

# Risk Factors for Hip Fracture in US Men Aged 40 through 75 Years

## ABSTRACT

Relatively few studies have examined risk factors for hip fracture among men. This study analyzes data from the Health Professionals Follow-up Study, a prospective study of approximately 50 000 men who were between the ages of 40 and 75 years in 1986. Body mass index, smoking status, and alcohol consumption were not associated with hip fracture in this population. However, age and height were related to hip fracture. Men who were 65 and older had a significantly higher risk of sustaining a hip fracture than younger adults. Men 6 feet or taller were more than twice as likely to sustain a hip fracture as those under 5 feet, 9 inches. (*Am J Public Health*. 1994;84:1843-1845)

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### Introduction

Hip fractures are a major public health problem in the United States.<sup>1</sup> The incidence is highest among White women, but it is still substantial among White men.<sup>2-4</sup> Yet little is known about risk factors for hip fracture among men.<sup>5,6</sup>

We employed a prospective approach to investigate risk factors for hip fracture among American males. With data from the Health Professionals Follow-up Study, a large prospective cohort study of predominantly middle-aged men, we estimated the effect of age, height, body mass index, and cigarette and alcohol consumption on the risk of fracture of the hip.

### Methods

The Health Professionals Follow-up Study is a prospective investigation of 51 529 male health professionals (primarily dentists and veterinarians) who were 40-75 years of age in 1986. Approximately 97% of the respondents are White.

The baseline questionnaire for the study was sent in 1986, and follow-up questionnaires were mailed in 1988, 1990, and 1992. Reported data for the independent variables are from the baseline questionnaire.

The five independent variables included in the analysis were (1) age (seven 5-year age categories: 40-44 through 65-69 and  $\geq 70$ ); (2) height (< 69 inches, 69 inches, 70-71 inches,  $\geq 72$  inches); (3) body mass index ( $\text{kg}/\text{m}^2$ , in quintiles); (4) cigarette smoking (never smoker, past smoker, present smoker); and (5) average daily alcohol intake (none, 0.1-15, 15.1-30, > 30 g/day).

For the present analysis, we included 49 895 members of the cohort. Excluded were 1634 individuals for whom baseline information regarding alcohol consumption was incomplete.

Various studies have validated questionnaire responses provided by study participants.<sup>7-10</sup> In addition, hip fracture cases were confirmed through follow-up. To ensure that all cases were identified

for fatalities, medical records as well as death certificates were reviewed.

Incidence rates were calculated as the number of hip fractures divided by the person-time of follow-up. Each participant accumulated person-years of follow-up from the date of the return of the 1986 questionnaire to the end of the follow-up period (January 31, 1992) or up to the date of fracture (271 484 person-years).

### Results

During approximately 270 000 years of follow-up, we documented 67 incident hip fractures. The incidence of hip fracture was substantially higher among older individuals (Table 1). Whereas the incidence of hip fracture did not vary significantly between the ages of 35 and 64 years, the multivariate relative risk (RR) of those aged 65 to 69 was three times that of younger respondents (RR = 3.41, 95% confidence interval [CI] = 1.54, 7.53). The multivariate relative risk of those age 70 and over was more than four times higher (RR = 4.44, 95% CI = 1.94, 10.18).

Body mass index, smoking, and alcohol consumption were neither protective nor risk factors for hip fracture (Table 2). However, we did observe a positive association between height and hip fracture. For men 6 feet or taller, compared with those shorter than 5 feet, 9 inches, the multivariate relative risk of hip fracture was 2.24 (95% CI = 1.14, 4.41). The risk of fracture increased monotonically

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**TABLE 1—Multivariate Relative Risk (RR) for Hip Fracture, by Age**

Age, y	No. Cases/ Person-Years	RR	Multivariate RR <sup>a</sup>	95% CI
40–44	10/57 115	1.00	1.00 (reference)	...
45–49	6/40 157	0.85	0.86	0.31, 2.35
50–54	6/41 389	0.83	0.85	0.31, 2.34
55–59	7/40 911	0.98	1.01	0.38, 2.67
60–64	7/40 401	0.99	1.07	0.40, 2.82
65–69	17/31 418	3.09	3.41	1.54, 7.53
≥ 70	14/20 093	3.98	4.44	1.94, 10.18

<sup>a</sup>Controlling for height, body mass index, smoking status, and alcohol consumption.

**TABLE 2—Age-Adjusted and Multivariate Relative Risk (RR) for Hip Fracture, by Height, Body Mass Index, Smoking Status, and Alcohol Consumption**

	No. Cases/ Person- Years	Age-Adjusted RR	Multivariate RR <sup>a</sup>	95% CI (Multivariate RR)
<b>Height, inches</b>				
< 69	13/72 084	1.00 (reference)	1.00 (reference)	
69	6/32 310	1.11	1.14	0.43, 3.00
70–71	22/83 410	1.68	1.74	0.87, 3.46
≥ 72	26/83 528	2.40	2.24	1.14, 4.41
<i>P</i> , trend <sup>b</sup>		<.01		
<b>Body mass index, kg/m<sup>2</sup></b>				
Quintile 1 (median = 21.8)	14/53 517	1.00 (reference)	1.00 (reference)	
Quintile 2 (median = 23.5)	14/53 223	1.01	1.02	0.49, 2.15
Quintile 3 (median = 24.8)	16/53 754	1.15	1.13	0.55, 2.32
Quintile 4 (median = 26.2)	9/52 457	0.67	0.68	0.29, 1.58
Quintile 5 (median = 28.9)	13/52 428	1.01	0.99	0.46, 2.12
<i>P</i> , trend <sup>b</sup>		.34		
<b>Smoking status</b>				
Never smoker	26/121 038	1.00 (reference)	1.00 (reference)	
Past smoker	29/114 021	1.06	1.05	0.61, 1.81
Present smoker	6/25 882	1.12	1.08	0.44, 2.67
<i>P</i> , trend <sup>b</sup>		.41		
<b>Alcohol consumption, g/day</b>				
None	16/63 992	1.00 (reference)	1.00 (reference)	
0.1–15	34/135 874	1.05	1.06	0.58, 1.93
15.1–30	9/38 504	0.98	0.95	0.42, 2.17
> 30	8/33 114	0.95	0.91	0.38, 2.17
<i>P</i> , trend <sup>b</sup>		.45		

<sup>a</sup>Controlling for age, height, body mass index, smoking status, and alcohol consumption.

<sup>b</sup>*P* values are two-sided.

with height, and the trend was significant at the .05 level. The height–hip fracture association remained after controlling for age, and also for body mass index, smoking, and alcohol consumption. In our population, body mass index and body height were not correlated ( $r = -.02$ ).

## Discussion

It is well known that after age 40–50 years, the risk of hip fracture rises exponentially for both women and men.<sup>2,4,11</sup> In our study population, we found a marked increase in hip fracture after age 65.

Body height also increased the risk of hip fracture. This finding is consistent with a recent prospective study of 50 000 Norwegian men and women.<sup>6</sup> The limited evidence from case-control studies is mixed. One investigation of postmenopausal women<sup>12</sup> and two of aged fallers found that subjects with hip fracture were significantly taller than control subjects.<sup>12,13</sup> A third found a suggestive, but nonsignificant, relationship between body height and risk of hip fracture.<sup>14</sup> However, in two other studies, case and control subjects were of equal mean height.<sup>15,16</sup>

One possible explanation for the relationship between body height and hip fracture is that because tall people fall from a greater height (for standing falls), they would be expected to impact the surface at a greater velocity.<sup>17</sup> On the other hand, the positive association of height and hip fracture may be mitigated by the fact that the bones of taller people may be stronger.<sup>18</sup>

Numerous studies have found that for both women<sup>6,12,15,19–24</sup> and men,<sup>5,6</sup> low body mass index is a risk factor for hip fracture. We found no relationship.

Two studies that examined hip fracture among men did not find that cigarette smoking was a risk factor for hip fracture.<sup>5,25</sup> We also failed to find such a relationship. However, fewer than 3% of our sample smoked more than 25 cigarettes per day.

The majority of recent investigations<sup>5,25–27</sup> found a significant positive association between heavy alcohol consumption and risk of hip fracture. We found no such association. However, only 4% of our cohort were heavy drinkers (> 30 g of alcohol per day). In addition, our alcohol measure was daily alcohol consumption rather than blood alcohol content at the time of injury.<sup>28,29</sup> As a result, our ability to discern a relationship between heavy drinking and hip fracture may have been limited.

In addition, it is possible that both smoking<sup>30,31</sup> and heavy alcohol consumption<sup>32–35</sup> increase the risk of osteoporosis but did not alter the risk of fracture among our population because they were too young.

The generalizability of our results is somewhat limited. We include only well-educated health professionals; virtually no one in this cohort would be expected to be poor. Our subjects appeared to sustain hip fractures at substantially lower rates than the national average for their age and gender.<sup>36</sup> Further, our study examined only the low-risk tail of the “at risk”

population. Women and the elderly are at greatest risk, but few of our subjects were elderly, and none were female.

Our most intriguing finding is the correlation between height and hip fracture. We found a significant, monotonic increase in risk of fracture with height. Men 6 feet or taller had over twice the age-adjusted relative risk of sustaining a hip fracture as those under 5 feet, 9 inches. Additional studies are needed to further investigate the body height-hip fracture relationship. □

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