

DAIRY-PRODUCT INTAKE AND HIP FRACTURE AMONG OLDER WOMEN: ISSUES FOR HEALTH BEHAVIOR

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Abstract:

Summary.— *The purpose of this study was to examine the association between dairy-product intake and hip fracture among a national sample of women aged 50 years and older. Univariate analyses using SAS procedures showed dairy-product intake was significantly associated with hip fracture. Women who had suffered hip fracture reported higher dairy use than women who had not experienced these fractures, a finding that is dramatically inconsistent with the literature. This finding may reflect positive behavioral changes resulting from the hip fracture event. Further research must focus on changes in health behavior after fracture, which may assist in understanding the roles of specific theories of health behavior. Application of principles of health behavior could improve the effectiveness of preventive treatment programs for osteoporosis.*

Article:

Osteoporosis is one of the most prevalent diseases of aging, affecting more than 25 million people in the United States, 80% of whom are women (McBean, Forgac, & Finn, 1994). It is responsible for approximately 250,000 hip fractures a year in the United States (Dempster & Lindsay, 1993). Most of the mortality associated with osteoporosis is due to hip fractures (Melton, O'Fallon, & Riggs, 1987).

Hip fracture is the leading cause of morbidity associated with osteoporosis. People who experience this serious event have a 5% to 20% reduction from expected survival within months (Melton, *et al.*, 1987). Twenty percent of people with hip fractures die within a year (McBean, *et al.*, 1994). After a hip fracture, possibly fatal complications can occur, such as massive hemorrhage or pulmonary embolism. Other associated complications include pressure ulcers, pneumonia, urinary tract complications, and severe depression (Riggs & Melton, 1995).

Approximately 50% of hip fracture patients who were ambulatory prior to the fracture never walk independently again (Mc-Bean, *et al.*, 1994), and one-quarter require long-term assisted health care (Phillips, Fox, Jacobs, & Wright, 1988).

The economic cost of hip fractures is estimated to be \$13.8 billion annually with \$10.3 billion spent on treatment for Euro-American women (Ray, Chan, Thamer, & Melton, 1997). As the population ages and medical costs *escalate*, estimates indicate that the annual number of hip fractures could triple by the year 2040. One conservative estimate states that the cost of hip fractures alone will escalate to approximately \$240 billion by the year 2040 (Cummings, Rubin, & Black, 1990).

Older women are considered a high-risk group for hip fracture. The federal government has stated the urgent need to reduce deaths from falls and incidences of hip fractures (U.S. Department of Health and Human Services, 1990). The Year 2000 Health Objectives for the Nation call for a reduction in the rate of hip fracture among Euro-American women aged 65 years and older to 2,177 per 100,000 (USDHHS, 1990). Unfortunately, progress in this area has been minimal. In 1988 there were 2,721 fractures per 100,000, and by 1995, this rate had only improved slightly; the rate was 2,604 fractures per 100,000 (USDHHS, 1997).

Maintaining positive nutritional status has been suggested to minimize risk of osteoporosis. Adequate nutrition has been estimated to reduce the effect of osteoporosis by *as* much as one-half (McBean, *et al.*, 1994). In 1984, the Consensus Development Conference on Osteoporosis suggested that increased intakes of calcium might help prevent osteoporosis (National Institutes of Health, 1994). Calcium has long been recognized as crucial to bone health; however, researchers disagree regarding the effect of calcium on bone health (Riggs, Wahner, Melton, Richelson, Judd, & O'Fallon, 1987). Traditionally, nutritionists have recommended obtaining calcium from food due to enhanced bioavailability and improved absorption (Weaver, 1992).

The purpose of this study was to examine the relationship between hip fracture and dairy-product intake among a national sample of women aged 50 years and older. In addition, other risk factors associated with hip fracture were examined.

METHOD

The subjects included in this study were participants in the Third National Health and Nutrition Examination Survey (NHANES III), Phase 1. This large-scale national health survey was conducted by the National Center for Health Statistics from 1988 to 1991 (USDHHS, 1994). Data were randomly collected and Hispanic Americans, African Americans, and all groups aged 60 years and older were oversampled to provide reliable estimates for these groups (Ezzati, Massey, Waksberg, Chu, & Mauer, 1992). This secondary data base was designed to collect cross-sectional data. For purposes of this study, only women aged 50 years and older were studied because these women were considered at risk for hip fractures (Black, 1995; Cummings, Nevitt, Browner, Stone, Fox, Ensrud, Cauley, Black, & Vogt, 1995; McKnight, Steele, Mills, Gilchrist, & Taggart, 1995). The sample for this study included 2,336 women aged 50 years and older.

The correlates examined were the nine most frequently cited risk *factors* for hip fracture (Cummings, *et al.*, 1995; Lindsay, 1995; Murray & O'Brien, 1995). These risk factors included age, race, biological mothers' osteoporosis status, biological mothers' hip fracture status, body mass index, physical activity, smoking status, alcohol use, and dairy-product intake.

Age and race were self-reported. Subjects were classified into age groups of 50 to 64 years ($n = 867$) and 65 years and older ($n = 1,469$). Women aged 50 years and older have been studied for osteoporosis most extensively (Melton, 1992), and women aged 65 years and older are recognized as a high-risk group for hip fracture (USDHHS, 1994). Ethnic categories included non-Hispanic Euro-American, non-Hispanic African American, Hispanic American, and other.

Body mass index values were calculated based on height and weight values and participants were grouped into four categories. Subjects were classified as underweight (BMI less than 20), acceptable weight (BMI between 20.1 and 25), overweight (BMI between 25.1 and 30), and severely overweight (BMI greater than 30) (Committee on Diet and Health, 1989).

Physical activity information was obtained from self-reported data from the following items: "In the past month, how often did you: walk a mile or more, jog or run, ride a bicycle or exercise bicycle, swim, do aerobics or aerobic dancing, do other dancing, do calisthenics or exercises, do gardening or yard work, lift weights, do other exercises, sports, or physically active hobbies not mentioned?" Data from these responses were summarized to yield a total frequency variable. Subjects were divided into categories of two times a week or more and less than two times per week (Nelson, Fiatarone, Morganti, Trice, Greenberg, & Evans, 1994).

Smoking information was obtained from responses regarding smoking behavior. Subjects were classified as former smokers, current smokers, and nonsmokers. Alcohol consumption was categorized according to *The Dietary Guidelines for Americans* recommendation that consumption be limited to one drink in a single day (Committee on Diet and Health, 1989). Subjects were grouped according to reported consumption of one or more times a day versus less than one time per day.

Dairy product intake was selected to obtain information regarding calcium *intake*. Food frequency information was utilized as it helps pinpoint food groups, and therefore nutrients, that may be deficient in the diet. Subjects *were* asked how often they consumed milk, yogurt, cheese, and ice cream. Responses to these questions were summarized to give a total number of dairy products consumed per day.

A large-scale national study of calcium intakes showed that for most people, about 50% of total dietary calcium was supplied by dairy products while the remaining 50% was supplied by food mixtures that contained dairy products and other nondairy calcium-containing products (Fleming & Heimbach, 1994). Therefore, if people consume two dairy products *a* day (600 mg), they are likely obtaining 'another 600 mg from other food sources.

Two servings of dairy products then translates into an estimated total of 1,200 milligrams of calcium per day, an amount equal to the Adequate Intakes value of the newly released Dietary Reference Intakes for women aged 51 years and older (National Academy of Sciences, 1997). In addition, national health objectives recommend that people aged 25 years and older: consume two or more servings of calcium-rich foods daily (USDHHS, 1990). Therefore, subjects who consumed these products two or more times a day were compared with those who consumed them fewer than two times a day.

Hip fracture status was measured by information obtained from responses to the following items: "Has a doctor ever told you that you had broken or fractured your hip?" and "Was that fracture a result of a fall from standing height or less, harder fall, or severe trauma?" Women who responded yes to having a hip fracture and yes to the fracture being a result from a fall from standing height or less were classified as positive for osteoporotic hip fracture (Looker, Harris, & Wahner, 1992).

Univariate analyses were conducted using the PC version of Standard Analysis System (SAS) programs (Version 6.11, SAS Institute, Cary, NC). SAS programs, widely used in social science research, are commonly used for univariate analysis (Hatcher & Stephanski, 1994).

RESULTS AND DISCUSSION

This sample consisted of 2,336 women aged 50 years and older who were interviewed for Phase 1 of the Third National Health and Nutrition Examination Survey (NHANES III). The mean age of the women in this study was 68.8 yr. ($SD = 11.5$, range 50 to 100). Results are displayed in Table 1. These results indicated age ($p = .001$), ethnic group ($p = .001$), mothers' hip fracture status ($p = .003$), body mass index ($p = .001$), physical activity ($p = .009$), and dairy product intake ($p = .004$) were significantly associated with hip fracture. Mothers' osteoporosis diagnosis, smoking status, and alcohol use were not significant variables.

Of particular concern was the analysis that pertains to calcium intake. At the time of the survey, only 25% (574) of the subjects consumed the recommended amounts of dairy products each day, while 75% (1,762) consumed fewer than two servings of dairy products per day. Ten percent (60) of the women who consumed adequate amounts of dairy products experienced hip fracture while a smaller percentage (7% or 120) of the women who consumed inadequate dairy products experienced fracture. This is *a* startling finding: a greater percentage of women who consumed adequate dairy products had fracture when compared to women who consumed inadequate amounts of dairy products. These findings were not consistent with prior studies that cite calcium intake as crucial to bone health.

In addition, women who had suffered hip fracture reported higher dairy use than women who had not experienced these fractures, a finding that appears to contradict the literature. This finding may not be contradictory, however; it is possible the measure may be of behavior which occurred after fracture. Cross-sectional data can not establish a time sequence between disease development and risk factors; therefore, it is possible that women who suffered hip fracture, the most serious outcome of osteoporosis, increased their dairy consumption after the trauma.

TABLE 1
CORRELATES FOR HIP FRACTURE: PERCENT OF SAMPLE RESPONDING

Correlate	Hip Fracture, %						p
	Yes n = 180		No n = 2,156		Total N = 2,336		
	f	%	f	%	f	%	
Age, yr.							.001
50-64	15	2	852	98	867	37	
≥ 65	165	11	1,304	89	1,469	63	
Ethnic Group							.001
Euro-American	148	11	1,225	89	1,373	59	
African American	10	2	496	98	506	21	
Hispanic	19	5	381	95	410	18	
Other	3	6	44	94	47	2	
Mother's Osteoporosis Dx							ns
Yes	7	8	82	92	89	4	
No	156	8	1,910	92	2,066	88	
Don't Know	17	9	164	91	181	8	
Mother's Hip Fracture Status							.003
Yes	24	14	148	86	172	7	
No	145	7	1,909	93	2,054	88	
Don't Know	11	10	99	90	110	5	
Body Mass Index							.001
Underweight	48	12	351	88	399	17	
Normal Weight	83	9	883	91	966	41	
Overweight	28	5	528	95	556	24	
Obese	21	5	394	95	415	18	
Physical Activity							.009
≥ 2 Times per Week	43	6	721	94	764	33	
< 2 Times per Week	137	9	1,435	91	1,572	67	
Smoking Status							ns
Current Smoker	21	5	377	95	398	17	
Former Smoker	51	9	496	91	547	23	
Nonsmoker	108	8	1,283	92	1,391	60	
Alcohol Use							ns
≥ 1 per Day	7	9	74	91	81	3	
< 1 per Day	173	8	2,072	92	2,255	97	
Dairy-product Use							.004
≥ 2 per Day	60	10	514	90	574	25	
< 2 per Day	120	7	1,642	93	1,762	75	

Health behavior explanations lend support to this notion. The Protection Motivation Theory (Maddox & Rogers, 1998) states that, when people perceive threats to their well being, they are likely to take action to protect themselves from harm. After suffering from serious fractures, participants may have perceived the threat of osteoporosis and, being counseled to increase calcium intake to protect themselves, may have increased their intakes of dairy products.

This behavior is further supported by the Health Belief Model developed by Rosenstock and Hochbaum (Rosenstock, 1974). This model states that people change health behaviors when they perceive they are susceptible to a disease and when they perceive the disease is serious (Danz & Becker, 1984). Experiencing a fracture would prompt a person to feel susceptible as well as to perceive the severity of osteoporosis.

Components of this behavior theory have been attributed to increased compliance with medical advice (Becker & Rosenstock, 1984). According to the Health Belief Model, these women would be very likely to take positive action such as increasing their calcium intakes. Many cues to action regarding calcium intake exist in dairy-product advertising.

Research supports the idea that the Health Belief Model may be valuable in understanding attitudes and behaviors of women regarding osteoporosis. A 1991 survey of 750 American women showed that 71% of

women at risk for osteoporosis were unaware of the severity of osteoporosis as 80% did not associate osteoporosis with disabling hip fractures, 90% did not know death was a potential outcome, and 60% could not identify potential risk factors (Gallup Survey Finds, 1992). Another study confirmed these undesirable attitudes among young women; they indicated awareness of the risks of osteoporosis but were unconcerned about the specific potential harm to them as individuals (Anderson, Auld, & Schiltz, 1996). In yet another study of 127 college women, only 6.7% consumed adequate calcium and most believed they would not develop osteoporosis (Kasper, Peterson, Allegrante, Galsworthy, & Gunn, 1994). These studies indicate that, when women do not perceive that they are susceptible to osteoporosis and when they do not understand the severity of osteoporosis outcomes, they are unconcerned and unlikely to take preventive actions.

Findings from this study point to the need for further research to examine behavior changes related to dairy-product intake following the event of hip fracture. Constructs of the Health Belief Model can be examined such as perceived severity and susceptibility for their usefulness in predicting dairy-product intake. If these constructs are useful, prevention and treatment programs could be designed to integrate and apply constructs of the model to encourage positive behaviors. In addition, components of this model could be applied in counseling about osteoporosis. Strategies which extend beyond traditional educational methods must be developed to impart knowledge and facilitate behavioral change.

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