ORIGINAL ARTICLE

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

Stefania Curti,1 David Coggon,2 Harald Hannerz,3 Stefano Mattioli1

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 rule out the remaining uncertainties.

INTRODUCTION

Retinal detachment (RD) is a serious ophthalmic emergency that can lead to irreversable 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 2.3:1.1–3

The major known risk factors for RD are age, severe myopia, cataract surgery and ocular trauma.4–6 Apart from avoidance of acute ocular trauma, 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 al7 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,5 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 al11 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...
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, its employment classification module, and the hospital patient register. 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), 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).

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=H133.0) 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) 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 V9.3 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 1.11), 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
study by Austin et al.42 0 A
diagnosed RRD with af
treated RD. Rather, they accord with the results of an incidence
between heavy manual handling at work and risk of surgically
exposure to heavy lifting.12 19

Manual workers unlikely to be heavy lifters (occupations in which
frequent heavy lifting is unlikely to occur)

Other manual workers (not included in the previous 2 categories)

Non-manual workers unlikely to be heavy lifters (occupations in
which frequent heavy lifting is unlikely to occur)

DISCUSSION
This study suggests that, in Denmark, at least among men, occupu-
tional 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 asso-
ciation 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 quan-
titative 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 hand-
dling during leisure-time activities (sports or hobbies), which
might be confounders. Additionally, the study provides no infor-
mation 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 socio-
economic status.21 22 Moreover, the relationship between educa-
tion 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 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

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

<table>
<thead>
<tr>
<th>Occupational category</th>
<th>DISCO-88</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy lifters (occupations in which frequent heavy lifting is highly likely)</td>
<td>712. Building frame and related trades workers</td>
</tr>
<tr>
<td></td>
<td>921. Agricultural, forestry and fishery labourers</td>
</tr>
<tr>
<td></td>
<td>931. Construction labourers</td>
</tr>
<tr>
<td></td>
<td>933. Transport and storage labourers</td>
</tr>
<tr>
<td>Manual workers unlikely to be heavy lifters (occupations in which frequent heavy lifting is unlikely to occur)</td>
<td>731. Precision workers in metal and related materials</td>
</tr>
<tr>
<td></td>
<td>732. Handicraft workers in wood, textile, leather and related material</td>
</tr>
<tr>
<td></td>
<td>734. Printing and related trades workers</td>
</tr>
<tr>
<td></td>
<td>741. Food processing and related trades workers</td>
</tr>
<tr>
<td></td>
<td>742. Textile, garment and related trades workers</td>
</tr>
<tr>
<td></td>
<td>744. Pelt, leather and shoemaking trades workers</td>
</tr>
<tr>
<td></td>
<td>815. Chemical-processing plant operators</td>
</tr>
<tr>
<td></td>
<td>816. Power-production and related plant operators</td>
</tr>
<tr>
<td></td>
<td>817. Automated-assembly-line and industrial-robot operators</td>
</tr>
<tr>
<td></td>
<td>822. Chemical-products machine operators</td>
</tr>
<tr>
<td></td>
<td>825. Printing, binding and paper products machine operators</td>
</tr>
<tr>
<td></td>
<td>826. Textile, fur and leather products machine operators</td>
</tr>
<tr>
<td></td>
<td>827. Food and related products machine operators</td>
</tr>
<tr>
<td></td>
<td>828. Assemblers</td>
</tr>
<tr>
<td></td>
<td>829. Other machine operators and assemblers</td>
</tr>
<tr>
<td></td>
<td>831. Locomotive engine drivers and related workers</td>
</tr>
<tr>
<td></td>
<td>912. Shoe cleaning and other street services elementary occupations</td>
</tr>
<tr>
<td></td>
<td>913. Domestic and related helpers, cleaners and launderers</td>
</tr>
<tr>
<td></td>
<td>914. Building caretakers, window and related cleaners</td>
</tr>
<tr>
<td>Other manual workers (not included in the previous 2 categories)</td>
<td>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</td>
</tr>
</tbody>
</table>
| 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. |
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 the prevalence of myopia 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.

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.

**Acknowledgements**

The authors would like to thank Andreas Holtermann and Karen Søgaard, who helped them to identify occupations that are strongly associated with heavy lifting. They would also like to thank Elsa Bach for her guidance through the study.

**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.

**Provenance and peer review**

Not commissioned; externally peer reviewed.

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

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

*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’.

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

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

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

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