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Factors Associated with Osteoarthritis of the Hip and Knee in Hong Kong Chinese: Obesity, Joint Injury, and Occupational Activities

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In 1998, a case-control study was conducted in Hong Kong on hospital patients with osteoarthritis of the hip ($n = 138$) and osteoarthritis of the knee ($n = 658$). Age- and sex-matched controls were recruited consecutively from general practice clinics in the same region. The following three risk factors were found to be associated with osteoarthritis of both the hip and the knee: first, a history of joint injury: for osteoarthritis of the hip, the odds ratio = 25.1 (95% confidence interval (CI): 3.5, 181) in men and 43.3 (95% CI: 11.7, 161) in women; for osteoarthritis of the knee, the odds ratio = 12.1 (95% CI: 3.4, 42.5) in men and 7.6 (95% CI: 3.8, 15.2) in women; second, climbing stairs frequently: for osteoarthritis of the hip, the odds ratio = 12.5 (95% CI: 1.5, 104.3) in men and 2.3 (95% CI: 0.6, 8.1) in women; for osteoarthritis of the knee, the odds ratio = 2.5 (95% CI: 1.0, 6.4) in men and 5.1 (95% CI: 2.5, 10.2) in women; third, lifting heavy weight frequently: for osteoarthritis of the hip, the odds ratio = 3.1 (95% CI: 0.7, 14.3) in men and 2.4 (95% CI: 1.1, 5.3) in women; for osteoarthritis of the knee, the odds ratio = 5.4 (95% CI: 2.4, 12.4) in men and 2.0 (95% CI: 1.2, 3.1) in women. In addition, subjects whose height and weight were in the highest quartile were at increased risk of osteoarthritis of the hip and knee, respectively ($p < 0.05$). *Am J Epidemiol* 2000;152:855–62.

hip; knee; obesity; occupation; osteoarthritis; risk factors; weight-bearing

The epidemiology of osteoarthritis of the hip and knee differs considerably between Caucasian and Chinese populations. Hoaglund et al. (1) observed the prevalence of osteoarthritis of the hip to be 1 percent or lower in Chinese and the prevalence of osteoarthritis of the knee to be 13 percent in Chinese women and 5 percent in Chinese men. Such findings were confirmed in a recent study, which showed the rate of hip replacement in American Chinese to be 10 percent of the rates in American Caucasians (2).

The racial difference in the prevalence of osteoarthritis may be attributable to both genetic and lifestyle factors. We have demonstrated that hip dysplasia was not infrequent in Hong Kong Chinese (3). This observation suggested that the low prevalence of osteoarthritis of the hip could not be explained solely by genetic differences. Constitutional and lifestyle factors may also be important in the etiology of osteoarthritis.

Many studies have been conducted on the risk factors for osteoarthritis of the hip and osteoarthritis of the knee in Caucasians. Nevertheless, none of these studies have focused on the risk factors for both of these conditions in the same populations. Joint injury, repetitive use, and load bearing at work have been found to be associated with osteoarthritis of the hip (4–8). However, obesity was found to be associated with osteoarthritis of the knee (9–12) but not of the hip (4, 12–17). The factors associated with osteoarthritis of the knee were joint injury (18–22) and kneeling and squatting at work (23–26). Smoking seemed to be protective against osteoarthritis of the knee (27–29).

We report here the first epidemiologic study on the risk factors for osteoarthritis of the hip and the knee in Chinese. The roles of the following risk factors for osteoarthritis were studied: body height, body weight, joint injury, occupational activities, sports activities, and cigarette smoking.

MATERIALS AND METHODS

The study was conducted in Hong Kong, a highly urbanized city with a population of 6.5 million, from January 1998 to December 1998. Patients with osteoarthritis of the hip and knee were recruited from the orthopedic units of regional hospitals in Hong Kong. All hospitals in the city, except one, were involved ($n = 7$). The 30 men and 108 women with osteoarthritis of the hip represented all patients who were attending the orthopedic clinics of the study hospitals at the time of the study. As it is customary to follow up patients with osteoarthritis of the hip for at least 3 years after joint replacement, the total number of patients represented the cumulative number of patients with osteoarthritis of the hip over a 3-year period. Patients with osteoarthritis of the knee

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Abbreviations: CI, confidence interval; OR, odds ratio.

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TABLE 1. Association of various factors with the risk of osteoarthritis of the hip and knee in Hong Kong Chinese, January 1998 to December 1998*

Men					Women				
Risk factor	No. of cases (n = 30)	No. of controls (n = 90)	OR†	95% CI†	Risk factor	No. of cases (n = 108)	No. of controls (n = 324)	OR	95% CI
Osteoarthritis of the hip									
Body height (m) (quartiles)									
<1.59	5	30	1.0		<1.49	18	85	1.0	
1.59–1.62	5	20	1.4	0.4, 5.5	1.49–1.51	33	75	2.3	1.2, 4.5
1.63–1.66	10	19	2.8	0.9, 9.2	1.52–1.56	22	83	1.3	0.6, 2.6
≥1.67	10	20	3.1	0.9, 11.3	≥1.57	30	74	2.0	1.0, 4.0
Body weight (kg) (quartiles)									
<54.5	7	24	1.0		<50.0	18	91	1.0	
54.5–61.9	7	25	0.9	0.2, 3.3	50.0–55.9	28	82	1.9	0.9, 3.7
62.0–68.9	10	17	1.9	0.6, 6.1	56.0–62.9	29	71	2.3	1.1, 4.7
≥69.0	6	23	0.9	0.3, 3.1	≥63.0	30	73	2.3	1.1, 4.6
History of joint injury									
No	19	87	1.0			74	319	1.0	
Yes	11	3	15.6	3.4, 70.5		34	5	32.7	10.0, 106.6
Cigarette smoking									
Nonsmoker	12	32	1.0			98	292	1.0	
Current or exsmokers	18	58	0.8	0.3, 2.0		10	32	0.9	0.4, 2.0
Regular sports activities									
Running	4	16	0.7	0.2, 2.3		3	10	0.9	0.2, 3.3
Badminton	0	4	NA†			2	6	1.0	0.2, 5.0
Football	3	7	1.3	0.3, 5.4		1	0	NA	
Gymnastics	2	5	1.2	0.2, 6.9		10	5	6.0	2.1, 17.6
Kung fu	1	4	0.8	0.08, 6.7		1	0	NA	
Occupational exposures in longest occupation									
Walking (≥2 hours/day)	26	56	3.9	1.3, 12.1		64	164	1.4	0.9, 2.3
Squatting (≥1 hour/day)	8	20	1.3	0.5, 3.2		28	58	1.6	1.0, 2.8
Kneeling (≥1 hour/day)	6	6	3.9	1.1, 14.2		16	38	1.3	0.7, 2.5
Climbing stairs (≥15 flights/day)	7	4	8.7	1.8, 42.7		10	13	2.5	1.0, 5.9
Digging (≥1 hour/day)	2	3	2.0	0.3, 12.0		18	23	2.7	1.4, 5.2
Driving (≥4 hours/day)	1	8	0.4	0.04, 3.0		0	0	NA	
Lifting 10 kg or more									
1–10 times/week	5	15	1.9	0.6, 6.6		10	50	0.7	0.4, 1.5
>10 times/week	13	15	5.3	1.8, 15.8		44	64	3.0	1.8, 5.1
Lifting 50 kg or more									
1–10 times/week	5	4	8.5	1.6, 45.3		10	18	2.0	0.9, 4.6
>10 times/week	8	6	9.6	2.2, 42.2		21	29	2.9	1.5, 5.6
Use of vibration tools	4	16	0.7	0.2, 2.3		5	3	5.0	1.2, 20.9

Table continues

were recruited simultaneously in all hospitals over 3 months, until the target sample size was reached. In this period, consecutive patients were interviewed while they attended orthopedic clinic sessions in the study hospitals.

All patients were diagnosed to have primary osteoarthritis of the hip or knee. The medical records of all subjects were reviewed, and patients were excluded if they had ever sustained a hip fracture; fulfilled the American College of Rheumatology criteria (30) for rheumatoid arthritis or the modified New York criteria for ankylosing spondylitis (31); or had a history of Perthe's disease, congenital dislocation, slipped capital epithesis, or other causes of secondary osteoarthritis. The orthopedic surgeons who were in charge of the patients were requested to grade osteoarthritis patients according to the Kellgren and Lawrence scale, using radiographs of the hip or knee (32). All surgeons referred to a copy of the *Atlas of Standard Radiographs* (32). Only patients who had grade 3 or 4 osteoarthritis were included in this study. The rationale for doing so was to avoid misclassification. Similar criteria have been used in recent studies (3–5).

All radiographs showing osteoarthritis of the hip were also read by one of the coinvestigators (D. L.), who was conduct-

TABLE 1. Continued

Men					Women				
Risk factor	No. of cases (n = 166)	No. of controls (n = 166)	OR	95% CI	Risk factor	No. of cases (n = 492)	No. of controls (n = 492)	OR	95% CI
Osteoarthritis of the knee									
Body height (m) (quartiles)									
<1.58	40	38	1.0		<1.48	125	124	1.0	
1.58–1.62	39	44	0.9	0.5, 1.7	1.48–1.50	131	127	1.0	0.7, 1.4
1.63–1.66	44	46	0.9	0.4, 1.6	1.51–1.54	113	113	1.0	0.7, 1.4
≥1.67	40	34	1.2	0.6, 2.3	≥1.55	113	119	0.9	0.6, 1.3
Body weight (kg) (quartiles)									
<57.0	29	58	1.0		<52.0	74	180	1.0	
57.0–64.5	32	43	1.3	0.7, 2.6	52.0–58.4	100	137	1.7	1.2, 2.5
64.6–71.8	44	40	2.1	1.1, 3.9	58.5–65.9	147	100	3.4	2.3, 5.0
≥71.9	59	23	4.8	2.4, 9.7	≥66.0	161	67	5.6	3.7, 8.5
History of joint injury									
No	125	159	1.0			364	476	1.0	
Yes	41	7	7.8	3.1, 19.8		128	16	9.6	5.4, 17.0
Cigarette smoking									
Nonsmoker	73	52	1.0			458	433	1.0	
Current or exsmokers	93	114	0.6	0.4, 0.9		34	59	0.5	0.3, 0.8
Regular sports activities									
Running	13	19	0.6	0.3, 1.4		19	14	1.4	0.7, 2.8
Badminton	0	5	NA			2	4	0.5	0.1, 2.7
Football	17	13	1.3	0.6, 2.8		1	0	NA	
Gymnastics	12	6	2.0	0.8, 5.3		43	6	7.2	3.1, 16.8
Kung fu	7	5	1.4	0.4, 4.4		20	1	20.0	2.7, 149
Occupational exposures in longest occupation									
Walking (≥2 hours/day)	134	104	2.2	1.4, 3.5		287	250	1.4	1.1, 1.8
Squatting (≥1 hour/day)	38	32	1.2	0.7, 2.0		109	99	1.1	0.8, 1.5
Kneeling (≥1 hour/day)	17	12	1.4	0.7, 3.0		55	63	0.9	0.6, 1.3
Climbing stairs (≥15 flights/day)	44	13	4.1	2.1, 8.2		87	15	6.1	3.5, 10.8
Digging (≥1 hour/day)	6	7	0.9	0.3, 2.6		38	44	0.9	0.5, 1.3
Driving (≥4 hours/day)	7	13	0.5	0.2, 1.4		0	0	NA	
Lifting 10 kg or more									
1–10 times/week	24	25	1.7	0.9, 3.2		71	70	1.5	1.0, 2.2
>10 times/week	75	20	5.8	3.1, 10.8		200	102	3.0	2.2, 4.1
Lifting 50 kg or more									
1–10 times/week	19	9	3.5	1.4, 8.8		22	31	0.9	0.5, 1.7
>10 times/week	46	12	7.1	3.1, 16.2		100	41	2.9	1.9, 4.5
Use of vibration tools	20	6	3.3	1.3, 8.3		16	3	5.3	1.6, 18.3

* By conditional logistic regression, without adjustment.
† OR, odds ratio; CI, confidence interval; NA, not applicable.

ing a separate study on prognosis at the time of the study. There was a difference in the grading of osteoarthritis of the hip between the two readers in only two patients, but such difference was between grades 3 and 4 only. In addition, the first 100 radiographs of osteoarthritis of the knee were also read by one of the coinvestigators (D. L.). Differences were observed in four patients, again between grades 3 and 4 only. The diagnoses of the orthopedic surgeons were hence considered adequate for the purpose of this study.

Controls were consecutive subjects who attended eight government general practice clinics during the period of the study. These clinics were located in the same regions as those for the study hospitals. The catchment areas for these clinics were the same as those for the study hospitals. Controls were individually matched to cases by sex and age (within a year). One control was matched to one case with osteoarthritis of the knee, and three controls were matched to one case with osteoarthritis of the hip. Controls were asked, "Have you ever been told by a Western practitioner that you had osteoarthritis of the hip or the knee?" and "Have you ever had pain or stiffness in your hip or knee which lasted for a week or more?" Only patients who

answered "no" to both questions were recruited as controls. Subjects who had other musculoskeletal disorders (described above) were also excluded. The rationale for excluding all patients with hip and knee pain was to avoid misclassification. A total of 34 percent of the subjects surveyed were excluded for this reason.

A team of four research assistants, using a standardized and structured questionnaire, interviewed cases and controls. Subjects were asked, for each job held for a year or more, whether they engaged in the following activities: walking for 2 hours or more each day, squatting for an hour or more each day, kneeling for an hour or more each day, climbing 15 flights of stairs or more each day, driving for 4 hours or more each day, lifting of loads (weighing 10 kg or more and 50 kg or more) for 1–10 times or more than 10 times each week, and use of vibration tools for an hour each day. The definition of exposure was similar to those of previous studies on occupation and osteoarthritis (4, 5, 33, 34).

In defining the main job, we considered only paid employment and excluded unpaid housework. For cases, the main job was defined as the occupation that had been held for the longest time before the onset of symptoms. For controls, it was the job that had been held for the longest period up to the date of interview. Jobs were coded according to the census in Hong Kong (35). In the present paper, only data relating to the main job are presented.

Subjects were asked if they had ever injured their hips and knees. Only injuries that resulted in medical consultations were included. Subjects were also asked if they performed sports activities regularly. A list of sports activities was then read out to the study subjects and records of activity were made. A smoking history was taken.

The body weight and height of all subjects were measured.

Analysis was by conditional logistic regression for matched sets, with three controls matched by sex and age to each case with osteoarthritis of the hip and one control matched by age and sex to each case with osteoarthritis of the knee.

Analysis was first performed variable by variable, without any adjustment. This was done to explore the association between each variable and osteoarthritis of the hip and the knee. We then proceeded to multiple logistic regression, by putting all variables that were found to be statistically significant, by univariate analysis, into the models. This was done to adjust for confounding between variables. Hence, a total of four models were produced for osteoarthritis of the hip and knee in men and women separately.

RESULTS

A total of 138 patients (30 men, 108 women) with osteoarthritis of the hip and 658 patients (166 men, 492 women) with osteoarthritis of the knee were recruited. Of the patients with osteoarthritis of the hip, 98 (71 percent) had a hip replacement; and of the patients with osteoarthritis of the knee, 185 (28.1 percent) had a knee replacement. Only 10 percent of the patients with osteoarthritis of the hip and 15 percent of the remaining patients with osteoarthritis of the knee were listed for joint replacement. For patients with joint replacement, the interview took place within 3 years of the operation.

The odds ratio and 95 percent confidence interval for the factors associated with osteoarthritis of the hip and knee are shown in table 1. Taller men and women were at a higher risk of osteoarthritis of the hip (odds ratio (OR) = 3.1, 95 percent confidence interval (CI): 0.9, 11.3 in men and OR = 2.0, 95 percent CI: 1.0, 4.0 in women whose height was in the highest quartile). Body weight was found to be associated with the risk of osteoarthritis of the hip only in women (OR = 2.3, 95 percent CI: 1.1, 4.6 for women whose body weight was in the highest quartile). A history of joint injury was strongly associated with osteoarthritis of the hip in both men and women (OR = 15.6, 95 percent CI: 3.4, 70.5 in men and OR = 32.7, 95 percent CI: 10.0, 106.6 in women).

The association between occupational activities and the risk of osteoarthritis of the hip was quite similar in men and women. The following activities in the longest held occupation were found to be associated with the risk of osteoarthritis of the hip in both sexes: climbing 15 flights of stairs or more each day (OR = 8.7, 95 percent CI: 1.8, 42.7 in men and OR = 2.5, 95 percent CI: 1.0, 5.9 in women) and lifting weight (of 10 kg or 50 kg) for 10 times or more each week. However, standing for 2 hours or more and kneeling for an hour or more each day were found to be associated with osteoarthritis of the hip only in men (OR = 3.9, 95 percent CI: 1.1, 14.2), while digging for an hour or more each day and the use of vibration tools were found to be associated with osteoarthritis of the hip only in women (OR = 5.0, 95 percent CI: 1.2, 20.9).

Few subjects performed recreational sports activities regularly. Women who performed gymnastics regularly were at an increased risk of osteoarthritis of the hip (OR = 6.0, 95 percent CI: 2.1, 17.6).

The relation between various factors and osteoarthritis of the knee is also shown in table 1. Height was not found to be associated with risk of osteoarthritis of the knee. However, subjects with greater body weight were at significantly higher risk of osteoarthritis of the knee (OR = 4.8, 95 percent CI: 2.4, 9.7 for men and OR = 5.6, 95 percent CI: 3.7, 8.5 for women whose body weight was in the highest quartile). A history of joint injury was associated with the risk of osteoarthritis of the knee in both men and women (OR = 7.8, 95 percent CI: 3.1, 19.8 in men and OR = 9.6, 95 percent CI: 5.4, 17.0 in women).

The following activities in the longest held occupation were found to be associated with the risk of osteoarthritis of the knee in both sexes: walking for 2 hours or more each day (OR = 2.2, 95 percent CI: 1.4, 3.5 in men and OR = 1.4, 95 percent CI: 1.1, 1.8 in women), climbing 15 flights of stairs or more each day (OR = 4.1, 95 percent CI: 2.1, 8.2 in men and OR = 6.1, 95 percent CI: 3.5, 10.8 in women), using vibration tools for an hour or more each day (OR = 3.3, 95 percent CI: 1.3, 8.3 in men and OR = 5.3, 95 percent CI: 1.6, 18.3 in women), lifting weight (of 10 kg or 50 kg) for 10 times or more each week (OR = 7.1, 95 percent CI: 3.1, 16.2 in men and OR = 2.9, 95 percent CI: 1.9, 4.5 in women for lifting 50 kg for 10 times or more).

TABLE 2. Association of various factors with the risk of osteoarthritis (OA) of the hip and knee in Hong Kong Chinese, January 1998 to December 1998*

Risk factor	OR†	95% CI†
OA of the hip in men (30 cases and 90 controls)		
History of joint injury	25.1	3.5, 181
Occupational exposure in longest occupation		
Walking (≥2 hours/day)	1.3	0.3, 6.7
Kneeling (≥1 hour/day)	7.4	0.7, 76.9
Climbing stairs (≥15 flights/day)	12.5	1.5, 104.3
Lifting 10 kg or more		
1–10 times/week	1.8	0.4, 8.1
>10 times/week	3.1	0.7, 14.3
OA of the hip in women (108 cases and 324 controls)		
Body height (m)		
Lowest quartile	1.0	
2nd quartile	3.7	1.5, 9.1
3rd quartile	1.0	0.4, 2.7
4th quartile	2.7	1.0, 7.2
Body weight (kg)		
Lowest quartile	1.0	
2nd quartile	2.5	1.0, 6.2
3rd quartile	1.4	0.5, 3.8
4th quartile	1.5	0.6, 4.1
History of joint injury	43.3	11.7, 161
Regular sports activities		
Gymnastics	1.9	0.3, 11.1
Occupational exposure in longest occupation		
Squatting (≥1 hour/day)	1.2	0.5, 3.0
Climbing stairs (≥15 flights/day)	2.3	0.6, 8.1
Digging (≥1 hour/day)	2.2	0.8, 6.5
Lifting 10 kg or more		
1–10 times/week	0.7	0.3, 1.7
>10 times/week	2.4	1.1, 5.3
Use of vibration tools	7.9	0.8, 77.8
OA of the knee in men (166 cases and 166 controls)		
Body weight (kg)		
Lowest quartile	1.0	
2nd quartile	1.4	0.6, 3.5
3rd quartile	2.7	1.1, 6.3
4th quartile	4.8	1.9, 12.1
History of joint injury	12.1	3.4, 42.5
Cigarette smoking	0.2	0.1, 0.5
Occupational exposure in longest occupation		
Walking (≥2 hours/day)	1.0	0.5, 2.1
Climbing stairs (≥15 flights/day)	2.5	1.0, 6.4
Lifting 10 kg or more		
1–10 times/week	1.5	0.6, 3.5
>10 times/week	5.4	2.4, 12.4
Use of vibration tools	2.8	0.8, 10.0
OA of the knee in women (492 cases and 492 controls)		
Body weight (kg)		
Lowest quartile	1.0	
2nd quartile	1.4	0.9, 2.3
3rd quartile	2.8	1.7, 4.4
4th quartile	4.3	2.6, 7.2
History of joint injury	7.6	3.8, 15.2
Cigarette smoking	0.7	0.4, 1.2
Regular sports activities		
Gymnastics	7.4	2.6, 20.8
Kung fu	22.5	2.5, 199
Occupational exposure in longest occupation		
Walking (≥2 hours/day)	0.8	0.5, 1.1
Climbing stairs (≥15 flights/day)	5.1	2.5, 10.2
Lifting 10 kg or more		
1–10 times/week	1.2	0.7, 2.0
>10 times/week	2.0	1.2, 3.1
Use of vibration tools	3.7	0.7, 20.1

* By conditional logistic regression; only variables that were found to be significantly associated with osteoarthritis in univariate analysis were included in each model.
† OR, odds ratio; CI, confidence interval.

Women who performed kung fu (traditional Chinese martial arts) or gymnastics regularly were at increased risk of osteoarthritis of the knee (OR = 20.0, 95 percent CI: 2.7, 149 and OR = 7.2, 95 percent CI: 3.1, 16.8, respectively). Smoking was protective against osteoarthritis of the knee in both sexes (OR = 0.6, 95 percent CI: 0.4, 0.9 in men and OR = 0.5, 95 percent CI: 0.3, 0.8 in women).

The results of multiple logistic regression are presented in table 2. In general, the risk factors associated with osteoarthritis of the hip and osteoarthritis of the knee were consistent in both sexes. A history of joint injury (OR = 25.1, 95 percent CI: 3.5, 181 in men and OR = 43.3, 95 percent CI: 11.7, 161 in women), lifting heavy weight at work (OR = 3.1, 95 percent CI: 0.7, 14.3 in men and OR = 2.4, 95 percent CI: 1.1, 5.3 in women), and climbing 15 flights of stairs or more each day (OR = 12.5, 95 percent CI: 1.5, 104.3 in men and OR = 2.3, 95 percent CI: 0.6, 181 in women) was consistently associated with osteoarthritis of the hip in both sexes.

On the other hand, a history of joint injury (OR = 12.1, 95 percent CI: 3.4, 42.5 in men and OR = 7.6, 95 percent CI: 3.8, 15.2 in women) and obesity (OR = 4.8, 95 percent CI: 1.9, 12.1 in men and OR = 4.3, 95 percent CI: 2.6, 7.2 in women) was associated with osteoarthritis of the knee. Moreover, climbing 15 flights of stairs or more each day (OR = 2.5, 95 percent CI: 1.0, 6.4 in men and OR = 5.1, 95 percent CI: 2.5, 10.2 in women) and lifting heavy loads at

work were associated with osteoarthritis of the knee in both sexes (OR = 5.4, 95 percent CI: 2.4, 12.4 in men and OR = 2.0, 95 percent CI: 1.2, 3.1 in women).

When the risk of osteoarthritis was studied in various occupational groups, female farmers were found to be at an increased risk of osteoarthritis of the hip (OR = 2.2, 95 percent CI: 1.0, 4.8), while fisherwomen were at an increased risk of osteoarthritis of the knee (OR = 3.0, 95 percent CI: 0.6, 14.9). No such statistically significant associations were observed in men. The lifting of heavy loads was found mainly in farmers, fishermen, construction site workers, and general laborers. Walking up stairs was experienced mainly by general laborers.

The interaction among joint injury, occupational activities, and the risk of osteoarthritis of the knee is shown in table 3. The data for osteoarthritis of the hip were too sparse for studying interactions. The odds ratio for subjects who were exposed to both joint injury and climbing 15 flights or more each day was 34.0 (95 percent CI: 4.7, 248.4). For subjects who were exposed to both joint injury and lifting weight of 10 kg 10 times or more each week, the odds ratio was 25.9 (95 percent CI: 8.1, 82.4). These results are suggestive of an interaction among joint injury, repetitive use, and load bearing in the etiology of osteoarthritis of the knee.

DISCUSSION

We report here the first epidemiologic study on factors associated with osteoarthritis of the hip and the knee in Chinese. Both constitutional and occupational factors were found to be associated with these conditions. Taller subjects were at an increased risk of osteoarthritis of the hip, while obese subjects were at an increased risk of osteoarthritis of the knee. A history of injury was an important risk factor for osteoarthritis of both the hip and the knee. Smoking was protective against only osteoarthritis of the knee.

The occupational factors, which predisposed to osteoarthritis of the hip and the knee, were remarkably similar. In general, subjects whose jobs entailed lifting heavy loads and walking up stairs frequently were at a higher risk of osteoarthritis of both the hip and knee. The association between the practice of gymnastics and kung fu with osteoarthritis of the hip and knee in women highlighted the importance of load bearing and repetitive use in the etiology of osteoarthritis of the knee.

Before proceeding to interpret these findings and to expound on the possibilities of prevention, we considered the potential sources of bias in our study. The current study was designed to investigate risk factors for symptomatic and advanced cases of osteoarthritis. We recruited osteoarthritis patients from orthopedic units in hospitals located throughout Hong Kong in order to minimize referral bias. Controls were general practice patients from the same regions. Subjects with a history of joint pain and stiffness were excluded. The objective of such a design was to avoid misclassification. However, in so doing, we ended up comparing subjects with fairly severe osteoarthritis with a very healthy (with respect to joint pain) control group. This may have resulted in spuriously high odds ratios. Nevertheless, some inference can be made on risk factors that are associated with severe osteoarthritis.

Our observation on the association between obesity and osteoarthritis of the knee concurs with those in Caucasians (11, 12, 15, 23). However, obesity was found to predispose to osteoarthritis of the hip in Caucasians (4, 5, 25), but not in our study. Previous epidemiologic study has demonstrated that obesity is much less prevalent and severe in Chinese than in Caucasians (36). We can hypothesize that the lesser extent of obesity in Chinese may be associated with forces large enough to induce osteoarthritis of the knee but not osteoarthritis of the hip. We have also demonstrated in our study that being tall is a risk factor for osteoarthritis of the hip but not of the knee. The reason for this finding is unclear and merits further research.

The protective effect of smoking on osteoarthritis of the knee has been demonstrated previously (27–29). Prospective results from the Framingham Study implied that the association was unlikely to be due to bias (29). The mechanisms of this association remain to be explored, but this may be mediated by a difference in cartilage physiology and bone density in smokers and nonsmokers.

TABLE 3. Odds ratios for osteoarthritis (OA) of the knee in subjects who were exposed to both joint injury and climbing stairs or lifting of weight, Hong Kong Chinese, January 1998 to December 1998

Occupational activities	Patients with OA of the knee and with injury (n = 658)*		Controls with injury (n = 658)		OR†,‡	95% CI†
	Yes	No	Yes	No		
Climbing ≥15 flights/day						
Yes	34	97	1	27	34.0	4.7, 248.4
No	135	392	22	608		
Lifting weight ≥10 kg						
Yes (>10 times/week)	74	201	3	119	25.9	8.1, 82.4
Yes (1–10 times/week)	24	71	3	92	8.9	2.6, 30.1
No	71	217	17	424		

* The odds ratios were calculated by conditional logistic regression; the baseline odds ratio was assumed to be one in subjects who were not exposed to either joint injury or the occupational activities.

† OR, odds ratio; CI, confidence interval.

‡ For being exposed to both.

Kellgran and Lawrence (37) had demonstrated the relation between joint injury and osteoarthritis of the knee as early as 1958. This finding was recently corroborated by longitudinal data from the Framingham Study (38). It was observed that men with a history of major knee injury have from five to six times the risk of osteoarthritis of the knee, compared with those without such a history. For women, the risk was increased by about threefold (38). More recently, Cooper et al. (4) also demonstrated the importance of joint injury in the etiology of osteoarthritis of the hip. Our findings are hence in agreement with observations among Caucasians. Indeed, patients who underwent total or partial meniscectomy are at high risk of developing subsequent osteoarthritis of the knee (18–21). This illustrated the possibility of injury-induced biomechanical changes that may cause osteoarthritis.

Studies in Caucasians suggested that distinct occupational risk factors existed for osteoarthritis of the hip and the knee. Jobs that required kneeling and squatting were associated with osteoarthritis of the knee (23–26). On the other hand, walking and lifting heavy loads seemed to be major occupational factors for osteoarthritis of the hip (5–8). However, the results of our study seemed to suggest that the occupational risk factors of osteoarthritis of the hip and the knee were quite similar. We have found that walking up stairs frequently and lifting of loads at work predisposed to osteoarthritis of both the hip and the knee. To a lesser extent, digging was associated with the risk of osteoarthritis of the hip, and the use of vibration tools was associated with osteoarthritis of both the hip and the knee in women.

Our study population seldom performed sports activities. Nevertheless, we found that women who practiced gymnastics and kung fu (Chinese martial arts) were at increased risk of osteoarthritis of the knee. These findings further support the significance of repetitive use in the etiology of osteoarthritis. Ours was a cross-sectional study on factors associated with osteoarthritis in Chinese. However, taken with the ample evidence on the etiology of osteoarthritis in Caucasian populations, some suggestions on the prevention of osteoarthritis could be attempted. Obesity is less prevalent in Hong Kong Chinese than in Caucasians, but the rates are rising with increasing affluence. The prevention of obesity is important, as it has adverse effects on health. Changes in occupational practice may also be useful and feasible. For instance, mechanical aids should be used more often in the lifting of heavy loads, and walking up stairs too frequently should be avoided.

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