# CLINICAL STUDIES

## Prevalence of Osteopenia and Osteoporosis in a Normal Female Puerto Rican Population

LILLIAN HADDOCK MD, MACP

**ABSTRACT. The World Health Organization criteria for the diagnosis of Osteopenia and Osteopoposis was applied to a control group of 33 females ages 50 to 59 years and 24 females ages 60 to 69 years. The general exclusion criteria for the selection of subjects included early menopause and diseases, use of drugs and toxic habits such as smoking and alcoholism, known to affect bone and mineral metabolism. Bone mineral densities were measured with a DEXA Hologic, model 1000. In the reference population mean peak bone mineral density expressed in g/cm$^2$ was 1.051 ( SD= 0.119 ) for the lumbar spine at age 30 to 39 years and for the femoral neck 0.861 ( SD= 0.098 ) at age 20 to 29 years. Bone densities below 1 to 2.5 SD from mean peak bone mass ranged from 0.932 to 0.754 g/cm$^2$ in the lumbar spine and 0.763 to 0.616 g/cm$^2$ for the femoral neck. The mean age of the pooled group was 58.4 years. The prevalence of osteopenia in the pooled group was 42 % for the lumbar spine and 56 % for the femoral neck and of osteoporosis, 12 % for the lumbar spine and 8.7 % for the femoral neck. A similar prevalence has been found by other investigators in hispanic populations. Such a high percentage of females with osteopenia implicates that bone densitometry must be done in the perimenopausal years and in young individuals at risk so as to proceed with early medical intervention to prevent osteoporosis.** *Key words: Osteopenia, Osteoporosis, Control female population, Hispanic female population*

The reference values for the bone mineral densities of the lumbar spine and the proximal femur have been established in a control female Puerto Rican population (1). The availability of criteria to define osteopenia and osteoporosis in the female population as established by the World Health Organization (2) gives an unique opportunity to determine the prevalence of both in a group at low risk of developing osteoporosis. The aim of this analysis is to determine such prevalence in a control female population in the age group 50 to 69 years.

## Study Subjects and Methods

The female population comprised 24 females ages 50 to 59 years, and 19 females ages 60 to 69 years of the reference control female population, 9 additional females in the age group 50 to 59 years and 5 females ages 60 to 69 years which complied with the exclusion criteria used in the selection of the control population. The volunteers were recruited among the employees, faculty, and students of the University Hospital and patients attending the University Medical Services. The general exclusion criteria for the selection of subjects included diseases, use of drugs or toxic habits such as smoking and alcoholism, known to affect bone and mineral metabolism. Females who had an early menopause were also excluded. A mixed population was selected representative of the genetic composition of the Puerto Rican population, white and black influence with very limited Indian heritage. The study population comprised 33 females ages 50 to 59 years and 24 females ages 60 to 69 years. The WHO criteria for the diagnosis of osteopenia and osteoporosis was applied to the reference values of the mean peak bone density of the lumbar spine and the femoral neck obtained in the control population. Such criteria defines as osteopenia bone mineral densities between 1 and 2.5 standard deviations (SD) below the mean peak bone density (T score) and osteoporosis as more than 2.5 standard deviations below the mean peak bone density.

Spinal radiographs were taken of women age 60 or more to exclude spinal defects or artifacts. Bone mineral densities were measured with a dual energy X Ray absorptiometer (Hologic, model 1000). The mean coefficient of variation for the bone mineral density in the spine phantom is 0.37 % and for the hip phantom in the femoral neck, 0.7 %. The results of the bone densities are presented as mean ± SD.

## Results

The results of the mean bone mineral densities at the lumbar spine and the areas of the proximal femur, as previously published for our reference control population, are presented in Table 1. The mean peak bone mineral

the lumbar spine and from 0.763 to 0.616 $g/cm^2$ for the femoral neck. Table 3 shows the prevalence of osteopenia and osteoporosis in the lumbar spine when the above criteria is applied to the age groups 50 to 59 years and 60 to 69 years of our sample population. In the age group 50 to 59 years 18 (55%) had osteopenia and the remaining had normal bone densities. In the age group 60 to 69 years 6 had osteopenia (25%), and 7 (29%) had osteoporosis. Table 4 shows the prevalence of osteopenia and osteoporosis in the femoral neck for the respective age groups. In the age group 50 to 59 years, 21 (64%) had osteopenia and 1 (3%) had osteoporosis and in the age group 60 to 69 years 11 (46%) had osteopenia and 4 (17%) had osteoporosis. To qualify further the degree of osteopenia T scores between -1 to -1.5 were defined as

**Table 1.** Bone Mineral Densities ($g/cm^2$) in the Different Age Groups Values are Mean ± (SD)

| Age (yrs) | Spine L2-L4 | Femoral neck | Ward's triangle | Trochanter |
|---|---|---|---|---|
| 20-29 n=30 | 1.029 (0.087) | 0.861 (0.098) | 0.713 (0.124) | 0.683 (0.090) |
| 30-39 n=30 | 1.051 (0.119) | 0.850 (0.107) | 0.691 (0.116) | 0.676 (0.091) |
| 40-49 n=28 | 1.021 (0.106) | 0.97 (0.091) | 0.638 (0.100) | 0.664 (0.082) |
| 50-59 n=24 | 0.918 (0.094) | 0.746 (0.097) | 0.554 (0.106) | 0.617 (0.084) |
| 60-69 n=19 | 0.860 (0.117) | 0.721 (0.091) | 0.520 (0.105) | 0.601 (0.097) |

density at the lumbar spine was 1.051 $g/cm^2$ (SD= 0.119) at age 30 to 39 years and 0.861 $g/cm^2$ (SD=0.908) at the femoral in the age group 20 to 29 years. Table 2 depicts the range of values of the bone mineral densities that would be classified as osteopenia and osteoporosis in our reference population for the lumbar spine and femoral neck upon application of the WHO criteria. Bone mineral densities from 1 to 2.5 standard deviations below the mean peak bone density ranged from 0.932 to 0.754 $g/cm^2$ for

**Table 2.** Osteopenia and Osteoporosis According to WHO Criteria as Applied to a Control Female Population

| SITE | MPBD | SD | OA | OP |
|---|---|---|---|---|
| LS | 1.051 | 0.119 | 0.932-0.754 | <0.754 |
| FN | 0.861 | 0.096 | 0.763-0.616 | <0.616 |

MPBD: mean peak bone density (g/cm²). SD; standard deviation.
OA: osteopenia (1 to 2.5 SD below MPBD). OP: osteoporosis (>2.5 SD below MPBD)

**Table 3.** Prevalence of OA and OP in a Control Female Population in the Lumbar Spine

| Age Group | N | OA | OP | Normal |
|---|---|---|---|---|
| 50-59yrs | 33 | 18 (55%) | none | 15 |
| 60-69yrs | 24 | 6 (25%) | 7 (29%) | 11 |

**Table 4.** Prevalence of OA and OP in a Control Female Population in the Femoral Neck

| Age Group | N | OA | OP | Normal |
|---|---|---|---|---|
| 50-59 yrs | 33 | 21 (64%) | 1 (3%) | 11 |
| 60-69 yrs | 24 | 11 (46%) | 4 (17%) | 9 |

mild, from -1.6 to -2.0 moderate and from -2.1 to -2.5 marked osteopenia. Following this classification 10 females of the 50 to 59 years had mild, 4 moderate and 4 marked osteopenia of the lumbar spine, and 10 had mild, 6 moderate and 5 marked osteopenia of the femoral neck. Among the 60 to 69 years group 1 had mild, 2 moderate and 3 had marked osteopenia of the lumbar spine, and 3 had mild, 6 moderate and 2 marked osteopenia of the femoral neck ( Tables 5 and 6 ).

## Discussion

Multiple prospective studies indicate that the risk of fragility fractures increase progressively as the bone mineral densities decline (3-7). There was a dire need to define osteoporosis having this decrease in bone mass in

**Table 5.** Degree of Osteopenia in the Lumbar Spine in a Control Female Population ( Standard Deviations from Mean Peak Bone Mass )

| Age Group | -1 to -1.5 | <-1.5 to -2 | <-2 to -2.5 |
|-----------|-----------|-------------|-------------|
| 50 - 59 yrs | 10 | 4 | 4 |
| 60 - 69 yrs | 1 | 2 | 3 |

**Table 6.** Degree of Osteopenia in the Femoral Neck in a Normal Female Population ( Standard Deviations from Mean Peak Bone Mass)

| Age Group | -1 to -1.5 | <-1.5 to -2 | <-2 to -2.5 |
|-----------|-----------|-------------|-------------|
| 50-59 yrs | 10 | 6 | 5 |
| 60-69 yrs | 3 | 6 | 2 |

consideration prior to the occurrence of a fracture for the purpose of osteoporosis prevention. In an attempt to do so an expert panel of the

World Health Organization proposed a diagnostic criteria for osteoporosis in the female population which is being used universally. A cutoff of 2.5 standard deviations below the mean peak bone density of young healthy adult females identifies aproximately 30 % of postmenopausal women as having osteoporosis using measurements at the spine, hip or forearm, which is aproximately equivalent to the lifetime risk of fractures at these sites (8).

The cutoff level of 1 standard deviation below the mean peak bone density includes the vast majority of females who sustain osteoporotic fractures (9). This diagnostic criteria is not applicable to the male population which risk of fracture is less than that of the female population and if applied would not capture the real number of men at risk. The values to be used as mean peak bone density are those determined as reference values for a specific population rather than the reference values given in the software of the various densitometers available for use. Our reference values were determined using a DEXA Hologic Model 1000 and were not found to be statistically different from Hologic reference values.

This diagnostic criteria when applied to several hispanic female populations yields similar results to ours. Tamayo (10) in a Mexican population of 960 females with an average age of 54 years found a prevalence of 33 % of osteopenia of the lumbar spine and 35 % of osteopenia of the femoral neck. In the same population they found a prevalence of 18 % of osteoporosis of the lumbar spine and 5 % of osteoporosis of the femoral neck. If our population is pooled, the mean age is 58.4 years and the prevalence of osteopenia of the lumbar spine is 42 % and 56% for the femoral neck; the prevalence of osteoporosis of the lumbar spine is 12% and 8.7% for the femoral neck. Gómez (11) in the study of 261 Spanish females from ages 50 to above 70 years and using either lumbar spine and or femoral neck found a prevalence of osteopeniaof 54.8% in the age group 50 to 60 years and 50% in the age group 61 to 70 years. Osteoporosis was found in 17.2% and 35.2% respectively.

Benítez (12) studied 71 hispanic females from San Diego County with a mean age of 60.9 years. He found a prevalence of osteopenia of the lumbar spine of 75% and of the total femoral bone density of 65%; osteoporosis was found in 21% and 10% respectively. In a mixed population of a younger group Williams (13) studied 39 collegiate females, mean age 21.4 years, and found osteopenia of the femoral neck in 36%. T scores compatible with osteoporosis of the femoral neck were found in 5%.

The high prevalence of low bone mass in these group of females, younger and post menopausal at a low risk of developing osteoporosis mandates earlier screening of bone mineral density and appropiate intervention to promote higher peak bone mass in the younger group and to start preventing osteoporosis in the early premenopausal years. So as to contain costs an adequate amount of dietary calcium, aerobic exercises and the avoidance of toxic habits such as smoking and excessive intake of alcohol should be emphasized in the young. If there is history of having had diseases known to alter bone and mineral metabolism or intake of medications having such untoward effects, bone densities sholud be done in the younger group. All females should have bone densities done in the perimenopausal period so as to start early intervention to prevent osteoporosis. At present there are two alternatives to be used for prevention: hormonal therapy and Alendronate in a dose of 5 mg (14,15).

The active research that is being conducted in this field will most likely result in a near future in the development of drugs that not only will inhibit bone resorption but will also stimulate bone formation.

## Resumen

El criterio para el diagnóstico de Osteopenia y Osteoporosis de la Organización Mundial de la Salud fué aplicado a un grupo control de 33 mujeres entre las edades de 50 a 59 años y 24 entre 60 a 69 años. Los criterios de exclusión para la selección del grupo incluyeron menopausia temprana, la presencia de enfermedades, el uso de drogas y medicamentos y hábitos como fumar y alcoholismo que se sabe afectan el metabolismo mineral óseo. Densitometrías lumbar y femoral se hicieron por densitometría radiológica cuantitativa usando el modelo Hologic 1000. En la población control de referencia el pico de densidad ósea promedio fué 1.051 g/cm$^2$ ( SD=

0.119 ) para la espina lumbar a la edad entre 30 y 39 años y para el cuello femoral 0.861 ( SD=0.098 ) a la edad entre 20 y 29 años. Densidades de 1 a 2.5 desviaciones standards del promedio del pico de masa ósea fluctuaban entre 0.932 y 0.754 $g/cm^2$ para la espina lumbar y entre 0.763 y 0.616 $g/cm^2$ para el cuello femoral. La edad promedio del grupo completo fué de 58.4 años. La prevalencia de osteopenia en el grupo completo fué de 42 % para la espina lumbar y 56 % para el cuello femoral. La prevalencia de osteoporosis en el grupo completo fué de 12 % para la espina lumbar y 8.7 % para el cuello femoral. Una prevalencia similar se ha reportado en varios grupos de mujeres hispanas. Este hallazgo tiene grandes implicaciones clínicas. La prevalencia tan alta de osteopenia en este grupo significa que debemos hacer estudios de densitometría ósea en mujeres en la perimenopausia y en mujeres jovenes a riesgo de manera que podamos tratarlas temprano para prevenir que desarrollen osteoporosis.

# References

1. Haddock L, Ortiz V, Vázquez M C, Aguiló F, Bernard E, Ayala A, and Mejias N. The Lumbar and Femoral Bone Mineral densities in anormal female Puerto Rican population. PRHSJ 1996;15(1):5-11
2. Kanis J, Melton J, Christiansen C, Johnston C C , and Khaltev N. The Diagnosis of Osteoporosis. J Bone & Miner Res 1994; 9(8): 1137-1141
3. Hui SL, Slemenda CW, Johnston CC. Age and bone mass as predictor of fracture in a prospective study. J Clin Invest 1988;81:1804-1809
4. Ross PD, Wasnick RD, Vogel JM. Detection of prefracture spinal osteoporosis using bone mineral absorptiometry. J Bone & Miner Res 1988;3:1-11
5. Garsdell P, Johnell O, Nilson BE. The predictive value of bone loss for fragility fractures in women. A longitudinal study over 15 years. Calcif Tissue Int 1991;49:90-94
6. Cummings SR, Black DM, Nevitt MC, Browner W, Cauley J, Ensrud K et al. Bone density at various sites for prediction of hip fractures. Lancet 1992;341:72-75
7. Melton LJ, Atkinson EJ, O'Fallon WM, Wahner HW, and Riggs BL Long term fracture prediction by bone mineral assessed at different skeletal sites. J Bone & Miner Res 1993;8:1227-1233
8. Newton-John HF, and Morge DB. The loss of bone with age, osteoporosis and fractures. Clin Orthop 1970;71:229
9. Odvina CV, Wergedal JE, Libanati CR, Schultz FE, Baylink DJ. Relationship between trabecular vertebral bone density and fractures. A quantitative definition of spinal osteoporosis Metabolism 1988;37:221-228
10. Tamayo J, Riera G, Garrido F, Fernández L, Cedeño J and Ramos J. Risk factors associated with diminished bone mass in two Latin American populations: Mexico and Venezuela (abstract). Osteoporosis Int 1996;6 Suppl 1:126
11. Gómez C, Díaz Naves M, Díaz López JB, Barreto S, Cannata JB Could we assume in the clinical practice the WHO densitometric criteria for the diagnosis of osteopenia and osteoporosis (abstract) Osteoporosis Int 1996; 6 Suppl 1:154
12. Benitez CL, and Schneider DL. Prevalence of osteopenia and osteoporosis in postmenopausal hispanic women ( abstract). Abstracts of Second annual meeting of International Society for Bone Densitometry 1996; abstract 5
13. Williams ST, Marcantonio DR, Schneider DL, and Sartoris DJ (abstract). Abstracts of Second Annual Meeting of International Society for Bone Densitometry 1996; abstract 6
14. Einsman JA, Christiansen C, Mc Clung M, Gilchrist N, Luckey M, Hale E. Alendronate prevents bone loss at the spine and hip in recently postmenopausal women ( abstract) J Bone & Miner Re 1995;10 Suppl 1, abs 151, pg S-176
15. Hosking DJ, Mc Clung MR, Ravn P, Wasnich RD, Thompson DE, Daley MS. Oral Alendronate in the prevention of osteoporosis: EPIC study two years results ( abstract ) J Bone & Miner Res 1996;11 Suppl 1: S133, abstract 153