Spinal bone density and calcium intake in healthy postmenopausal women

Mark B Andon, Kenneth T Smith, Mark Bracker, David Sartoris, Paul Saltman, and Linda Strause

ABSTRACT Dietary calcium intake and bone mineral density (BMD) of the lumbar spine (L2–L4) were determined in 131 healthy free-living postmenopausal women (aged 64.7 ± 7.6 y, x ± SD). The calcium consumption for the total population was 606 ± 302 mg/d. Subjects consuming less than the population mean of dietary calcium had significantly lower BMDs than did subjects with intakes above the mean (P < 0.009); these two groups did not differ in basic demographic characteristics. Additional analyses using a stepwise univariate regression model demonstrated that BMD was significantly associated with body weight (P < 0.001) and dietary calcium intake (P < 0.02). These data support the hypothesis that dietary calcium intake is a determinant of skeletal health in postmenopausal women. *Am J Clin Nutr* 1991;54:927–9.

KEY WORDS Bone density, spine, calcium intake, postmenopausal, dual-photon absorptiometry

Introduction

Osteoporosis is a major health concern affecting 15–20 million Americans and it resulted in a total cost to the US economy of $7–10 billion in 1983 (1). Although increased calcium intake yields an initial positive shift in calcium balance and suppresses biochemical indices of bone remodeling (2–5), a positive relationship between calcium intake and bone mineral density (BMD) in postmenopausal women is not universally accepted (6). To a large extent this stems from intervention trials of women in early postmenopause, when calcium appears to have little benefit (7–9). The effect of calcium on the bone mass of women several years after menopause is less well-documented. This study examines the cross-sectional relationship between dietary calcium intake and BMD in a group of older, free-living, postmenopausal women.

Subjects and methods

A total of 232 Caucasian, postmenopausal women were recruited from the San Diego greater metropolitan area. Recruitment was accomplished through advertisements and mailers to local family-practice clinics. Volunteers were eligible if they were aged ≥ 50 y and in good general health as judged by medical history and routine clinical blood analyses (complete blood count and differential count). Volunteers with a history of estrogen-replacement therapy (ERT) were included and classified as positive for ERT if they had received therapy for a consecutive period of ≥ 1 y since menopause. Volunteers were excluded from the study if they had a history of calcium supplementation; a positive Pap smear or mammogram during the previous year; used any drug other than estrogen or had any disease or condition known to affect bone or calcium metabolism; taken corticosteroid medications longer than 6 mo at any time during their life; or a history of chronic renal, hepatic, or gastrointestinal disease and/or evidence of collapsed or focal vertebral sclerosis. One hundred thirty-one women aged 52–92 y were included in the study. All procedures were approved by the Human Studies Research Committee of the University of California, San Diego, and written informed consent was obtained from each woman before her inclusion in the study.

A food-frequency questionnaire was administered to each subject to determine dietary calcium intake. The questionnaire was a modification of one used at the Clinical Research Center, Indiana University. The questionnaire contained 18 different food or food-group categories with portion sizes rated as small, medium, or large and frequency of consumption rated as per day, week, month, or year. Subjects were instructed to estimate the amount and frequency of foods consumed over the past year. Estimates of dietary calcium intake by postmenopausal women using similar food-frequency instruments were shown to correlate well with values generated with 7-d food records (10). In addition, food-frequency instruments have the advantage of obtaining retrospective information of usual dietary habits over a longer period of time rather than specific estimates of nutrient intake on the days they are collected.

Lumbar (L2–L4) vertebral BMD was determined with a Lunar dual-photon absorptiometer (DPA) model DP-3 (Madison, WI). The coefficient of variation for this method is ~2% (11). Subjects were scanned while lying supine on the scanner table with feet elevated on a block to straighten the lumbar lordotic curvature. All spinal bone density scans were reviewed for evidence of ver-

1 From the Procter & Gamble Company, Miami Valley Laboratories, Cincinnati, and the Departments of Community and Family Medicine, Radiology, and Biology, University of California—San Diego, La Jolla.
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3 Address reprint requests to MB Andon, The Procter & Gamble Company, Miami Valley Laboratories, PO Box 39175, Cincinnati, OH 45239.

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tebrae with collapsed or focal sclerosis by an experienced radiologist.

A mean and SD or SE about the mean were calculated for each variable. Pearson correlations were calculated from least-squares linear-regression analysis. The contribution of continuous variables for predicting BMD was evaluated with a stepwise (forward) univariate multiple-linear-regression procedure. Additional analyses were performed subsequent to dividing the subjects' data into two groups according to whether their dietary calcium intake was above or below the mean intake. With the data partitioned in this way, unpaired two-tailed t tests and chi-square analysis were used to assess the effect of the level of dietary calcium intake on BMD and other variables. Statgraphics version 2.1 (STSC, Inc, Rockville, MD) was used for all statistical analyses.

Results

Characteristics of subjects and results of linear-regression analysis are summarized in Tables 1 and 2, respectively. Dietary calcium intake and body weight were independently and significantly correlated with BMD. Dietary calcium intake was not significantly correlated with age, age at menopause, weight, or height. A stepwise multiple-regression procedure was used to determine the effects of all continuous variables in a model to predict BMD (Table 3). Because body weight possessed the most significant independent association with BMD, it was first variable added to a univariate multiple-linear-regression model. After weight was controlled for, the addition of dietary calcium intake was the only other variable that significantly improved the regression model.

The results obtained by grouping the subjects by dietary calcium intake are presented in Table 4. Subjects consuming less than the population mean of dietary calcium had significantly lower BMD than did subjects with intakes above the mean (P < 0.009). There were no significant differences between these two groups for history of ERT, years of ERT, current age, age at menopause, height, weight, body mass index, or use of tobacco or alcohol.

Discussion

Age-related bone loss has a complex etiology involving gender, race, heredity, physical activity, endocrine factors, and nutritional influences. Diet may affect skeletal health throughout the life cycle. Increased calcium intake causes a positive shift in calcium
References


