gen and progestins (other hormones in some estrogen-replacement therapies) at a dose taken by many U.S. women today.

The investigators compared these women with 42 others who had average-density bones. Though intended as a control group, those 42 proved nearly as active as the volunteers on the experimental regimens.

In the Oct. 24 NEW ENGLAND JOURNAL OF MEDICINE, Prince and his colleagues report that the women had to undertake the equivalent of two hours of brisk walking daily before they halted bone loss. Because most women did not reach that activity level, the exercise-only and control groups lost about 2.5 percent of their bone density each year. Women who combined calcium and exercise slowed their bone loss to between 0.5 and 1.3 percent annually, depending on the forearm site. Only those receiving the hormone showed a density increase, ranging from 0.8 to 2.7 percent per year.

Though interesting, these results may not reflect similar changes in the load-bearing bones, such as the hip and spine, which are most likely to undergo osteoporotic fractures, cautions Miriam E. Nelson of the Agriculture Department's Human Nutrition Research Center on Aging in Boston.

Still, the Australian investigators think their findings have important implications for public health. Because estrogen-replacement therapy requires medical supervision and may cause side effects, Prince and his co-workers suggest reserving the hormone treatment for women at highest risk – those with low bone density – and advising others simply to exercise and take calcium.

But estrogen's cardiovascular benefits, reported in the same journal, may tip the balance in favor of the hormone. Researchers at Harvard Medical School and Brigham and Women's Hospital in Boston have shown for the first time that even low doses of estrogen – 0.625 milligrams per day – can foster positive blood-cholesterol changes in postmenopausal women. Over time, they say, the observed decreases in low-density lipoprotein ("bad") cholesterol and increases in high-density lipoprotein ("good") cholesterol might reduce cardiovascular risk in women by more than 40 percent.

The Boston study, which involved 31 women aged 43 to 69, also shows why estrogen offers greater benefits when administered orally rather than through the skin or into the blood: It goes straight to the liver, the central organ in lipoprotein metabolism. "It now appears that women who take [oral] estrogen may produce a little more low-density lipoprotein cholesterol [in the liver] compared with women who don't take estrogen, but that their ability to get cholesterol out of their bloodstream is massively increased," explains Brian W. Walsh, who led the study.

– J. Raloff

NMR improvements earn chemistry Nobel

A Swiss physical chemist who helped advance nuclear magnetic resonance (NMR) technology has won the 1991 Nobel Prize in Chemistry. Richard R. Ernst, 58, of the Federal Institute of Technology in Zurich, improved upon NMR techniques initially developed in 1945. His contributions paved the way for magnetic resonance imaging (MRI), a biomedical technique for depicting tissues deep within the body.

The Royal Swedish Academy of Sciences in Stockholm, which announced the $1 million award last week, calls NMR spectroscopy "perhaps the most important instrumental measuring technique within chemistry."

Basically, nuclear magnetic resonance works because atoms placed in a very strong magnetic field align with the field and behave as though they were spinning tops. The atomic tops wobble at certain frequencies, depending on what other atoms are nearby.

For imaging, scientists or physicians then bombard these atoms with high-frequency radio waves. When the radio waves encounter atoms wobbling at the same frequency as the waves, they cause the atoms to resonate. After the radio waves are turned off, the atoms give off a pulse of energy. A detector picks up the timing and type of pulses, which reveal the kinds of atoms emitting them. Thus, scientists can discern the chemical makeup of a sample.

Ernst spurred this technology by increasing its sensitivity and by making it easier to interpret the pulses. In 1966, he and a U.S. colleague, Weston A. Anderson, changed the type of radio wave from slow sweeps to short, intense pulses. Then Ernst discovered that he could obtain even more information about a sample by using sequences of short pulses of radio waves and varying the timing of the pauses in between. He later applied a mathematical technique called Fourier transformation to NMR spectroscopy and further increased NMR's sensitivity.

NIH

Human head depicted by magnetic resonance imaging, a tissue-scanning method based on an analytical technique called nuclear magnetic resonance.

These and other advances have made it possible to determine the three-dimensional structure of large, complex molecules that contain hundreds of atoms, to examine interactions between molecules, to study molecular motion and rates of chemical reactions, and to image soft tissues not clearly revealed by X-rays.

Ernst learned of his Nobel last week from a pilot during a transatlantic flight.

– E. Pennisi

Physics Nobelist linked materials with math

While most physicists prefer to study simple systems, this year's winner of the Nobel Prize in Physics proved that even "untidy" schemes can elucidate basic principles.

The $1 million prize goes to 59-year-old French physicist Pierre-Gilles de Gennes, of the University of Paris, for discovering broad mathematical methods to describe phenomena of order and chaos in such widely differing materials as liquid crystals, superconductors and polymers. In announcing the decision last week, the Royal Swedish Academy of Sciences called de Gennes "the Isaac Newton of our time."

"Some of the systems de Gennes has treated have been so complicated that few physicists had earlier thought it possible to incorporate them at all in a general physical description," the Academy observed.

Phase transitions – in which atoms or molecules in a material shift between ordered and disordered states – have long piqued de Gennes' interest. In the 1950s, he began studying how tiny atomic magnets alter their alignment with changes in temperature. In the 1960s, he worked with liquid crystals – which display characteristics of both solid and liquid phases – to test general physical theories. Those studies enabled him to explain how fluctuating molecular order in liquid crystals affects the scattering of light. De Gennes also mathematically demonstrated similarities between liquid crystals and superconductors.

In the 1970s, his curiosity extended to polymers. Seeking a way to describe how these long-chained molecules form a spaghetti-like tangle in a dilute solution, de Gennes discovered a mathematical way to link their complicated arrangements with general physical principles of phase transitions.

– K. Schmidt