How Important Is Dietary Calcium in Preventing Osteoporosis?

Researchers are questioning whether dietary calcium plays a significant role in the prevention of osteoporosis and report evidence that it may not

At a recent meeting of the American Society for Bone and Mineral Research, two investigators reported evidence that, contrary to popular belief, calcium intake in adulthood may have nothing to do with osteoporosis. The studies call into question the dietary recommendations of a 1984 National Institutes of Health consensus panel on osteoporosis yet they are consistent with a large body of evidence indicating no relationship between calcium intake and bone density within populations.

The calcium boom began a few years ago when the consensus panel on osteoporosis recommended that all Americans consume at least 1000 milligrams of calcium a day—the equivalent of three glasses of milk—and that postmenopausal women consume at least 1500 milligrams of calcium a day. The suggestion was that any less calcium could lead to osteoporosis.

Now millions of Americans consume calcium supplements and sales of calcium products have been increasing explosively. Sales are up a third from 1985, according to the *Wall Street Journal*, and are expected to hit $166 million this year. But, says osteoporosis researcher Michael Parfitt of Henry Ford Hospital in Detroit, the calcium advice was based on what was at best tenuous evidence that the mineral might help coupled with the reasoning that, at worst, it would do no harm.

B. Lawrence Riggs of the Mayo Clinic agrees. "The advertisers are out way ahead of the scientific evidence," he says. His own feeling about the consensus panel's advice is that "it may have been premature." Richard Mazess of the University of Wisconsin in Madison goes still further, calling calcium "the laetrile of osteoporosis."

The consensus panel's recommendations for calcium intake are derived in part from data presented at the consensus conference by Robert Heaney of Creighton University in Omaha. Heaney did calcium balance studies—notoriously difficult metabolic studies to determine how much calcium an individual must consume to stay in a biochemical equilibrium. His results are that premenopausal women and men need 1000 milligrams of calcium a day and that postmenopausal women need 1500 milligrams.

Still, the real question is, will consuming at least as much calcium as the consensus panel recommends decrease the risk of osteoporosis?

Others doing similar studies have gotten different answers, and sometimes obtained significantly lower figures—as low as 550 milligrams a day. Nonetheless, says Heaney, "I think our figures have held up quite well."

Still, the real question is, will consuming at least as much calcium as the consensus panel recommends decrease the risk of osteoporosis? At the meeting of the American Society for Bone and Mineral Research, Riggs and, independently, C. Christiansen of Golstrup Hospital in Denmark presented studies that failed to show a relationship between calcium intake and osteoporosis.

Riggs' study is of 107 women living in Rochester, Minnesota, who are 23 to 88 years of age. They were studied for an average of 4.3 years, and, during that time, Riggs and his associates repeatedly measured their bone density. The women consumed a wide range of calcium—anywhere from 269 to 2000 milligrams a day. But, for each woman, the calcium intake was steady throughout the study period, Riggs found.

The result, Riggs reports, is that "we found no correlation at all between calcium intake and bone loss, not even a trend." Even when Riggs and his colleagues took into account age, menopause status, and serum estrogen level, there was no correlation. Finally, Riggs tried still another way to look at the data. He looked specifically at those women in the upper quartile of calcium intake—those consuming more than 1400 milligrams a day—and compared them to those in the lower quartile—those consuming less than 500 milligrams a day. The rate of bone loss in the two groups, Riggs found, "was essentially the same."

Christiansen did a different sort of study. His was a 2-year double-blind trial comparing estrogen supplements to a 2000-milligram daily supplement of calcium to placebo in 43 women who were immediately postmenopausal. Only the estrogen significantly retarded bone loss. His conclusion is that calcium is no substitute for estrogen in preventing bone loss.

Mazess says he is not surprised by Riggs' and Christiansen's results because they are entirely consistent with numerous population studies showing that those in a population who consume the most calcium have no denser bones that those who consume the least calcium. "There is an abundance of data showing that calcium intake in a population is unrelated to bone density," he emphasizes.

In particular, Mazees says, there are quite a few studies of populations, including those of the United States, the Netherlands, and Switzerland. In each of these studies, according to Mazees, researchers looked at bone densities and dietary calcium. As a group, those who consumed the most calcium had no denser bones than those who consumed the least, so long as appropriate adjustments were made for body size and ethnic group.

A number of researchers are telling their patients that calcium supplements should be used only as a last resort, if at all. Parfitt says "I don't advise anyone to take calcium." Riggs says he tells his patients that despite "the enormous media hype" the answers on calcium are by no means in. He does not suggest calcium supplements but does advise patients to try and consume at least 1000 milligrams a day by drinking milk and eating foods such as cheese and yogurt. The

reason, he says, is that "osteoporosis is a serious disease and the nutritional value in dairy products goes beyond calcium. It is safe and inexpensive [to get calcium this way]. It is quite something else to say that the entire population should take calcium supplements."

Mazess says he is on record as opposing the consensus panel's calcium recommendations. "There is no evidence of efficacy and the safety has never been evaluated." He points out that a high calcium intake can lead to kidney stones in susceptible people and that calcium supplements cut off vitamin D, which is necessary for the cellular activation of bone cells.

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Riggs points out that his study applies only to adults. There is a body of evidence indicating that calcium intake in childhood and adolescence determines peak bone mass in adulthood. Those with greater peak bone mass are less likely to develop osteoporosis. Mazess notes that his remarks about calcium also apply only to adults.

The real danger of the calcium bandwagon, say Riggs and Mazess, is that women will believe that calcium is a substitute for estrogen in preventing osteoporosis. Estrogen supplements for postmenopausal women, the researchers agree, are the best way to slow bone loss.

Riggs also notes that a number of studies have shown that weight-bearing exercise can slow bone loss. And there are risk factors for osteoporosis that can be reduced. Smoking doubles a person's risk, as does drinking as few as two alcoholic drinks a day.

Yet the calcium debate is likely to continue as researchers, provoked by Riggs' and Christiansen's results, try to decide whether dietary calcium is really as crucial as it has been said to be. At this point, Riggs notes, "it is important to try and settle the issue." ■ GINA KOLATA

ADDITIONAL READING

"Osteoporosis," *National Institutes of Health Consensus Development Conference Statement* **5** (no. 3) (1984).

B. L. Riggs and L. J. Melton, "Involutional osteoporosis," *N. Engl. J. Med.* **314**, 1676 (1986).

Briefing:

Quake Prediction Under Way in Earnest

In June the 25-kilometer section of the San Andreas fault that passes by the tiny town of Parkfield in central California showed signs that it might rupture and produce the moderate earthquake officially predicted to occur by 1993. The fault's unusual behavior gave the U.S. Geological Survey's most sophisticated earthquake prediction network its best test to date.

The threatening fault activity, which became obvious on 6 June and prompted a mid-level earthquake alert, eventually subsided. Nevertheless, the experience has reassured researchers that the direction that prediction research has taken since a major reassessment in the 1970's is a sound one. "It gives us confidence," says one USGS scientist, "that all these instruments we've installed do measure something."

In hindsight, the activity along the Parkfield section of the fault started in late May, but the fault's behavior was not unusual enough by the standards of the USGS's response plan to warrant any kind of alert until the seismometer system picked up a flurry of tiny, imperceptible earthquakes between 6 and 8 June beneath Middle Mountain. That is where the fault broke first during the Parkfield earthquakes of 1966, 1934, and presumably those of 1922, 1901, 1881, and 1857.

On the USGS's scale of e up to a, the June microearthquakes created a d-level alert. According to the best estimates of the response plan, the probability of a repeat of the 1966 quake within the next 3 days jumped from the background level of 0.01% to between 1 and 3%. But no more quakes of significance appeared and the d-level alert lapsed according to schedule on 11 June.

On 13 June Parkfield chief scientist William Bakun of the USGS in Menlo Park passed the word that the other mainstay of the network, the creepmeter system, had triggered another d-level alert. Accelerated creep of the sides of the fault past each other had begun on 6 June, when the flurry of microearthquakes began, at an instrument in the central area of the typical Parkfield rupture. One and a quarter millimeters of creep in a week rated a d-level alert.

By 15 June each of two water wells straddling the creepmeter independently exceeded the d alert criterion, presumably after shifting stresses in the surrounding rock squeezed water levels upward several centimeters. Two d's at water wells make a c alert under the response plan. Both a strainmeter at the southern end of the rupture zone and laser distance measurements around the anomalous creepmeter, while not rating an alert on their own, showed "seriously anomalous" readings. The net result under the plan was still an overall c alert, so the probability of an imminent repeat of 1966 rose to between 3 and 11%.

By the next afternoon the USGS's Parkfield working group hypothesized that all or most of the observations could be explained if a 3-kilometer-square patch on the fault 1 to 4 kilometers below the creepmeter had slipped perhaps 10 millimeters. Although the slipping patch was well above the deep fault patch thought to be tightly locked and awaiting the next rupture, it was the same area in which ground cracks that may have been the result of accelerated slip were seen weeks before the 1966 earthquake.

By 17 June, the alert began to wind down. No ground cracks appeared, and the anomalously high rates of change on the network began to slow. On 18 June the alert was dropped back to the d level. That was the same day that the response plan that directed the whole procedure became official with the USGS director's signature. On 27 June the status returned to normal.

"When it [the alert] was going on," says Bakun, "there wasn't anyone who didn't think it might be the start of a repeat of the '66 earthquake." There will likely be a lot more such excitement. If the anticipated magnitude 6 earthquake does not strike until 1993, there could be another 5 to 15 c-level alerts and one to two a-level alerts, when the probability reaches better than 37% and the USGS sends a warning to the California Office of Emergency Services. The working group is generally pleased with this first experience. The event appeared on several types of instruments, researchers could tell what was happening at the time, and the response procedures went reasonably smoothly.

The June alert also points up a problem. "We saw the slip event where we had the sensors to see it," says Allan Lindh of the working group, "We don't have much of an idea what happened beneath Middle Mountain," where the magnitude 6 rupture will likely begin. Whether the flurry of microearthquakes had anything to do with the slip event 10 kilometers to the south thus remains unknown. The problem is that the rugged Middle Mountain area remains relatively lightly instrumented with strainmeters of any kind. Money to beef up that part of the network is now available and installation of several new instruments should be complete by fall, less than 2 years before the predicted most likely date of the next Parkfield quake. ■ RICHARD A. KERR