a British cohort, the relationship between education and severe myopia was not confirmed,[26] and in the EPIC-Norfolk Eye Study, there were no major differences in refractive error between manual and non-manual workers.[27]

To reduce confounding by myopia, we included only manual workers in our primary comparison group. It should be noted that these might include occupations in which lifting was to

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Table 2 Follow-up on diagnosed rhegmatogenous retinal detachment among all men aged 20–59 years in Denmark, 1995–2010

Calendar-year	Number of participants 1 January	Number of exits due to			Number of entries* due to
		Emigration, death or 60th birthday	Eye injury	Retinal detachment	Immigration or 20th birthday
1995	1 498 949	41 429	6037	192	55 777
1996	1 507 068	42 911	6022	163	47 640
1997	1 505 612	42 811	6177	202	43 696
1998	1 500 118	43 738	5840	206	43 363
1999	1 493 697	43 610	5618	171	41 171
2000	1 485 469	38 291	5716	180	40 529
2001	1 481 811	39 173	5749	172	38 951
2002	1 475 668	42 100	5501	200	37 968
2003	1 465 835	43 395	5183	198	36 470
2004	1 453 529	46 108	5080	196	37 247
2005	1 439 392	47 361	5159	203	39 616
2006	1 426 285	48 724	4887	211	42 930
2007	1 415 393	46 583	5046	211	47 558
2008	1 411 111	42 990	4686	215	51 731
2009	1 414 951	39 911	4539	193	49 399
2010	1 419 707	37 273	4297	226	–

*People who immigrated or turned 20 years of age in calendar year 'n' were included in the follow-up from the 1 January calendar-year 'n+1'.

some extent present, biasing risk estimates towards the null. At the same time, the comparison between heavy lifters and non-manual workers might have been confounded negatively by differences in the prevalence of myopia.

Surgical repair of RD almost always prompts hospital attendance. However, our focus on diagnosed RRD, defined as RD with retinal break (ICD-10=H33.0), did not require cases to have been treated surgically, and the case series may therefore have included some minor RD. This could have caused bias if men of higher social class with minor RD were more likely than others to access an ophthalmology service and receive a diagnosis. Thus, differences in case definition (surgically treated cases RD or diagnosed RRD) may have contributed to the discrepant findings of some studies as compared with others. However, a sensitivity analysis based only on cases treated as inpatients produced results similar to those obtained with the broader case definition.

Table 3 Age-standardised rates (per 100 000 person-years) of diagnosed RRD by occupational category among men in Denmark, 1995–2010

Occupational category	Cases	Person-years at risk	Age-standardised rate (per 100 000)
Heavy lifters	155	1 705 194.61	9.2
Manual workers unlikely to be heavy lifters	163	1 590 893.87	10.1
Other manual workers	564	5 717 713.54	9.6
Non-manual workers unlikely to be heavy lifters	1502	7 587 002.98	18.0
Workers with other DISCO-codes	191	1 796 139.75	14.1
Economically active with missing DISCO-code	269	2 273 448.82	12.7
Not economically active	295	2 585 860.52	12.4

DISCO-88, Statistics Denmark's Standard Classification of Occupations; RRD, rhegmatogenous retinal detachment.

We included only cases of RRD and thereby types of RD associated with diabetes (eg, tractional RD) were excluded. We also excluded cases that might be related to eye injuries, as ascertained from the hospital register. Furthermore, the potential for confounding by cataract surgery should not be a major concern, since we studied only men aged less than 60 years.

Follow-up of the study sample was through prospectively compiled registers, and since the participants did not need to fill in a questionnaire, recall and non-response biases should not have been a problem. Furthermore, because informed consent is not required for register studies, the study was not limited to those willing to participate—avoiding so-called "volunteer bias". It was also free from sampling bias, since all the participants in the study population were included.

CONCLUSION

The results of this study do not support an association of occupational heavy lifting with diagnosed RRD, and, despite its methodological limitations, it seems unlikely that a major hazard would have been missed. This calls into question the positive findings from earlier studies, but further research using a more specific measure of exposure would be needed to rule out a relationship with confidence.

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Contributors DC, SC, SM and HH contributed to the conception and design of the study. HH participated in acquisition of data. SC drafted the manuscript together with SM. HH carried out the statistical analysis. DC oversaw the statistical analyses. DC and HH commented on the draft manuscript. All the authors participated in the interpretation and have read and approved the final manuscript.

Competing interests None declared.

Ethics approval The study complied with The Act on Processing of Personal Data (Act number 429 of 31 May 2000), 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, journal number: 2001-54-0180. According to Danish law, questionnaire and register based studies do not need approval by ethical and scientific committees, nor informed consent.

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