EMC Lau 劉明珠
TK Lam
NH Chan
SM Kumta

Risk factors for primary osteoarthritis of the hip and knee in the Hong Kong Chinese population

Key Message

Osteoarthritis of the hip and knee can be prevented by controlling obesity, joint injury, repetitive use, and joint overload.

Introduction

The epidemiology of osteoarthritis (OA) of the hip and knee differs considerably between Caucasian and Chinese populations. The prevalence of OA of the hip is 1% or lower in Chinese, and the prevalence of OA of the knee is 13% in Chinese women and 5% in Chinese men.[1] These data are confirmed by another study, which showed the rate of hip replacement in American Chinese to be 10% of the rates seen in American Caucasians.[2]

This racial difference in the prevalence of OA may be attributable to both genetic and lifestyle factors. We have demonstrated that hip dysplasia is not infrequent in the Hong Kong Chinese population.[3] This observation suggests that the low prevalence of OA of the hip could not be explained solely by genetic differences. Constitutional and lifestyle factors may also be important in the aetiology of OA.

Many studies have been conducted on the risk factors for OA of the hip and OA 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 OA of the hip.[4,5] but obesity has been found to be associated with OA of the knee but not of the hip.[4] The factors associated with OA of the knee are joint injury and kneeling and squatting at work.[6] Smoking has been negatively associated with OA of the knee.[7]

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

Methods

The study was conducted in Hong Kong, a highly urbanised city with a population of 6.5 million from January 1998 to December 1998. Patients with OA of the hip and knee were recruited from the orthopaedic units of regional hospitals in Hong Kong. All but one of the city hospitals (n=7) were involved. The 30 men and 108 women with OA of the hip represented all patients who were attending the orthopaedic clinics at those hospitals at the time of the study. As it is customary to follow-up patients with OA of the hip for at least 3 years after joint replacement, the total number of patients represented the cumulative number of OA of the hip patients over a 3-year period. Patients with OA of the knee were recruited simultaneously in all hospitals over 3 months, until the target sample size was reached. During this period, consecutive patients were interviewed while they attended orthopaedic clinic sessions in the study hospitals.

All patients were diagnosed with primary OA 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 for rheumatoid arthritis or the Modified New York Criteria for ankylosing spondylitis[8,9]; had a history of Perthe's disease, congenital dislocation, slipped

Hong Kong Med J 2007;13(Suppl 3):S9-14

Department of Community and Family Medicine, The Chinese University of Hong Kong, Hong Kong
EMC Lau*
Department of Orthopaedics and Traumatology, Tuen Mun Hospital, Hong Kong
TK Lam*, SM Kumta
Department of Orthopaedics and Traumatology, Queen Elizabeth Hospital, Hong Kong
NH Chan

* Currently at: Hong Kong Orthopaedic and Osteoporosis Centre for Treatment and Research

HSRF project number: 531025

Principal applicant and corresponding author:
Prof Edith MC Lau
Hong Kong Orthopaedic and Osteoporosis Centre for Treatment and Research, Hong Kong SAR, China
E-mail: edithmclau@netvigator.com

Table 1. Association of height, body mass index (BMI), a history of joint injury and smoking with the risk of osteoarthritis (OA) of the hip and knee in Hong Kong Chinese patients

Risk factor	Men		
	No. of cases	No. of controls	Odds ratio (95% CI)
OA of the hip	n=30	n=90	
Height for men / women (m) [quartiles]*			
<1.59 / <1.49	5	30	1.0
1.59-1.62 / 1.49-1.51	5	20	2.18 (0.46-10.44)
1.63-1.67 / 1.52-1.57	10	19	6.31 (1.27-31.43)
>1.67 / >1.57	10	20	4.75 (0.94-24.02)
BMI for men / women (kg/m^2) [quartiles]*			
<21.1 / <21.8	9	21	1.0
21.1-23.3 / 21.8-23.9	10	20	1.89 (0.42-8.63)
23.4-26.0 / 24.0-26.8	5	26	0.69 (0.16-2.97)
>26.0 / >26.8	6	22	0.99 (0.24-4.07)
History of joint injury†			
No	19	87	1.0
Yes	11	3	15.30 (3.40-69.70)
Cigarette smoking‡			
Non-smoker	12	32	1.0
Ex smoker	9	40	0.65 (0.18-2.32)
Current smoker	9	18	0.83 (0.23-2.94)
OA of the knee	n=166	n=166	
Height for men / women (m) [quartiles]*			
<1.58 / <1.48	40	38	1.0
1.58-1.62 / 1.48-1.50	39	44	0.91 (0.47-1.80)
1.63-1.67 / 1.51-1.55	44	46	0.81 (0.40-1.62)
>1.67 / >1.55	40	34	1.01 (0.50-2.06)
BMI for men / women (kg/m^2) [quartiles]*			
<22.3 / <22.8	25	56	1.0
22.3-24.5 / 22.8-25.4	38	44	2.57 (1.13-5.87)
24.6-26.7 / 25.5-28.4	45	36	4.26 (1.90-9.55)
>26.7 / >28.4	55	26	5.60 (2.49-12.54)
History of joint injury†			
No	125	159	1.0
Yes	41	7	9.13 (3.41-24.55)
Cigarette smoking‡			
Non-smoker	73	52	1.0
Ex smoker	56	78	0.47 (0.25-0.88)
Current smoker	37	36	0.71 (0.34-1.47)

* Height and weight were not available for some subjects; the OR for height and BMI were adjusted for injury
† The OR for injury was adjusted for BMI
‡ The OR for cigarette smoking was adjusted for injury and BMI

capital epiphysis, or any other causes of secondary OA. The orthopaedic surgeons managing the patients were requested to grade them according to the Kellgren and Lawrence Scale, using radiographs of the hip or knee.[10] All surgeons referred to a copy of the atlas of standard radiographs.[10] Only patients who had grade 3 or 4 OA were included in this study in order to avoid misclassification, as has been done in other recent studies.

All OA of the hip radiographs were also read by one of the co-investigators. There was a difference in the grading of OA of the hip between the two readers in two patients, but the differences were only grading differences, between grades 3 and 4. The first 100 OA of the knee radiographs were also read by one of the co-investigators. Differences were observed in four patients, again between grades 3 and 4 only. The diagnoses made by the orthopaedic surgeons were hence considered adequate for the purpose of this study.

The controls were patients who attended eight government general practice clinics during the study period. These clinics were located in the same regions as the study hospitals and their areas were the same as those of the study hospitals. Controls were individually matched to cases by sex and age (within a year). One control was matched to one OA of the knee case and three controls were matched to one OA of the hip case. 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. As a result, 34% of subjects surveyed were excluded for this reason.

A team of four research assistants interviewed cases and controls using a standardised and structured questionnaire. 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

Women			Combined odds ratio (95% CI)
No. of cases	No. of controls	Odds ratio (95% CI)	
n=108	n=324		
18	85	1.0	1.0
33	75	3.13 (1.38-7.10)	2.89 (1.42-5.89)
22	83	1.27 (0.55-2.97)	1.82 (0.87-3.78)
30	74	2.74 (1.20-6.27)	3.04 (1.46-6.29)
21	84	1.0	1.0
23	82	0.90 (0.41-1.94)	1.04 (0.53-2.03)
28	76	1.18 (0.53-2.61)	1.06 (0.53-2.12)
31	74	1.18 (0.56-2.46)	1.15 (0.60-2.19)
74	319	1.0	1.0
34	5	29.81 (9.06-97.66)	24.37 (9.64-61.61)
98	292	1.0	1.0
7	22	0.94 (0.34-2.59)	0.83 (0.38-1.82)
3	10	1.07 (0.27-4.25)	1.07 (0.44-2.63)
n=492	n=492		
125	124	1.0	1.0
131	127	0.97 (0.66-1.43)	0.96 (0.68-1.34)
113	113	0.85 (0.57-1.26)	0.84 (0.59-1.18)
113	119	0.84 (0.56-1.26)	0.88 (0.62-1.24)
61	180	1.0	1.0
110	132	2.59 (1.63-4.13)	2.56 (1.71-3.83)
139	101	3.86 (2.40-6.19)	3.90 (2.60-5.84)
172	69	6.68 (4.04-11.02)	6.27 (4.11-9.57)
364	476	1.0	1.0
128	16	7.21 (3.96-13.15)	8.00 (4.77-13.41)
458	433	1.0	1.0
27	36	1.04 (0.56-1.94)	0.66 (0.43-1.01)
7	23	0.32 (0.10-0.99)	0.66 (0.38-1.16)

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, and ≥50 kg) for 1 to 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 previous studies on occupation and OA.

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 classification used in the Hong Kong census.[11] In this report, only data relating to the main job are presented.

Participants were asked if they had ever injured their hips and knees. Only injuries that resulted in medical consultations were included. Participants 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 and body weight and height was measured. Analysis was done using conditional logistic regression for matched sets, with three controls matched by sex and age to each OA of the hip case, and one control matched by age and sex to each OA of the knee case.

Analysis was first performed variable by variable, without any adjustment. This was done to explore the association between each variable and OA 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 four models were produced, for OA of the hip and knee in men and women separately. Wherever the odds ratios (ORs) for men and women were similar, a combined OR is presented.

Results

A total of 138 patients (30 men, 108 women) with OA of the

Table 2. Association of occupational activities with the risk of osteoarthritis (OA) of the hip and knee in Hong Kong Chinese patients

Activity	Men		
	No. of cases	No. of controls	OR (95% CI)*
OA of the hip	n=30	n=90	
Walking (≥2 h/day)	26	56	4.02 (1.04-15.56)
Squatting (≥1 h/day)	8	20	0.87 (0.29-2.65)
Kneeling (≥1 h/day)	6	6	5.22 (0.82-33.30)
Climbing stairs (≥15 flights/day)	7	4	15.90 (2.30-109.98)
Digging (≥1 h/day)	2	3	1.98 (0.21-19.07)
Driving (≥1 h/day)	1	8	0.30 (0.03-3.09)
Lifting ≥10 kg			
1-10 times/week	5	15	2.13 (0.59-7.72)
≥10 times/week	13	15	4.15 (1.23-14.01)
Lifting ≥50 kg			
1-10 times/week	5	4	14.00 (1.96-100.01)
≥10 times/week	8	6	9.40 (1.26-70.42)
Use of vibration tools	3	3	2.15 (0.36-12.73)
OA of the knee	n=166	n=166	
Walking (≥2 h/day)	134	104	1.87 (1.06-3.29)
Squatting (≥1 h/day)	38	32	1.55 (0.83-2.89)
Kneeling (≥1 h/day)	17	12	1.16 (0.48-2.82)
Climbing stairs (≥15 flights/day)	44	13	3.57 (1.64-7.75)
Digging (≥1 h/day)	6	7	0.68 (0.18-2.54)
Driving (≥1 h/day)	7	13	0.74 (0.24-2.30)
Lifting ≥10 kg			
1-10 times/week	24	25	1.73 (0.80-3.74)
≥10 times/week	75	20	6.53 (3.10-13.74)
Lifting ≥50 kg			
1-10 times/week	19	9	4.61 (1.51-14.07)
≥10 times/week	46	12	8.88 (3.29-24.00)
Use of vibration tools	20	6	3.06 (1.08-8.68)

* The ORs were adjusted for BMI and injury
† N/A denotes not applicable

Table 3. Number of osteoarthritis (OA) of the knee patients and controls exposed to both joint injury and various occupational activities

Occupational activity	OA of the knee patients (n=658)		Controls (n=658)		Odds ratio (95% CI) for being exposed to both joint injury and activity
	Injured	Not injured	Injured	Not injured	
Climbing 15 flights/day					
Yes	34	97	1	27	31.45 (4.08-242.29)
No	135	392	22	608	
Digging ≥1 h/day					
Yes	9	35	1	50	7.53 (0.87-65.41)
No	160	454	22	585	
Lifting weight ≥50 kg once or more/day					
Yes	50	137	1	92	58.48 (7.78-439.46)
No	99	372	19	546	

hip and 658 patients (166 men, 492 women) with OA of the knee were recruited. Of the patients with OA of the hip, 98 (71%) had a hip replacement; and of the patients with OA of the knee, 185 (28%) had a knee replacement. Only 10% of the OA of the hip patients and 15% of the remaining OA of the knee patients were listed for joint replacement. Patients with joint replacements were interviewed within 3 years of the operation.

The ORs and 95% confidence intervals (CIs) for the factors associated with OA of the hip and knee are shown in Tables 1 and 2.

The interactions between joint injury, occupational activities, and the risk of OA of the knee are shown in Table 3. The data for OA of the hip was too sparse for studying interactions. The OR for subjects who were exposed to both joint injury and climbing 15 flights or more each day was 31.45. For subjects who were exposed to both joint injury and lifting weights of 50 kg once or more each week, the OR was 58.48. These results are suggestive of an interaction between joint injury, repetitive use, and load bearing in the aetiology of OA of the knee.

Discussion

We found that taller men and women were at a higher risk of OA of the hip. Body weight was found to be associated with the risk of OA of the hip only in women. A history of joint injury was strongly associated with OA of the hip in both

Women			Combined OR (95% CI)
No. of cases	No. of controls	OR (95% CI)*	
n=108	n=324		
64	164	1.16 (0.69-1.96)	1.41 (0.88-2.25)
28	58	1.99 (1.07-3.71)	1.62 (0.95-2.78)
16	38	1.52 (0.76-3.05)	1.70 (0.90-3.21)
10	13	2.60 (0.97-7.08)	4.13 (1.78-9.60)
18	23	3.25 (1.47-7.20)	2.92 (1.40-6.11)
0	0	N/A†	0.37 (0.04-3.17)
10	50	0.74 (0.32-1.74)	1.01 (0.51-2.00)
44	64	3.24 (1.71-6.14)	3.17 (1.83-5.52)
10	18	3.53 (1.33-9.40)	4.60 (2.00-10.57)
21	29	2.71 (1.21-6.10)	3.39 (1.63-7.04)
5	3	7.68 (1.32-44.80)	3.94 (1.18-13.12)
n=492	n=492		
287	250	1.21 (0.88-1.66)	1.35 (1.03-1.78)
109	99	0.88 (0.60-1.30)	1.04 (0.75-1.43)
55	63	0.87 (0.54-1.39)	0.93 (0.61-1.41)
87	15	5.58 (2.96-10.52)	4.73 (2.90-7.72)
38	44	0.67 (0.38-1.16)	0.68 (0.41-1.13)
0	0	N/A	0.76 (0.24-2.32)
71	70	1.37 (0.87-2.17)	1.44 (0.98-2.12)
200	102	2.20 (1.52-3.18)	2.84 (2.05-3.92)
22	31	0.84 (0.42-1.69)	1.42 (0.81-2.50)
100	41	2.17 (1.33-3.54)	3.04 (1.98-4.69)
16	3	10.15 (2.01-51.19)	4.47 (1.88-10.62)

men and women. Cigarette smoking was not associated with the risk of OA in either joint. Our observation that obesity is associated with OA of the knee concurs with observations in Caucasians[6,12] but, although obesity has been found to predispose to OA of the hip in Caucasians,[4] it was not a predisposing factor for Chinese. These differences may be due to the lower body mass index (BMI) of Chinese compared with Caucasians. In our study, the cut-off for the highest BMI quartile was 26. While some of the subjects were overweight, few were obese. It is known that the force exerted on the knee by body weight is much larger than that exerted on the hip. During a single-leg stance, the force exerted on the knee joint is about three to six times of the body weight, while this is only about three times of the body weight at the hip. Hence, in overweight Chinese subjects, the force exerted on the knee may be sufficient to induce OA in the knee, but not in the hip. Our finding that joint injury predisposed to OA of the hip and the knee concurred with findings in Caucasians. The relationship between trauma and OA of the knee has been demonstrated previously.[13] Joint injury also predisposes to OA of the hip.[4]

The association between occupational activities and the risk of OA of the hip was quite similar in men and women. Climbing 15 flights of stairs or more each day and lifting weights (of ≥10 kg or ≥50 kg) 10 times or more each week, were associated with a risk of OA of the hip in both sexes. Standing for 2 hours or more, and kneeling for an hour or more each day were found to be associated with OA of the hip only in men; while digging for an hour or more each day and the use of vibration tools was found to be associated with OA of the hip only in women. In previous studies, jobs that required kneeling and squatting were found to be associated with OA of the knee[6]; while standing, walking, and lifting heavy objects were associated with OA of the hip.[5]

Few participants in this study performed recreational sports activities regularly. Women who performed gymnastics and Kung Fu regularly were at an increased risk of OA of the hip but no associations were found between other sports activities and OA. An increased risk of lower limb OA in participants of repetitive, high-impact sports strongly associated with joint injury, has been reported. There seems to be little risk associated with recreational running.[14]

Conclusions

Our study results suggest that joint injury predisposes to OA of the hip and the knee in Chinese, while obesity is associated with OA of the knee only. Load-bearing and repetitive use are associated with OA of both the hip and the knee in our population, as indicated by the positive relationship between risk of OA, and jobs and sports which entail these exposures. Moreover, the effects of load-bearing and repetitive use seemed to be largest in injured joints. This suggests that controlling obesity, joint injury, manual

lifting, and repetitive use during work may prevent OA. This study is cross-sectional hence these results cannot be used to calculate important utility indices such as the cost-benefits of prevention. This requires further longitudinal and interventional studies.

Acknowledgement

This study was supported by the Health Services Research Fund (#531025).

References

1. Hoaglund FT, Yau AC, Wong WL. Osteoarthritis of the hip and other joints in southern Chinese in Hong Kong. J Bone Joint Surg Am 1973;55:545-57.
2. Hoaglund FT, Oishi CS, Gialamas GG. Extreme variations in racial rates of total hip arthroplasty for primary coxarthrosis: a population-based study in San Francisco. Ann Rheum Dis 1995;54:107-10.
3. Lau EM, Liu F, Lam D, Silman A, Croft P. Hip osteoarthritis and dysphasia in Chinese men. Ann Rheum Dis 1995:54:965-9.
4. Cooper C, Inskip H, Croft P, et al. Individual risk factors for hip osteoarthritis: obesity, hip injury, and physical activity. Am J Epidemiol 1998;147:516-22.
5. Croft P, Cooper C, Wickham C, Coggon D. Osteoarthritis of the hip and occupational activity. Scand J Work Environ Health 1992;18:59-63.
6. Anderson JJ, Felson DT. Factors associated with osteoarthritis of the knee in the first national Health and Nutrition Examination Survey (HANES I). Evidence for an association with overweight, race, and physical demands of work. Am J Epidemiol 1988;128:179-89.
7. Felson DT, Anderson JJ, Naimark A, Hannan MT, Kannel WB, Meenan RF. Does smoking protect against osteoarthritis? Arthritis Rheum 1989;32:166-72.
8. Arnett FC, Edworthy SM, Bloch DA, et al. The American Rheumatism Association, 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis Rheum 1988;31:315-24.
9. Rigdy AS. Ankylosing spondylitis. In: Silman AJ, Hochberg MC, editors. Epidemiology of the rheumatic disease. Oxford: Oxford University Press; 1993:105-47.
10. Kellgren JH, Lawrence JS. Atlas of standard radiographs: the epidemiology of chronic rheumatism. Vol 2. Oxford: Blackwell; 1963.
11. Land Census Coding Manual. Hong Kong: Hong Kong Census and Statistics Department; 1981.
12. Tepper S, Hochberg MC. Factors associated with hip osteoarthritis: data from the First National Health and Nutrition Examination Survey (NHANES-I). Am J Epidemiol 1993;137:1081-8.
13. Kellgren JH, Lawrence JS. Osteo-arthrosis and disk degeneration in an urban population. Ann Rheum Dis 1958;17:388-97.
14. Conaghan PG. Update on osteoarthritis part 1: current concepts and the relation to exercise. Br J Sports Med 2002;36:330-3.