EXTENDED REPORTS

Osteoarthrosis of the hip in women and its relation to physical load at work and in the home

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Abstract

***Objectives*—The aim of this case referent study was to investigate the relation between physical workload and osteoarthrosis of the hip in women.**

***Methods*—The study base comprised all women of ages 50-70 years, living in five counties and four towns in Sweden 1991-1994. Cases (n=230), who had undergone total hip replacement for primary osteoarthrosis of the hip were identified by means of the Swedish National Register of Total Hip Replacements, and the referents (n=273) were women without hip problems randomly selected from the study base. All women were interviewed about state of health, smoking habits, occupational history, work in the home, sports activities, etc. Each subject's history of occupational work and work in the home up to the age of 50 was divided into periods within each of which the work tasks were similar, and a questionnaire for each such period was filled in by the participants. On the basis of information given by the referents, the women were classified as having had low, medium, and high exposure to different factors. Relative risks (RRs) and 95% confidence intervals (CI) were calculated.**

***Results*—Physically demanding tasks at work and in the home were associated with increased RRs of osteoarthrosis of the hip in those with high exposure compared with the low exposure group. A RR in the range of 2 or higher was found for those who frequently jumped or moved between different levels (RR=2.1, CI 1.9, 4.2), who frequently climbed stairs (RR=2.1, CI 1.2, 3.6), and who had physically demanding tasks outside occupational life (RR=2.3, CI 1.5, 3.6). The highest RR (RR=4.3, CI 1.7, 11.0) was found for those exposed to high physical loads both at work and during sports activities.**

***Conclusion*—High physical loads at work and in the home up to the age of 50 seem to be risk factors for development of severe osteoarthrosis of the hip in women.**

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Osteoarthrosis of the hip is a common degenerative joint disorder among both men and women, and increases in frequency with age. The clinical signs are pain and a decreased range of motion. The arthrotic hip shows a typical roentgenological picture. Total hip replacements are common among persons with osteoarthrosis of the hip and in Sweden about 10 000 such operations are performed annually.

Possible aetiological factors for osteoarthrosis of the hip are a history of trauma and congenital and developmental changes, hereditary factors, and overweight. Certain race differences may also play a part. Patients with an unknown aetiology are classified as having idiopathic or primary osteoarthrosis of the hip.

Experimental studies in monkeys, rabbits, dogs, and sheep have shown that compressive forces on a joint, especially in an extreme position, with or without a simultaneous oscillating load cause arthrotic changes in the cartilage and bone.[1–6]

Sports activities of different kinds have been found in many studies to be associated with early development of osteoarthrosis of the hip in men.[7–11] Soccer and track and field athletics, in particular, seem to be harmful to the hip joints. In other studies no relation between osteoarthrosis of the hip and sports activities has been observed.[12–15] Those studies, however, mostly comprised athletes who were still active.

Studies on work load factors have mainly been performed in men. Many of the studies have been cross sectional and carried out among occupational groups without individual exposure assessments.[16–18] Farmers have been found to have more osteoarthrosis of the hip than reference groups in studies in Sweden,[19–21] Finland,[22] and England.[23–24] In the Swedish study by Axmacher and Lindberg[19] 15 000 farmers, farmers' wives, and farm workers were asked about past roentgenological examinations of the colon or urinary tract. In total 565 men and 151 women had had such examinations and their hip joints were examined on the roentgenograms by the same investigator and using the same criteria as in a population study in Malmö, Sweden in 1984.[25] The prevalence of osteoarthrosis of the hip in male farmers, 40-60 years old was more than 10 times higher than in the male population of

Malmö of the same age. Only two cases of osteoarthrosis of the hip were found among the 151 farmers' wives, which meant the same prevalence as in the female control population.

Retired professional male and female ballet dancers from five Scandinavian dance companies have high prevalences of osteoarthrosis of the hip.[26] In dancers there is considerable loading of the joints, but they also have increased joint laxity, both factors that may contribute to the development of osteoarthrosis.

In a register based cohort study in Sweden, blue collar workers who had reported the same occupation in the census of 1970 as in the census of 1960 were studied.[21] Male farmers, construction workers, food processing workers (grain mill workers, butchers, and meat preparers), and fire fighters were found to have excess risks of developing osteoarthrosis of the hip resulting in hospital care in 1981-1983 compared with other blue collar workers. The number of women with the same job title in 1960 and 1970 was small. However, female mail carriers ran an excess risk of hospitalisation because of osteoarthrosis of the hip.

In a previous case control study, with a design similar to this study, our group investigated the influence of physical workload on the risk of developing osteoarthrosis of the hip in men. Both dynamic exposures, such as lifting and carrying burdens, and static exposures, for example, sitting in a fixed position, seemed to be risk factors, with relative risk (RR) estimates of around 2-3.[27]

The aim of this study was to investigate the relation between physical workload and osteoarthrosis of the hip in women.

The study base comprised all women of ages 50 to 70 years, living in five counties in western Sweden (counties of Halland, Göteborg- and Bohus, Älvsborg, Skaraborg, and Värmland,) and in the referral areas of five hospitals (Gävle, Linköping, Norrköping, Malmö, and Huddinge) during the period 1991 to 1994. Women with any other form of arthritis and with a history of severe trauma to the leg were excluded from the study base. The relation between physical workload and hip arthrosis in the study base was investigated by means of case referent methods.

Sweden has a National Registry of total hip replacements (THR). All orthopaedic departments report to the Registry. The database in the Registry is validated in several different ways and annually aggregated data are fed back to the reporting departments.[28] From the general database several subsets of patients can be defined. One of them, used in this study, comprises women with primary osteoarthrosis of the hip from certain well defined geographical regions in Sweden. Preoperatively all patients were examined clinically and radiographically according to a well defined protocol and only patients with primary osteoarthrosis of the hip were included. The diagnosis was based on radiographic and clinical examinations according to a well defined protocol.[29]

At least one referent for each case was randomly selected from the study base by means of local population registers, with matching for age (same year of birth) at the time of the survey, and for county or for hospital referral area. Referents with known hip disorders were excluded.

Methods

All the women were contacted by letter and telephone and were interviewed by the same experienced nurse concerning their state of health, medication (including hormones), smoking habits, education, number of children, occupational history, work in the home, and sports activities up to the age of 50. On the basis of the information given at the interview each subject's history of occupational work and work in the home up to the age of 50 was divided into periods within each of which the work tasks were similar. A questionnaire regarding the physical load during each period was then filled in by the participants (see appendix). The mean time between operation and interview was 4.5 years (range 0-13) and the mean interview age was 63 years (range 50-75).

The study initially comprised 255 cases and 334 referents. Three cases and 14 controls refused to participate, six cases and eight controls could not be reached by telephone, and four cases and 14 controls were too ill to answer. The remaining 242 cases (95%) and 298 controls (89%) agreed to participate. Twelve of the cases and 25 of the controls did not return their questionnaires. The group investigated therefore consisted of 230 women (90% participation rate) with THR and 273 women (82% participation rate) without hip problems.

For periods with similar activity at the workplace or at home, questions were asked about how many hours each day on average the women had spent either in a sitting, standing or twisted position, if there had been any lifting and if so the weight of the lifted items, how many times on average there had been jumps or movements between different levels, and how many stairs were climbed every day, and also if there had been any physically non-occupationally demanding tasks (for example, taking care of a handicapped child or an elderly disabled relative). For periods with work at home only, assessments of the same exposures were made.

Exposure information was collected from the age of 16 to the age of 50. Each exposure was aggregated throughout life. The aggregation was also performed in 10 year intervals with the aim of finding out whether exposure during any particular period was more hazardous than during another. For each exposure three subclasses were defined on the basis of the distribution of the exposure in the referent group (1) the 25% with the lowest exposure ('low exposure group'), (2) the 25% with the highest exposure ('high exposure group'), and (3) the 50% in between ('medium exposure group'). Table 1 shows the limits between low

Table 1 Aggregated data on self reported exposures in the referent group to the age of 50 for different exposures in the three exposure classes

Exposure	*Low*	*Medium*	*High*
Sitting (h)	0–13563	13564–35816	35817–65384
Standing (h)	0–22792	22793–51546	51547–67760
Heavy lifts (n)	0–20328	20329–44088	44089–95040
Work in twisted positions (h)	0–3388	3389–28633	28634–63162
Jumps or movements between different levels (n)	0–264	365–9240	9241–55924
Flights of stairs climbed (n)	0–64680	64681–564960	564961–3353400
Years with non-occupational physically demanding tasks	0	1–9	10–45

and medium exposure and between medium and high exposure.

For cases and referents information was also collected on sports activities (total number of hours in all sports activities), body mass index (BMI) during life, number of children, whether the women were smokers or non- smokers, and current or previous hormone therapy.

STATISTICAL ANALYSIS

The relation between physical work load and osteoarthrosis of the hip was estimated by calculating the odds ratio for the high exposure and medium exposure groups respectively, compared with the low exposure groups. The odds ratio was interpreted as an estimate of the incidence rate ratio because the design was that of a population based case referent study.[30] The influence of potential confounding factors on the rate ratios was considered by means of stratified analysis. Adjusted estimates of RR were calculated according to Mantel-Haenszel,[31] together with 95% confidence intervals according to the method proposed by Greenland and Robins.[32] Initially the analysis was done conditionally on the matching—that is, age (same year of birth) and county or hospital referral area. In the final unconditional analysis consideration was paid to confounding by age (five year classes), BMI (high, medium or low at the age of 40), sports activities (high, medium or low up to the age of 50), number of children and hormone therapy (medication with contraceptive pills more or less than one year before the age of 50).

Results

Twenty six per cent of the women had left sided, 35% right sided, and 39% bilateral hip arthrosis. The mean (SD) interval between the first symptom and diagnosis was 4.5 (7.1) years, the mean (SD) interval between the first visit to a doctor and diagnosis 2.0 (4.5) years, and the mean (SD) interval between diagnosis and operation 5.8 (5.1) years.

Table 2 gives the RRs of developing osteoarthrosis of the hip leading to THR associated with different exposures aggregated over the period from the age of 16 to the age of 50. With the exception of hours of sitting, each of the exposures seemed to be associated with osteoarthrosis of the hip, with higher RRs in the high exposure group than in the group with medium exposure. A RR in the range of 2 and more was seen for those who frequently jumped (RR=2.1, CI 1.9, 4.2), who frequently climbed stairs (RR=2.1, CI 1.2, 3.6), and who had physically demanding job tasks outside occupational life (RR=2.3, CI 1.5, 3.6). Analysis of exposures restricted to different 10 year intervals (time windows) did not substantially change the results.

Table 3 shows the RR of developing osteoarthrosis associated with different combinations of work and sports activities. A highly consistent pattern emerged indicating a dose response relation. Across each level of one activity the RR increased with the level of the other. The highest RR (RR=4.3, CI 1.7, 11.0) was found for those exposed to high physical loads both during work and sports activities.

Discussion

According to the results of this study there seems to be an association between physical workload and osteoarthrosis of the hip among women. When sports activities are also considered, the findings indicate a dose response relation between physical load and osteoarthrosis of the hip.

CASE ASCERTAINMENT

The study base comprised a geographically defined population mainly within the western parts of Sweden. These areas were selected for the reason that a well defined subregister comprising women with primary osteoarthrosis of the hip was available there and that both urban and rural areas and a wide range of industry were included. There are many hospitals in the area and the opportunity for surgery was good during the study period. Cases of total hip replacements performed for primary osteoarthrosis of the hip were identified through the National Register of THR, which is managed by one of the authors (HM). The rate of reporting to the register is good, according to continuous validation studies.[28] Despite this some cases might not have been reported to the

Table 2 Relative risks (RR) and 95% confidence intervals (CI) for developing osteoarthrosis in women exposed to high and to medium physical loads of various kinds, compared with those with low exposure

	Medium exposure			*High exposure*		
*Exposure**	*RR†*	*95% CI*	*Exposed cases*	*RR†*	*95% CI*	*Exposed cases*
Sitting (h)	0.8	0.5, 1.2	106	0.8	0.4, 1.3	59
Standing (h)	1.4	0.8, 2.2	123	1.6	0.9, 2.8	59
Heavy lifts (n)	1.1	0.7, 1.7	101	1.5	0.9, 2.5	82
Twisted position (h)	1.1	0.7, 1.8	110	1.6	0.9, 2.6	72
Jumps (n)	1.0	0.5, 2.0	15	2.1	1.1, 4.2	24
Stairs climbed (n)	1.3	0.8, 2.0	106	2.1	1.2, 3.6	80
Non-occupational physically demanding tasks (y)	1.6	0.8, 2.9	24	2.3	1.5, 3.6	81

*Exposures aggregated from the age of 16 to the age of 50. †RR adjusted for age, body mass index, smoking, sports activities, number of children, and hormone therapy.

Table 3 Relative risks (RR) and 95% confidence intervals for developing osteoarthrosis of the hip in women with different degrees of exposure to physical load during work and sports activities*

	Physical load at work			
Exposure	*Degree of exposure*	*Low*	*Medium*	*High*
Sports activities†	Low	1.0	1.1 (0.5, 2.0)	1.7 (0.8, 3.5)
	Medium	1.1 (0.3, 3.4)	1.8 (0.8, 4.1)	2.7 (1.1, 7.0)
	High	2.0 (0.7, 5.2)	2.7 (1.2, 5.9)	4.3 (1.7, 11.0)

*RR adjusted for age and body mass index. †Sports activities aggregated as hours in all sports up to the age of 50.

Table 4 Calculated 'aetiological fraction (AF)' for certain exposures in the high exposure case group and in the whole case group

Type of exposure	*Degree of exposure*	*Number of cases*	*RR*	*AF in high exposure cases (%)*	*AF in all cases (%)*
Jumps	Low	190	1.0		
	High	24	2.1	51	5
Number of stairs	Low	44	1.0		
	High	80	2.1	52	18
Heavy lifting	Low	47	1.0		
	High	82	1.5	28	10
Physically demanding tasks	Low	125	1.0		
	High	81	2.3	56	20

register. However, it is not likely that such missed cases were related to exposure status. As regards diagnosis, all patients had undergone a special investigation and on this basis had been classified as having primary osteoarthrosis. Potential misclassification of the diagnosis is probably non-differential with regard to exposure status. Furthermore it is unlikely that women were selected for or excluded from operation on the basis of their exposures at work and at home to the age of 50. 'Heavy jobs' in the traditional sense are not common among women in Sweden and many of the exposures, such as non-occupational physically demanding tasks, were reported from early life. In summary, it is unlikely that unidentified or misdiagnosed cases would be related to the exposure status up to the age of 50 for the women. This implies that any misclassification of the disease that might have occurred would be of a non-differential kind, thus bringing the estimates of RR towards the null value.

SELECTION BIAS

The participation rate was high both among cases and controls. As expected, the number was higher in the group of women with total hip replacement. However, 89% among the controls were interviewed and 82% participated in the whole investigation. The information obtained by interview regarding occupation, family status, and general state of health among those 8% who did not return their questionnaires did not differ substantially from that among the questionnaire respondents.

A small number did not wish to participate, could not be reached by telephone, or were too ill to answer (5% among the cases and 11% among the controls). The exposures among these refusals could of course have differed from those among the participants in either directions and thus could have influenced the RR estimates in different ways. As the number of non-responders was relatively small, the impact on the results is considered limited.

MISCLASSIFICATION OF EXPOSURE

In epidemiological research continuous longitudinal data on exposure are important but very difficult to obtain, especially regarding a disorder such as osteoarthrosis of the hip, with a probably long onset period. For these cases exposure assessments and changes in exposure many years ago can be of interest both in respect to causation and in the understanding of modifying effects on the disorder under study as well as on the severity of the disorder and its consequences.[33]

In most epidemiological studies we therefore have to rely on retrospective exposure assessments based on questionnaires or interviews. The validity and reliability of the data collected depend on the accuracy of the study design, the quality of the questionnaires, and the questions asked. The instrument can never be perfect and a certain degree of misclassification is impossible to avoid.

To remember every exposure in life and far back in time is difficult. In the assessments of physical load in this study we used exposure estimates up to the age of 50. From other reports we know that exposures close to the investigation period are better recalled than those distant in time. The information given by the women regarding hours spent in different positions, numbers of stairs climbed, kilograms lifted, and so on was divided into three exposure classes—low, medium, and high. The non-differential misclassification because of memory deficiencies that most certainly have occurred in the study would lead to a dilution of the RRs in the high exposure group. In the group with medium exposure the bias in the RR estimates could have gone both ways. However, the risks in the medium exposure group were almost invariably lower than in the high exposure group, indicating a dose response relation. If there had been a substantial misclassification, the dose response trend would not have been so clear.

Most investigators are concerned about differential misclassification of exposure. Such bias can occur if the cases and the referents recall their exposure differently. The question as to whether a differential misclassification has occurred is complicated and in most cases impossible to answer. In a few studies retrospective information on exposure has been compared with original information, but whether this original information is true and valid is not clear.

In a Swedish study on cigarette smoking 10 356 persons who, in a postal questionnaire in 1963, reported that they smoked were asked identical questions again in 1969 about their smoking habits currently and in 1963.[34] In relation to the original information on smoking, the retrospective information showed a strong tendency to overestimate previous cigarette consumption among subjects who had increased their cigarette smoking and to underestimate the previous consumption among those who had decreased it. Subjects with unchanged habits showed a high level of agreement between original and retrospective information. The cohort in that study was also followed up to 1979 concerning the occurrence of ischaemic heart disease and lung cancer. RRs of death associated with smoking as assessed from original and retrospective information were then calculated. The RRs did not differ substantially when these different sources of exposure data were used. There is a risk in the use of retrospective data, however, if the information on the disease outcome is obtained long after the onset of the disease. The cases may then have changed their habits to a higher degree than the non-cases, leading to the introduction of a differential misclassification. If a similar pattern is true for recalling physical load, those with osteoarthrosis of the hip would probably have decreased their physical load, causing an underestimation of the RRs.

Other studies in which exposure information has been compared with retrospective information have considered dietary habits in relation to bowel cancer.[35 36] In these investigations the same pattern as for smoking can be seen. People who have changed their habits in the period between the data collections tend to over or underestimate their previous exposure depending upon the direction in which their habits have changed.

As far as we know no studies on possible recall bias in epidemiological investigations of risk factors for musculoskeletal disorders have been carried out.

CONFOUNDING FACTORS

Age, body mass index at different ages, number of children, smoking, hormone therapy, and sports activities were considered to be possible confounding factors and taken into account in the analysis. To our knowledge there are no other known potential confounding factors.

In conclusion, as previously demonstrated in men, mechanical loads during occupational activity seem to be a risk factor for developing hip arthrosis in the women also. The risk estimates are somewhat lower in women, but the trends are similar. The observed differences in RR estimates between men and women may represent a true difference as women in general are less exposed to physical load. Another explanation may be that the exposure contrasts were smaller in women and that very few women were unexposed. Among men in a similar study[27] the number of unexposed was much larger. A third possible explanation is that women may be less able to estimate different physical exposures than men, leading to greater non-differential misclassification of exposures and thus diluted RR.

Provided the association between physical load and osteoarthrosis of the hip in women seen in this study is causal, the aetiological fractions for different exposures can be calculated.[37] The aetiological or attributable fraction for a certain exposure is the proportion of cases that could be prevented if the exposed subjects were not exposed. The aetiological fraction may be regarded as a measure of the maximal preventive potential. The calculated aetiological fractions presented in table 4 are just over 50% for women with THR with high exposure to jumps, stair climbing, and non-occupational physically demanding tasks. Thus the preventive potential concerning physical work load seems considerable.

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Appendix

Some examples of questions in the self administered questionnaire about physical load at work and in the home.

1 How many hours did you work outside the home during this period, including overtime?

Between 10-19 hours/week
Between 20-29 hours/week
Between 30-39 hours/week
Between 40-49 hours/ week

2 What proportion of the working day were you sitting down?

Less than one hour/day
One hour/day or more but less than two hours/day
Two hours/day or more but less than four hours/day
Four hours/day or more but less than six hours/day
Six hours/day or more but less than eight hours/day
Eight hours/day or more

3 What proportion of the working day were you standing?

Less than one hour/day
One hour/day or more but less than two hours/day
Two hours/day or more but less than four hours/day
Four hours/day or more but less than six hours/day
Six hours/day or more but less than eight hours/day
Eight hours/day or more

4 Did you do any lifting at this occupation?

Yes
No

If yes, how many days during an average week did you do any lifting? ....days/week

How many times each day did you lift items weighing

1-5 kilograms..................times/day
6-10 kilograms..................times/day
11-15 kilograms..................times/day
16-20 kilograms..................times/day
more than 20 kilograms............times/day

5 Did you do any jumping or movements between different levels during this work? (For example getting in or out of a lorry or truck)

Yes
No

If yes, how many days during an average week did you do this?

1-5 times/day

6-15 times/day

16-25 times/day

more than 25 times/day

6 Did you have any physically demanding tasks outside paid work during this period?

Taking care of a handicapped child? Yes No

Taking care of an elderly relative Yes No

Others Yes No. If yes what......?

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