



Bone Health and Physical Activity

By BABY DOJONEGORO, MS MPH

Physical activity, primarily weight bearing exercise, is an important factor in the development and maintenance of bone health. Although the exact mechanism is unknown, many studies have shown that weight loading leads to higher bone mass density (BMD). Therefore, weight bearing exercise is important in developing bone mass during growth and adolescence, and in reducing BMD loss in the aging process. The latter is especially important for women, as they show more tendency to lose bone mass after menopause than men in the same age group. As illustrated in Figure 1, men and women show declining bone mass after reaching their peak bone mass at the age of 20-30 years, but women show a steeper decline starting around the age of 50 years as compared to men.

Weight bearing exercise is defined as any physical activity in which you support your weight (e.g., running, walking) or move weight using your muscles (e.g.,

weightlifting, resistance training).

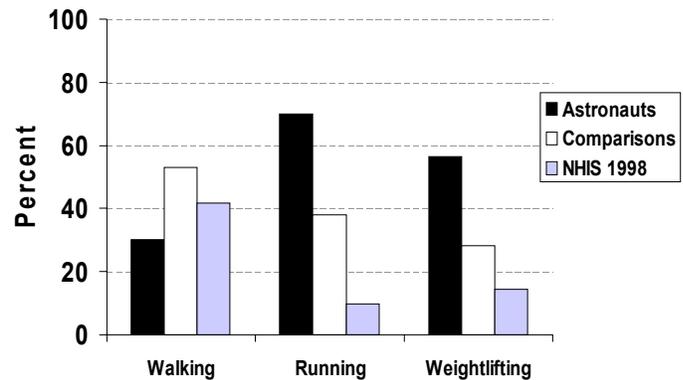
For this article, weight bearing exercise is represented by the specific physical activities of walking, running, and weightlifting. LSAH participants' data on such exercises are obtained through the Lifestyle Questionnaire,

where respondents are asked to select the types of exercises they usually perform. These exercises are not mutually exclusive, so values do not add up to 100%. Of the astronaut respondents, 30% reported walking, while 70% chose running, and 56% reported weightlifting as part of their exercise routine (N=238). The corresponding values for comparison participants are 53%, 38%, and 28%, respectively (N=842). In comparison, the 1998 National Health

Interview Survey had values of 42%, 10%, and 14% for U.S. general adult population's participation in walking, running, and weightlifting, respectively (N=32,440).

As Figure 2 makes clear, astronauts reported the highest participation in running and weightlifting as compared to comparison participants and the general population. The most striking difference between the astronauts and the

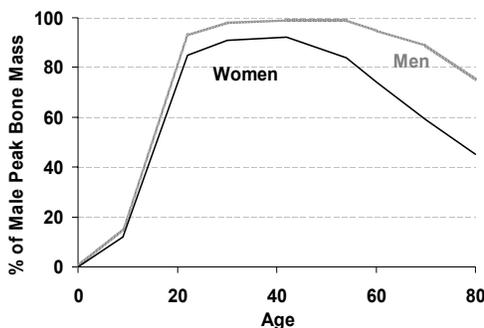
Figure 2. Selected Weight Bearing Exercises of LSAH Participants and U.S. General Population



other two groups is in running, where about two thirds of the astronauts reported participating, whereas more than a third of the comparison participants and only about a tenth of the general population did. Astronauts reported higher participation in the more vigorous activities of running and weightlifting than the comparison participants or the general population. Comparison participants appeared to have a similar pattern with the general population in the types of exercise they participate in, albeit with higher participation percentages.

Because bone loss is of particular concern to women, exercise levels of female participants are examined more closely below. Female astronauts reported 26%, 84%, and 84% participation in walking, running, and weightlifting (N=31). The corresponding values for comparison participants (N=117) and general population (N=18,238) are 65%, 27%, 21%, and 25%, 4%, and 6%, respectively (see Figure 3). The female astronauts' preference of running and weightlifting is even

Figure 1. Changes in Skeletal Mass Throughout the Lifecycle



Source: New SA. Nutrition, exercise and bone health. Proceedings of the Nutrition Society 2001;60 (2):265-274

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Osteoporosis: How Bone Healthy Are You?

By CORTNI HARALSON, MPH

Osteoporosis is considered a major public health problem in the United States. Approximately 44 million Americans are affected by this disease in some form; about 34 million suffer from some form of low bone mass problems or osteopenia, while approximately 10 million individuals suffer from osteoporosis. Of this 10 million, about 80% are women and 20% are men. Because of its great impact on the public's health and quality of life, osteoporosis is a focus area of Healthy People 2010, the nationwide health promotion and disease prevention agenda.

What is Osteoporosis?

Osteoporosis or porous bone is a systemic disease characterized by decreased bone mass and structural deterioration of bone tissue, leading to bone fragility and increased susceptibility to fractures of hip, spine, and wrist. There are many risk factors associated with developing osteoporosis. These include, but are not limited to, having a history of fracture after age 50, low bone mass, being female, advanced age, a family history of osteoporosis, estrogen deficiency, low calcium and vitamin D intake, cigarette smoking, excessive use of alcohol, inactive lifestyle, and being Caucasian or Asian.

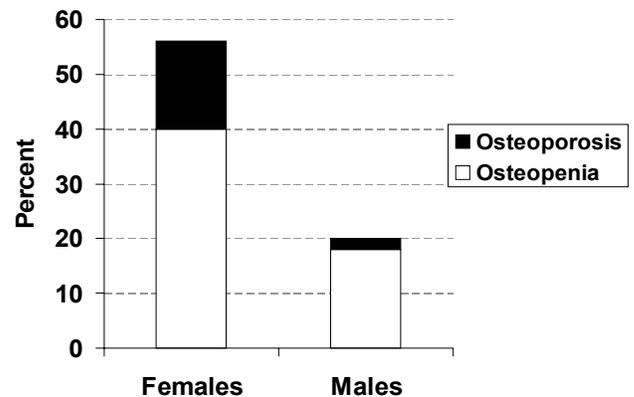
There are two forms of osteoporosis, primary and secondary. Primary osteoporosis is the age-related loss of bone from the skeleton. Bone mass usually peaks for individuals in their late 20s, and bone loss starts to occur in the mid-30s. There are two types of primary osteoporosis, Type 1 and Type 2. Type 1 refers to post-menopausal osteoporosis and usually occurs in women after 15 to 20 years of menopause. For women, the loss of bone density speeds up during the first five to seven years after menopause and then slows down again. Scientists believe that this rapid postmeno-

pausal increase in bone loss is caused by a sharp decline in the body's production of estrogen, which appears to help keep calcium in the bones. Type 2 primary osteoporosis refers to senile osteoporosis and usually occurs in men and women more than 70 years of age. In contrast to primary osteoporosis, secondary osteoporosis is a consequence of the presence of other conditions or diseases that cause bone loss. It can occur at any age for both men and women.

The National Health and Nutrition Examination Survey (NHANES) was the first to look at bone mass data on a national scale. In NHANES III (1984-1994), bone mineral density was collected and estimates of the prevalence of low femur bone mass according to gender, race, and age were calculated. As shown in Figure 1, the prevalence of low femur bone density in women 50 years and older was 56%, while the prevalence for men of the same age group was 20%.

The prevalence of osteoporosis for women and men 50 years and older are 16% and 2%, respectively. The

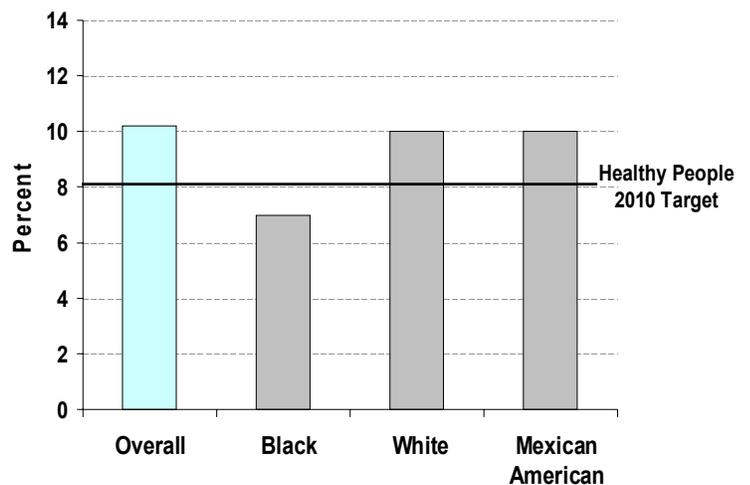
Figure 1. Prevalence of Low Femur Bone Density in U.S. Adults Age 50 Years and Over, 1988-1994



overall age-adjusted osteoporosis rate for adults over the age of 50 years is 10.2%. When broken down by race/ethnicity, the data show that both Whites and Mexican Americans had an osteoporosis rate of approximately 10%, whereas Blacks had a slightly lower rate of about 7% (Figure 2). One of the goals of the Healthy People 2010 Initiative is to reduce the proportion of adults with this

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Figure 2. U.S. Adults Age 50 Years and Over With Osteoporosis by Race/Ethnicity, 1988-1994



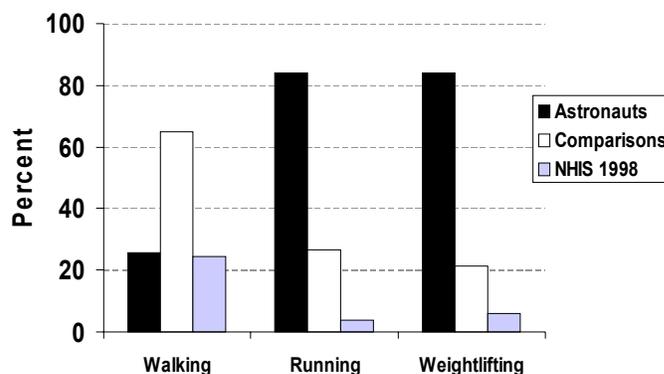
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more pronounced as compared to the previous reported figures for all astronauts. This may reflect their higher awareness of the overall benefit of weightlifting, and their ready access to exercise facilities and personal trainers. Female comparison participants showed a clear preference for walking over the other two activities, but their participation percentages for running and weightlifting are still somewhat similar to the percentages for all comparison participants in the previous figure. This is in contrast to the female general population, whose reported participation percentages in running and weightlifting drop to less than half of the values for all general population sample. The participation values for both female groups of LSAH participants seem to show that they are more likely to maintain their bone health than the female

general population. Note that the small numbers of female astronaut respondents makes their results more sensitive to variation.

Overall, LSAH participants reported higher participation in weight bearing exercises as compared to the general population, with astronauts having the highest rates. The difference between astronauts and comparison participants is to be expected as astronauts by definition need to maintain their health for mission readiness. Both astronauts and comparison participants

Figure 3. Selected Weight Bearing Exercises of Female LSAH Participants and U.S. General Population



therefore have a better chance of maintaining their bone density as they age as compared to the U.S. general population. ■

Quick Glance: Reported Daily Calcium Intake

By **BABY DJOJONEGORO, MS MPH**

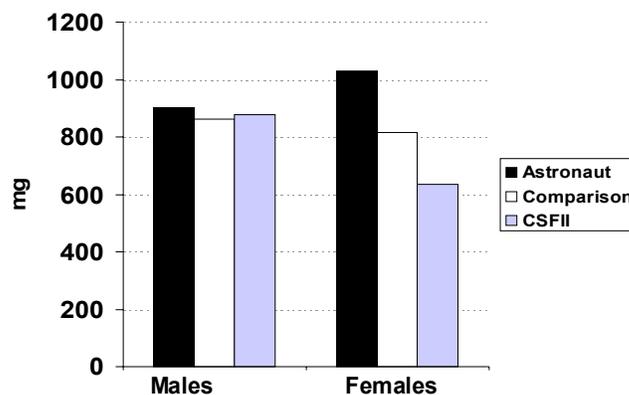
Adequate calcium intake is one of the five steps recommended by the National Osteoporosis Foundation for prevention of osteoporosis and promotion of bone health (see *Osteoporosis: How Bone Healthy Are You?* on page 2). The dietary calcium intake for LSAH participants is examined to see if they meet that recommendation. These data are obtained through the Food Frequency Questionnaire sent out in the fall of 1998. A total of 645 participants responded to this questionnaire (116 male astronauts, 21 female astronauts, 448 male comparisons, and 66 female comparisons). To compare the LSAH participants to the U.S. general population, results of a national survey, the 1996 Continuing Survey of Food Intakes by Individuals (CSFII), are also presented. The findings for respondents over 20 years of age (1704 males and 1532 females) are used

as comparison to those of LSAH participants (Figure 1).

All respondents report dietary intake below the recommended amount of 1000 mg per day, with the exception of female astronauts. Female comparison participants also report higher calcium intake than the female general population. The same can not be said for male participants, who reported the lowest calcium intake as compared to male astronauts and male general population.

Calcium intake, along with physical activity, are two factors which are easily adjusted to lessen the risk of osteoporosis. In this

Figure 1. Daily Calcium Intake of LSAH and U.S. General Population



regard, both male and female comparisons, and male astronauts would improve their chance of maintaining their bone density if they increase their dietary calcium intake. ■

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disease, with a target goal of 8% for all groups.

The Cost of Osteoporosis on Society

Most people are not aware that they may have this disease which is why osteoporosis is commonly referred to as the “silent disease”. Some general symptoms are backaches, a gradual loss of height, and stooped posture, but the most common sign is the fracture of the spine, wrists, or hips. Osteoporotic fractures, particularly vertebral fractures, can be associated with chronic disabling pain. According to data collected in the National Hospital Discharge Survey, there were approximately 17.5 hospitalizations per 10,000 adults aged 65 and older in 1998 due to osteoporotic fractures (Figure 3). Although that number has decreased over the years, the 2001 rate is still slightly higher than the target set by Healthy People 2010 of 14 hospitalizations per 10,000 adults. Interventions that reduce the number of people with osteoporosis

should decrease the number fractures associated with this disease.

Detection, Treatment, and Prevention

Low bone mass is usually detected by performing a specialized test called a bone density test. Bone mineral density (BMD) is a measure of the amount of bone contained in a given area. It is expressed in g/cm² and is the main parameter measured by bone densitometry. The benefits of the bone density test include the detection of osteoporosis before a fracture occurs, the prediction of fracture risk in the future, determination of the rate of bone loss, and monitoring of the effects of treatment for osteoporosis.

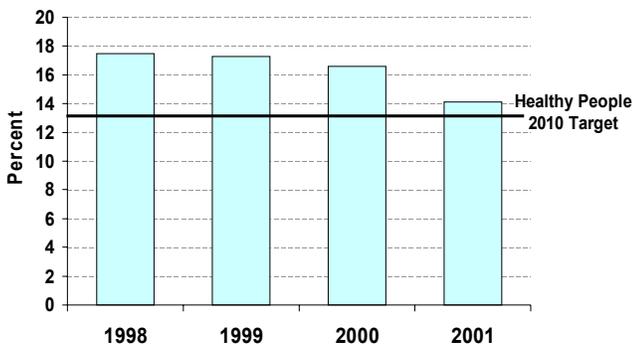
The National Osteoporosis Foundation (NOF) provides guidelines for those who should receive BMD testing. They include all women aged 65 and older (regardless of risk factors), postmenopausal women with one or more risk factors, postmenopausal women who present with fractures, estrogen deficient women at clinical risk for os-

teoporosis, individuals receiving long-term glucocorticoid (steroid) therapy, individuals with primary hyperparathyroidism, and individuals being monitored to assess the response of drug therapy (osteoporosis). At this time, there is no cure for osteoporosis, although there are some medications that have

been approved by the U.S. Food and Drug Administration for its treatment. These include biophosphonates (alendronate and risendronate), calcitonin, estrogens, parathyroid hormone, and raloxifene. Because there is no cure, the best way to tackle this disease is to prevent it. The NOF lists five steps to the prevention of osteoporosis and the promotion of good bone health:

- Get your daily recommended amounts of calcium and vitamin D. Calcium is the nutrient most important for attaining peak bone mass while also assisting with the proper functioning of the heart, muscles, and nerves. Vitamin D is required for the absorption of calcium in the body.
- Engage in regular weight-bearing exercise. According to the National Institutes of Health, there is strong evidence that physical activity early in life contributes to higher peak bone mass. Exercising during the middle and late years has numerous health benefits. The best exercise for bones is weight-bearing exercise.
- Avoid smoking and excessive alcohol. Smoking is a well-established risk factor for osteoporosis.
- Talk to your doctor about bone health. Ask questions about your bone health and openly discuss your concerns with your doctor.
- Have a bone density test and take medication when appropriate. ■

Figure 3. Hospitalizations for Vertebral Fractures Associated With Osteoporosis Among U.S. Adults Aged 65+ Years, 1988-1994



For your information

If you want a copy of your exam results, please complete and sign a release form while you are visiting the Clinic for your examination. The form is called *Privacy Act Disclosure Authorization and Accounting Record (DAAR)*, or NASA Form 1536.

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