

## Bone Mineral Density Measurement (BMD)

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Bone mineral density is a measured calculation of the true mass of bone. The absolute amount of bone as measured by bone mineral density (BMD) generally correlates with bone strength and its ability to bear weight. For every decrease in bone mass of one standard deviation, the relative risk of fracture increases 1.5 to 3 fold.

By measuring BMD, it is possible to predict fracture risk in the same manner that measuring blood pressure can help predict the risk of stroke. ( Kanis J, et al. Perspective: the diagnosis of osteoporosis. J Bone Mineral Research. 1994;9:1137-1141.) It is important to remember that BMD cannot predict the certainty of developing a fracture; it can only predict risk.

BMD measurement should be performed in the following circumstances:

- for risk assessment in perimenopausal or postmenopausal women who are concerned about osteoporosis and willing to accept available interventions;
- in women with x-ray findings that suggest the presence of osteoporosis;
- in women beginning or receiving long-term glucocorticoid therapy, provided intervention is an option;
- for perimenopausal or postmenopausal women with asymptomatic primary hyperparathyroidism in whom evidence of skeletal loss would result in parathyroidectomy;
- in women undergoing treatment for osteoporosis, as a tool for monitoring the therapeutic response (this includes simple dietary supplements in the very conservative treatments).

Some women have several compression fractures upon initial evaluation with x-rays, and there is no need for a BMD measurement to make the diagnosis of osteoporosis. However, the only effective way to monitor therapy objectively is by comparison with a baseline BMD measurement. The World Health Organization has used bone mineral density to define specific diagnostic categories:

**Normal:** A value for BMD statistically within one standard deviation of a young adult. These people fall within the normal range.

**Low bone mass:** A value for BMD statistically more than one standard deviation but less than 2.5 standard deviations than an average young adult. These people have an increased fracture risk but do not meet the criteria for osteoporosis.

**Osteoporosis:** A value for BMD statistically greater than 2.5 standard deviations below an average young adult.

By these criteria, it is estimated that 30% of all postmenopausal Caucasian women have osteoporosis and that almost 60% have low bone mass.

It should be noted that all "normal" values of BMD are based on Caucasian data. It is well documented that there is significant variation in BMD between ethnic groups. For example, African Americans in general have greater BMD compared to Caucasians of the same age and weight. Interpretation of results must take this difference into account.

The purpose of BMD testing is to:

1. help predict the risk of future fracture;
2. measure the amount of bone mass; and
3. monitor the effectiveness of treatment.

In subjects with low bone mass (as defined above), there is a 2-3 fold increase in the incidence of spinal fractures. In subjects with a BMD in the osteoporosis range, there is approximately a five-fold increase in the occurrence of fractures.

At present, the National Osteoporosis Foundation has recommended that testing be performed on all postmenopausal women under the age of 65 who have risk factors for osteoporosis (these include a previous history of fractures, low body weight, cigarette smoking, and a family history of fractures). In addition, it is recommended that all women over the age of 65 be tested, regardless of risk factors.

Dual x-ray absorptometry (DXA) is the preferred technique for measuring BMD. [DXA is also called dual energy x-ray absorptometry or DEXA.] DXA is relatively easy to perform, and the amount of radiation exposure is low. A DXA scanner is a large machine that produces two x-ray beams, each with different energy levels. One beam is high energy while the other is low energy. The amount of x-rays that pass through the bone is measured for each beam. This will vary depending on the thickness of the bone. Based on the difference between the two beams, the bone density can be measured.

At present, DXA scanning focuses on two main areas - the hip and spine. Because osteoporosis involves the whole body, measurements of BMD at one site are usually predictive of fractures at other sites. However, by directly measuring the areas of particular interest, such as the hip and the spine, a direct observation can be made. For example, hip measurements provide a better prediction of hip fracture risk than measurements taken at other skeletal sites. In general, DXA scanning is performed on the hip (including an area of the femur called "Ward's triangle") and the spine. Scanning generally takes 10-20 minutes to complete.

Practitioners treating patients for osteoporosis should make certain they follow their patient's response to therapy with a BMD measurement at regular intervals. The frequency of testing is determined by the initial baseline measurements and severity of the bone loss.

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