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Osteoarthritis of the Hip and Occupational Lifting

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To test the hypothesis that occupational lifting is a cause of hip osteoarthritis, the authors examined associations with lifting and other occupational activities in a case-control study. The study was performed in two English health districts (Portsmouth and North Staffordshire) from 1993 to 1995. A total of 611 patients (210 men and 401 women) listed for hip replacement because of osteoarthritis over an 18-month period were compared with an equal number of controls selected from the general population and individually matched for age, sex, and general practice. Information about suspected risk factors was obtained by a questionnaire administered at interview and a short physical examination. Analysis was by conditional logistic regression. After adjustment for potential confounders, the risk in men increased progressively with the duration and heaviness of occupational lifting. Relative to those with low exposure, men who had regularly lifted weights in excess of 50 kg for 10 years or longer had an odds ratio of 3.2 (95% confidence interval 1.6–6.5). No comparable association was found in women. Of the other occupational activities examined, only frequent climbing of stairs showed a pattern suggestive of a causal relation. These findings are consistent with the results of other studies, and there is now a strong case for regarding hip osteoarthritis as an occupational disease in men whose work has involved prolonged and frequent heavy lifting. *Am J Epidemiol* 1998;147: 523–8.

arthroplasty; hip joint; occupations; osteoarthritis; risk factors

Hip osteoarthritis is an important cause of pain and disability, especially in the elderly. Established risk factors include obesity, previous injury or hip deformity, and a generalized susceptibility to osteoarthritis in multiple joints (1, 2). In addition, several studies have found an increased frequency of the disease in farmers (3–7). This has been a remarkably consistent observation, with relative risks from 2 to more than 10. Suggested explanations include mechanical stress on the joint from heavy lifting or frequent walking over rough ground and exposure to vibration from driving agricultural machinery (8). To test the hypothesis that occupational lifting is a cause of hip osteoarthritis, we have examined associations with lifting and other occupational activities in a case-control study of surgically treated disease.

MATERIALS AND METHODS

The method of data collection is described in detail in a companion paper (2). The cases comprised residents of two English health districts (Portsmouth and North Staffordshire) who were placed on the waiting list for total hip replacement for osteoarthritis over an 18-month period and who did not have a history of lower limb fracture in the past year, rheumatoid arthritis, ankylosing spondylitis, or other documented causes of secondary osteoarthritis. Controls were selected from the general population and were individually matched to the cases for age, sex, and general practice. Controls who had undergone previous hip surgery for osteoarthritis were replaced, as were those who declined to participate in the study.

Cases and controls were interviewed with a structured questionnaire that asked about history of hip injury severe enough for them to consult a doctor and about all jobs that they had held for longer than a year since leaving school. For each job we inquired whether the work entailed lifting weights of at least 20 lb (10 kg), at least 56 lb (25 kg), and at least 112 lb (50 kg) for more than 10 times in an average working week. In addition, the interviewer measured the subject's height and weight and examined his or her hands for Heberden's nodes (as a marker of generalized osteoarthritis).

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Abbreviation: CI, confidence interval.

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In total, 726 cases and 1,060 controls were approached. The analysis presented focuses on 611 case-control pairs with complete information on the history of hip injury, height, weight, and Heberden's nodes. Associations between hip osteoarthritis and occupational activities were assessed by conditional logistic regression with adjustment for body mass index (classified to three levels), history of hip injury, and the presence of Heberden's nodes (classified as absent, possible, or definite). Activities were considered during two periods: up to age 30 years and up to 10 years before entry into the study (defined as the date when the case member of the matched pair was interviewed). More recent activities were ignored as, in some cases, these may have been modified as a consequence of early symptoms of arthritis.

A few subjects (16 cases and 19 controls) could not remember the ages at which they had changed some of their jobs. In this circumstance, we interpolated ages with equal spacing so that, for example, if the first job started at age 20 and the second job finished at age 30, the transition was assumed to have occurred at age 25. Uncertainty also arose when subjects could not decide whether or not a job had entailed a particular activity. In our main analysis we assumed that activities had occurred only when they were definitely reported. However, we also conducted a parallel analysis in which both definite and possible exposures were classed as having occurred.

RESULTS

Of the 611 cases, 210 were men and 401 were women. Their ages ranged from 45 to 91 years with a mean of 70 and a median of 71 years. All controls were matched to within 3.4 years of age, and the ages of 94 percent were matched to within 1 year. The jobs reported by the men accounted for most of their working lives, but among the women gaps were common (table 1). This was largely attributable to the demands of child care.

After adjustment for potential confounders, hip osteoarthritis was more common in men whose work had entailed regularly lifting weights of 10 kg or more for prolonged periods. In comparison with those who had never done such lifting, the odds ratio for at least 10 years' exposure before age 30 was 2.3 (95 percent confidence interval (CI) 1.2–4.2), while for 20 or more years' exposure up to 10 years before entry into the study the odds ratio was 1.8 (95 percent CI 1.0–3.4). No association with heavy lifting was apparent in women, however.

For heavier lifting, defined as weights of 25 kg or more, the corresponding risks in men were even higher (table 2). Moreover, there was a trend to increasing risk with increasing duration of exposure. Again, however, no association was found in women.

Table 3 lists the occupations in which male subjects reported lifting weights of 25 kg or more. The distribution of these occupations was broadly similar in cases and controls, and only a small part of the excess prevalence of lifting among the cases was attributable to work in agriculture.

To explore further the influence of severity of lifting, we examined risk according to the maximum weight that each subject reported lifting regularly for at least 10 years in total (table 4). Among men there was a clear exposure-response relation, such that those who had lifted the heaviest weights (≥50 kg) had an odds ratio of 3.2 (95 percent CI 1.6–6.5). As before, no relation was found with occupational lifting in women.

Table 5 shows associations between hip osteoarthritis and occupational activities other than lifting. There were indications of increased risk with frequent climbing of stairs in both men and women, and a trend was found in relation to the duration of such exposure when both sexes were analyzed together. Risk was

TABLE 1. Completeness of occupational histories, Portsmouth and North Staffordshire, England, health districts, 1993–1995

Proportion of working life* for which occupations were reported (%)	Men		Women		Both sexes	
	Cases (n = 210)	Controls (n = 210)	Cases (n = 401)	Controls (n = 401)	Cases (n = 611)	Controls (n = 611)
Up to age 30 years						
0–49	4	8	125	119	129	127
50–89	42	46	190	200	232	246
90–100	164	156	86	82	250	238
Up to 10 years before entry into study						
0–49	0	2	161	154	161	156
50–89	24	32	178	186	202	218
90–100	186	176	62	61	248	237

* The age range of working life was defined as 15–64 years for men and 15–59 years for women.

TABLE 2. Association of hip osteoarthritis with duration of heavy occupational lifting, Portsmouth and North Staffordshire, England, health districts, 1993–1995

Duration of lifting ≥25 kg (years)	Men			Women			Both sexes		
	Cases (no.)	Controls (no.)	Odds ratio*	Cases (no.)	Controls (no.)	Odds ratio*	Cases (no.)	Controls (no.)	Odds ratio*
Up to age 30 years									
0	97	120	1	349	352	1	446	472	1
0.1–4.9	17	25	0.6 (0.2–1.3)†	23	21	1.0 (0.5–2.0)	40	46	0.8 (0.5–1.3)
5.0–9.9	20	17	1.6 (0.7–3.7)	16	17	0.8 (0.4–1.7)	36	34	1.0 (0.6–1.7)
≥10.0	76	48	2.7 (1.4–5.1)	13	11	1.2 (0.5–2.6)	89	59	1.9 (1.2–3.0)
Up to 10 years before entry into study									
0	91	115	1	328	334	1	419	449	1
0.1–9.9	22	28	0.8 (0.4–1.7)	40	35	1.1 (0.6–1.7)	62	63	0.9 (0.6–1.4)
10.0–19.9	14	15	1.5 (0.6–3.8)	19	12	1.4 (0.7–2.9)	33	27	1.2 (0.7–2.2)
≥20.0	83	52	2.3 (1.3–4.4)	14	20	0.8 (0.4–1.5)	97	72	1.5 (1.0–2.3)

* All risk estimates are adjusted for body mass index, the presence of Heberden's nodes, and history of hip injury.
† Numbers in parentheses, 95% confidence interval.

TABLE 3. Occupations reported by men to involve lifting weights of 25 kg or more, Portsmouth and North Staffordshire, England, health districts, 1993–1995

Occupation	Cases (no.)	Controls (no.)
Agricultural workers	19	8
Miners and quarrymen	10	15
Ceramic formers	4	8
Other workers in ceramics	6	4
Furnace, forge, foundry, and rolling mill workers	5	3
Electrical and electronics workers	3	3
Metal machinists	4	5
Fitters	9	4
Other engineering workers	8	10
Woodworkers	10	5
Butchers, bakers, and food processors	3	3
Construction workers	23	16
General laborers	11	6
Truck drivers	14	12
Warehousemen and packers	11	8
Shop assistants and managers	8	9
Bread and milk roundsmen	4	5
Publicans and barmen	4	3
Military	23	18
Other	23	22

also elevated among women who reported jobs that involved walking for more than 2 miles (3.2 km) in total during an average working day, but it did not rise progressively with the time spent in such jobs. Otherwise the findings were unremarkable.

Repeat analyses in which occupational activities were counted as present even if subjects had been uncertain about them led to changes in lifting category for up to 47 subjects (approximately equal numbers of cases and controls were reclassified in each analysis). However, the pattern of the findings was unchanged. For example, men who had lifted weights of 50 kg or more for at least 10 years (excluding the 10 years before entry into the study) had an odds ratio of 2.9 (95 percent CI 1.4–5.8).

DISCUSSION

Our findings support the hypothesis that occupational lifting is a cause of hip osteoarthritis in men. Risk was elevated in those who regularly lifted weights of 10 kg or more while at work and increased progressively with the duration and heaviness of such lifting. No corresponding pattern was observed in women, however. Of the other occupational activities examined, only frequent climbing of stairs showed an association that suggested a causal role.

Interpretation of these observations must take into account several limitations of the study method. One concern is the possibility of selection bias. By focusing on patients going forward for surgical treatment, we ensured that our cases had clinically important disease. However, it is possible that people with jobs that are physically more demanding are unusually handicapped by a given level of symptoms and therefore more likely to present themselves for treatment. If so, associations with physical activities at work could be spuriously exaggerated. We cannot rule out such bias completely, but most of our subjects were beyond the normal age of retirement. Moreover, the specificity of the relation with lifting argues against a large effect. Thus, no comparable increase in risk was found in men who had to walk more than 2 miles per day in their work, although this is an activity that would normally be made more difficult by osteoarthritis in the hip.

Bias could also have arisen from the incomplete

TABLE 4. Association of hip osteoarthritis with prolonged occupational lifting, Portsmouth and North Staffordshire, England, health districts, 1993–1995

Maximum level of lifting for at least 10 years (kg)	Men			Women			Both sexes		
	Cases (no.)	Controls (no.)	Odds ratio*	Cases (no.)	Controls (no.)	Odds ratio*	Cases (no.)	Controls (no.)	Odds ratio*
Up to age 30 years									
<10	104	135	1	364	368	1	468	503	1
10–24	30	27	1.7 (0.9–3.4)†	24	22	1.0 (0.6–1.8)	54	49	1.2 (0.8–1.9)
25–49	41	24	3.0 (1.5–6.3)	6	7	0.8 (0.3–2.5)	47	31	1.9 (1.1–3.4)
≥50	35	24	2.9 (1.3–6.4)	7	4	1.7 (0.5–6.1)	42	28	2.1 (1.1–3.9)
Up to 10 years before entry into study									
<10	85	112	1	308	305	1	393	417	1
10–24	28	31	1.4 (0.7–3.0)	60	64	0.9 (0.6–1.3)	88	95	1.0 (0.7–1.4)
25–49	37	31	1.9 (0.9–3.9)	20	21	0.9 (0.5–1.7)	57	52	1.1 (0.7–1.8)
≥50	60	36	3.2 (1.6–6.5)	13	11	1.1 (0.5–2.5)	73	47	1.8 (1.1–2.9)

* All risk estimates are adjusted for body mass index, the presence of Heberden's nodes, and history of hip injury.
† Numbers in parentheses, 95% confidence interval.

response to the study. Of all the subjects whom we invited to participate, only 84 percent of cases and 58 percent of controls were included in the analysis. In some cases the losses occurred because individual items of data were missing for one or both of a matched pair (e.g., some subjects could not be weighed), but most exclusions were because of refusal to take part. This might lead to bias if, for example, it meant that blue collar occupations were relatively underrepresented in the control group. In this situation,

TABLE 5. Associations between hip osteoarthritis and occupational activities other than lifting, Portsmouth and North Staffordshire, England, health districts, 1993–1995

Activity*	Duration of exposure up to 10 years before entry into study (years)	Men			Women			Both sexes		
		Cases (no.)	Controls (no.)	Odds ratio	Cases (no.)	Controls (no.)	Odds ratio	Cases (no.)	Controls (no.)	Odds ratio
Sitting for more than 2 hours in total	0	52	56	1	109	103	1	161	159	1
	0.1–9.9	44	30	1.8 (0.9–3.7)†	120	129	0.9 (0.6–1.3)	164	159	1.0 (0.7–1.4)
	10.0–19.9	28	22	1.7 (0.7–3.9)	92	76	1.2 (0.8–1.8)	120	98	1.2 (0.9–1.8)
	≥20.0	86	102	1.0 (0.6–1.7)	80	93	0.9 (0.6–1.3)	166	195	0.9 (0.6–1.2)
Standing for more than 2 hours in total	0	5	4	1	38	43	1	43	47	1
	0.1–9.9	5	12	0.2 (0.0–1.4)	82	83	1.1 (0.6–2.0)	87	95	1.0 (0.6–1.7)
	10.0–19.9	11	11	0.4 (0.1–2.4)	107	113	1.1 (0.6–1.9)	118	124	1.0 (0.6–1.7)
	≥20.0	189	183	0.5 (0.1–2.3)	174	162	1.3 (0.7–2.1)	363	345	1.2 (0.7–1.9)
Kneeling for more than 1 hour in total	0	103	109	1	301	297	1	404	406	1
	0.1–9.9	30	42	0.8 (0.4–1.4)	68	69	0.9 (0.6–1.4)	98	111	0.9 (0.6–1.2)
	10.0–19.9	22	11	2.0 (0.8–4.7)	20	26	0.7 (0.4–1.3)	42	37	1.0 (0.6–1.7)
	≥20.0	55	48	1.0 (0.6–1.7)	12	9	1.2 (0.5–3.0)	67	57	1.1 (0.7–1.7)
Squatting for more than 1 hour in total	0	126	127	1	344	348	1	470	475	1
	0.1–9.9	32	35	0.9 (0.5–1.6)	33	30	1.1 (0.6–1.9)	65	65	1.0 (0.7–1.5)
	10.0–19.9	14	9	1.4 (0.5–3.6)	16	11	1.5 (0.6–3.4)	30	20	1.5 (0.8–2.7)
	≥20.0	38	39	0.9 (0.5–1.6)	8	12	0.7 (0.3–1.8)	46	51	0.9 (0.6–1.4)
Driving for more than 4 hours in total	0	147	151	1	387	396	1	534	547	1
	0.1–9.9	28	19	1.3 (0.7–2.6)	11	4	4.0 (1.2–13.7)	39	23	1.8 (1.0–3.1)
	10.0–19.9	10	16	0.5 (0.2–1.3)	3	1	2.7 (0.3–26.5)	13	17	0.7 (0.3–1.5)
	≥20.0	25	24	0.9 (0.4–1.8)	0	0		25	24	1.0 (0.5–1.9)
Walking for more than 2 miles (3.2 km) in total	0	24	25	1	116	142	1	140	167	1
	0.1–9.9	24	33	0.8 (0.4–1.9)	111	95	1.5 (1.0–2.3)	135	128	1.3 (0.9–1.9)
	10.0–19.9	24	23	1.1 (0.4–2.5)	84	71	1.5 (1.0–2.3)	108	94	1.4 (0.9–2.0)
	≥20.0	138	129	1.2 (0.6–2.5)	90	93	1.3 (0.8–2.0)	228	222	1.3 (0.9–1.8)
Climbing more than 30 flights of stairs	0	120	132	1	337	354	1	457	486	1
	0.1–9.9	29	29	1.3 (0.7–2.5)	44	35	1.4 (0.8–2.2)	73	64	1.3 (0.9–1.9)
	10.0–19.9	23	17	2.3 (1.1–4.9)	9	6	1.3 (0.4–4.0)	32	23	1.7 (1.0–3.1)
	≥20.0	38	32	1.8 (0.9–3.4)	11	6	2.3 (0.8–6.3)	49	38	1.7 (1.0–2.8)

* Each activity was defined in relation to an average working day and examined in a separate regression model with adjustment for body mass index, the presence of Heberden's nodes, and history of hip injury.
† Numbers in parentheses, 95% confidence interval.

however, associations would also be expected with other activities such as standing and kneeling.

Another inevitable source of error was the method of exposure assessment. We have shown previously that, when questioned about their current jobs, people accurately report whether they lift weights of 10 kg or more, but they are less reliable in their reporting of heavier loads (9). Recalled information about earlier jobs is unlikely to be better and could well be worse. Provided they were not differential with respect to disease, the effect of errors in exposure assessment would be to obscure associations with arthritis. However, a spurious association could occur if patients with hip osteoarthritis recalled their past exposure to lifting more completely than did controls. In designing our questionnaire, we therefore included a range of occupational activities so that our particular interest in lifting would not be obvious. The absence of associations with these other activities again argues against important bias. Furthermore, the jobs in which cases and controls reported heavy lifting were generally those in which it would be expected to occur (table 4).

A role of lifting in the causation of hip osteoarthritis is plausible. Mechanical stress has been linked with the development of osteoarthritis in other joints, such as the knee (4, 10–12) and in the fingers (13). Moreover, patients with unilateral weakness of a lower limb following poliomyelitis are more likely to develop hip osteoarthritis on the unaffected side where the joint is subject to greater mechanical loading (14). Also, increased rates of osteoarthritis have been reported in sportsmen who place unusual stresses on their hip joints (15–18), although the finding has not been universal (19, 20).

Three case-control studies have previously addressed the relation of hip osteoarthritis to occupational activities that stress the joint, and all have found associations. In Sweden, men undergoing hip replacement for osteoarthritis were more heavily exposed than controls to activities that involved dynamic or static work loads, and risk was particularly high in subjects with high exposure to heavy lifting between the ages of 30 and 49 years (21). A British investigation, in which cases were identified from intravenous urograms, found increased risk with prolonged employment in jobs that entailed standing for more than 2 hours per day and lifting or moving weights greater than 56 lb by hand (5). Finally, a study in Chicago found an odds ratio of 2.4 for men who had performed heavy work (including lifting and walking) for at least 15 years in comparison with those whose work was light (22). The consistency of our results with these earlier findings and the plausibility of damage from mechanical loading of the hip together make a strong case for regarding hip osteoarthritis as an occupational disease in men whose work has entailed frequent heavy lifting over long periods.

When analyzing associations with lifting, we looked at exposures up to age 30 years as well as up to 10 years before entry to the study. This was to explore the possibility that stresses on the hip during early adult life, before the joint is fully developed, might be particularly damaging. In fact, we were able to discern little difference in the patterns of risk according to the period of exposure, but this may have been because many of those who carried out heavy lifting as young adults continued to do so throughout their working lives.

The absence of any association with occupational lifting in women may reflect a greater impact of confounding by nonoccupational activities. Only 15 percent of the women studied had been in paid employment for 90 percent or more of their working lives as compared with 86 percent of the men, and many of the women not in employment will have been exposed to frequent lifting in the course of housework and child care, which we did not assess. Alternatively, there could be a real difference between men and women in susceptibility to the effects of lifting. Most previous studies have been restricted to men but, where women have been included, the occupational associations with hip osteoarthritis have generally been weaker than in men (4, 7).

The association that we have found between occupational lifting and hip osteoarthritis could explain much if not all of the excess incidence in farmers. Almost all agricultural workers are required to lift at work, and in the past it was not unusual for farmers in Britain to handle weights as heavy as 125 kg (6). The risk from lifting could not be explained by a confounding effect of other exposures specific to agriculture, since only 19 of the 119 male cases who reported heavy lifting had worked as farmers.

Of the other occupational activities analyzed, only frequent climbing of stairs showed a pattern suggestive of a causal relation with hip osteoarthritis. This association has not been reported before and may have occurred by chance. However, an impact of stair climbing on the disease is plausible, and the possibility warrants further study in future investigations. Meanwhile, our results should give further impetus to the steps that are already being taken to reduce heavy manual handling in the workplace.

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