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Physical activity and calcium intake in fracture of the proximal femur in Hong Kong

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Abstract

In Hong Kong physical activity and calcium intake of 400 Chinese men and women with hip fractures were compared with those of 800 controls. Daily walking outdoors, upstairs, uphill, or with a load protected against fracture. This was independent of cigarette smoking and alcohol consumption. Higher levels of reported activity in middle life were also protective. Average calcium intake was around one quarter that in Britain because of the low consumption of dairy products. Differences in calcium intake depended mainly on consumption of green vegetables and small fish. High intake protected against hip fracture.

These findings point to the importance of maintaining daily physical activity and calcium intake in urbanised Chinese populations.

Introduction

Hip fractures are an increasing public health problem among elderly Chinese in Hong Kong.^{1,2} This population eats a traditional Chinese diet, which is low in calcium, and urbanisation has reduced their physical activity. The contribution of these two factors to the rising incidence of fracture is unknown. We compared calcium intake and activity in elderly Chinese men and women with hip fractures and controls of similar ages.

Patients and methods

The study group comprised 400 patients with radiologically diagnosed hip fracture who were admitted consecutively to the orthopaedic wards of two main hospitals in Kowloon. Their activity and diet were compared with those of two sets of controls. Hospital controls comprised surgical inpatients from the wards of the same hospital. No diagnostic groups were excluded, and the first patient admitted after the case of the same sex and within five years of age was recruited. Community controls came from two sources. For patients aged over 70 they were systematically sampled from a register for the old age allowance in Shatin; for patients aged under 70 controls were randomly selected from attenders at the Chinese University general practice unit in Shatin. Community controls were individually matched to the patients by sex and five year age group. When a control refused to participate a substitute was selected.

All patients in the study group and controls were interviewed by one of two trained interviewers with a structured questionnaire. They were asked about their

history of falling, cigarette smoking, and alcohol consumption. The usual frequency of carrying out various forms of weight bearing physical activity was assessed by inquiring about the frequency of walking outdoors, upstairs, uphill, and with a load during the six weeks before admission to hospital. The frequencies of walking uphill and with a load at around the age of 35 were used as indices of past physical activity. Current calcium intake was assessed from the weekly frequency of consumption of nine foods that contain calcium and are commonly eaten in the Chinese diet. The intake was calculated from the calcium content of each food,³ typical portion sizes, and the frequency of consumption in a week. The results tended to underestimate the total intake.

The data were analysed with a conditional multiple logistic regression for matched case-control studies. As the estimates of relative risk when patients in the study group were compared with community controls were similar to those obtained when they were compared with hospital controls the two control groups were amalgamated.

Results

Eighteen patients could not be interviewed because of their poor mental state, and additional patients were recruited to make up 400. The rate of response among the controls was 90%. Table I shows the age and sex distribution of the patients in the study group. There were more older women, and the totals were 280 women and 120 men. Significant increases in the risk of hip fracture were found in people who were current or previous cigarette smokers (relative risk=1.3, 95% confidence interval 1.0 to 1.7), who consumed alcohol daily (3.9, 2.3 to 6.7), and who had reported a fall within the previous year (1.8, 1.3 to 2.5).

Table II shows the relation between current physical activity and the relative risk of hip fracture. Among women the risk was up to 2.1 times greater in those who reported walking outdoors, upstairs, uphill, or with a load less than once a day. After adjustment for cigarette smoking and alcohol consumption the

TABLE I—Age and sex distribution of patients with hip fracture

Age (years)	Women	Men
<70	54	47
70-79	108	45
≥80	118	28
Total	280	120

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TABLE II—*Current physical activity and risk of hip fracture in 400 patients with hip fracture and 800 controls**

Frequency of activity	Women					Men				
	No of patients	No of controls	Relative risk			No of patients	No of controls	Relative risk		
			Non-adjusted	Adjusted†	95% Confidence interval			Non-adjusted	Adjusted†	95% Confidence interval
Walking outdoors:										
Less than once a day	105	151	1.7	1.7	1.2 to 2.3	25	40	1.3	1.3	0.7 to 2.4
Once daily or more	175	409	1.0	1.0		95	200	1.0	1.0	
Walking upstairs:										
Less than once a day	182	323	1.4	1.4	1.0 to 1.9	71	133	1.2	1.0	0.6 to 1.7
Once daily or more	97	235	1.0	1.0		49	107	1.0	1.0	
Walking uphill:										
Less than once a day	267	523	1.5	1.6	0.8 to 3.1	111	216	1.4	1.9	0.7 to 4.7
Once daily or more	13	37	1.0	1.0		9	24	1.0	1.0	
Walking with a load:										
Less than once a day	268	513	2.1	2.3	1.2 to 4.7	111	218	1.3	1.4	0.6 to 3.3
Once daily or more	11	45	1.0	1.0		9	22	1.0	1.0	

*Information was not available for all subjects.

†Adjusted for cigarette smoking and alcohol consumption.

TABLE III—*Past physical activity and risk of hip fracture in 400 patients with hip fracture and 800 controls**

Frequency of activity	Relative risk						
	No of patients	No of controls	Non-adjusted	95% Confidence interval	Adjusted†	95% Confidence interval	
						Women	Men
Walking uphill:							
Less than once a day	53	154	1.6	1.1 to 2.2	1.6	1.1 to 2.3	
Once daily or more	227	406	1.0		1.0		
Walking with a load:							
Less than once a day	126	272	1.2	0.9 to 1.5	1.2	0.9 to 1.6	
Once daily or more	153	286	1.0		1.0		
Walking uphill:							
Less than once a day	19	51	1.5	0.8 to 2.8	1.5	0.8 to 2.9	
Once daily or more	101	189	1.0		1.0		
Walking with a load:							
Less than once a day	38	103	1.6	1.0 to 2.6	1.7	1.1 to 2.8	
Once daily or more	82	137	1.0		1.0		

*Information was not available for all subjects.

†Adjusted for cigarette smoking and alcohol consumption.

TABLE IV—*Dietary calcium intake and risk of hip fracture in 400 patients with hip fracture and 800 controls*

Fifths of the distribution of calcium intake (mg/day)	Relative risk						
	No of patients	No of controls	Non-adjusted	95% Confidence interval	Adjusted†	95% Confidence interval	
						Women	Men
Women							
<75	93	137	1.9	1.2 to 2.9	1.9	1.2 to 2.9	
75–	47	72	1.8	1.1 to 3.0	1.9	1.1 to 3.1	
83–	42	105	1.1	0.7 to 1.9	1.1	0.7 to 1.9	
129–	57	126	1.3	0.8 to 2.0	1.2	0.8 to 2.0	
≥244	41	120	1.0		1.0		
Men							
<75	44	67	2.0	1.1 to 3.7	2.1	1.1 to 4.2	
75–	14	30	1.4	0.6 to 3.2	1.4	0.6 to 3.4	
83–	23	44	1.6	0.8 to 3.2	1.7	0.8 to 3.7	
129–	20	40	1.5	0.7 to 3.2	1.5	0.7 to 3.2	
≥244	19	59	1.0		1.0		

*Adjusted for cigarette smoking and alcohol consumption.

increased risks associated with all these activities remained significant ($p=0.05$) except for that associated with walking uphill less often than once a day remained after adjustment for smoking and alcohol ($p<0.05$). For men a significant increase in risk associated with walking with a load less than once a day also remained after adjustment ($p<0.05$).

Table III shows the relation between past physical activity and the relative risk of fracture. Among women a significant increase in risk associated with walking uphill less often than once a day remained after adjustment for smoking and alcohol ($p<0.05$). For men a significant increase in risk associated with walking with a load less than once a day also remained after adjustment ($p<0.05$).

The mean daily calcium intake of the patients in the study group was lower than that of the controls. The intake was 128 mg in female patients (interquartile

range 75-176 mg) compared with 168 mg in female controls (76-214 mg) and 141 mg in male patients (75-164 mg) compared with 177 mg in male controls (75-226 mg). Table IV shows a fall in relative risk of hip fracture with increasing calcium intake in women and men. This trend remained significant after adjustment for cigarette smoking and alcohol intake in women ($\chi^2=21.4$, $df=1$, $p<0.01$) and men ($\chi^2=4.4$, $df=1$, $p=0.036$). In the logistic regression the trends in risk with physical activity and calcium intake were independent of each other.

Discussion

We showed that among elderly women in Hong Kong regular daily weight bearing activity and a higher dietary calcium intake were associated with a reduced risk of hip fracture. Among elderly men there was a similarly strong relation with calcium intake but the relation with activity was not significant.

The rates of response for both patients and controls were high. There were, nevertheless, potential sources of bias in both sets of controls. The hospital control group may have overrepresented people with an inactive lifestyle and atypical diet, whereas the community control group may have been biased towards fitter individuals who had moved out of Kowloon to a newly built suburb. The differences in physical activity and calcium intake between patients and controls were, however, similar for both control groups.

In 1970 Chalmers and Ho suggested that hard physical labour might be the factor that protected the Bantu, the Singaporean, and the Hong Kong Chinese against hip fracture.⁴ The increasing incidence of hip fracture that has been shown in the Chinese population of Hong Kong could be the result of rapid urbanisation and a reduction in weight bearing physical activity.¹²

The mean daily intake of calcium was low in both patients and controls in comparison with Britain. The estimated daily intake among controls was 171 mg compared with 689 mg in a population of similar age in Southampton (see accompanying paper, p 1443). There was little overlap in the two distributions. Calcium intake in Hong Kong was assessed from only nine food items and will have been underestimated. This, however, is unlikely to account for the large difference from Britain. Low calcium intake is a known characteristic of the Chinese diet,² in which consumption of dairy products is low. Rice is eaten with one or two other dishes in every meal in the traditional Chinese diet. These dishes can be of mixed (such as meat fried with green vegetables) or single ingredients (such as steamed fish); 78% of patients and 81% of controls ate green vegetables daily; 17% of patients and 27% of controls reported that they ate small fish at least once a

week. Soya bean curd, which is an important potential source of calcium in the Chinese diet, was eaten at least once a week by 35% of controls but by only 27% of patients. In contrast to the data from Southampton, calcium was found to protect against fracture in both women and men. In the past low calcium intake might have been offset by a high level of weight bearing physical activity, which maintained bone mass. The decline in activity which followed the construction of high rise apartments and the disappearance of walking space may have unmasked the adverse skeletal effect of a low calcium intake.

Public health strategies to reduce the rising incidence of hip fractures in urbanising oriental populations are urgently required. Our results point to the importance of maintaining physical activity and calcium intake in elderly Chinese people who grew up in rural communities, characterised by high levels of physical

activity and a diet low in calcium, but are now mostly living in flats in high rise buildings while continuing to eat a traditional diet.

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Physical activity, muscle strength, and calcium intake in fracture of the proximal femur in Britain

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Abstract

Regular exercise and high calcium intake possibly help to preserve bone mass. Little is known, however, about their role in preventing hip fracture. The physical activity and calcium intake of 300 elderly men and women with hip fractures were compared with those of 600 controls matched for age and sex. In both sexes increased daily activity, including standing, walking, climbing stairs, carrying, housework, and gardening protected against fracture. This was independent of other known risk factors, including body mass, cigarette smoking, and alcohol consumption. Strength of grip correlated with activity and was inversely related to the risk of fracture. Calcium intake was not related to the risk of fracture in women. Men with daily calcium intakes above 1g had lower risks.

These findings point to the importance of elderly people in Britain maintaining physical activity in their day to day lives.

Introduction

Hip fractures in elderly people are an important public health problem. Osteoporosis and falls are two known aetiological factors.¹ Regular exercise and high calcium intake, measures that possibly preserve bone mass,² offer the main immediate population based strategy for preventing osteoporosis. Little information, however, is available about their role in preventing hip fracture,³ and hence no scientific basis exists for recommending them as part of a national preventive campaign. We used validated methods to compare physical activity and calcium intake in a series of elderly patients with hip fractures and community controls. We measured the independent contribution of each of these two factors to the risk of hip fracture after allowing for the confounding effects of other known risk factors, which include low body mass, cigarette smoking, and alcohol consumption.³

Patients and methods

We recruited 473 patients aged 50 and over who lived in Southampton health district and were

admitted sequentially to the orthopaedic wards of this hospital. Fifteen patients died before they could be approached, and 12 declined to participate. The remaining 446 completed a 10 point Hodkinson abbreviated mental test score,⁴ and the 300 patients (240 women and 60 men) who scored more than 6 became the study group. We estimated that a study of this size had a 90% power of detecting a relative risk of 1.7 or more in women and 3.0 or more in men at the five per cent level of significance, assuming a 30% exposure of the controls to a dichotomous risk factor.

Patients in the study group were compared with 600 community controls, resident in the same district, who were selected from the register of Hampshire Family Practitioner Committee. Controls were individually matched to the patients in the study group by sex and age within four years. The rate of response among controls was 71% of those contacted. When a control refused to participate or failed the mental test score a substitute was selected.

All patients in the study group and the controls were interviewed by one of three trained interviewers. Each case-control set was seen by the same interviewer. Patients were interviewed in hospital within ten days of admission. Controls were interviewed within three months of their matched patient (68%) or during the corresponding quarter a year later (32%).

Physical activity in the six weeks before the interview was estimated with a validated questionnaire for the assessment of customary activity in the elderly.⁵ Five indices of current activity were derived: self reported walking speed, time spent standing indoors, time spent walking outdoors, frequency of muscle loading activity such as climbing stairs or carrying loads, and time spent in productive activities such as gardening and housework.

Current calcium intake was measured with a frequency and amount questionnaire, which obtained information about the consumption of six food items: milk, bread, cheese, puddings, cakes, and biscuits. A Department of Health survey of elderly people in Britain suggested that 87% of their total calcium intake was derived from these food items.⁶ We have shown previously that estimates of calcium intake with this questionnaire correlate well with those derived from

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